A CULTURALLY AWARE APPROACH TO LEARNING SYSTEM INTERFACE DESIGN

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ABSTRACT

This mixed methods research explored interface design strategies for users from different cultures and localized settings. Guided by the cultural-historical development theory and HCI research, four critical factors—navigation design, information organization, layout design, and visuals—were investigated in designing culturally relevant interfaces for Americans and Taiwanese.

American and Taiwanese groups—both contained two sub-groups of 30 participants—were recruited for the quantitative phase. Each participant was exposed to only one interface with content composed in their native language. However, one sub-group in each ethnic group was exposed to a culturally relevant interface and another was exposed to an alien interface. MANOVA on overall performance in both American and Taiwanese groups were significant. Americans performed better using the American interface (Wilks's Λ=.85, F= 5.15, p< .01). They had significantly shorter performance time in the American (M=775) than the Taiwanese (M=1003) interface (F=6.29, p<.05), but differences on performance accuracy were not significant (F=2.74, p=.103). Taiwanese performed better using the Taiwanese interface (Wilks's Λ=.67, F=14.06, p< .01). They had shorter performance time in the Taiwanese (M=743) than the American (M=1353) interface (F=6.29, p<.05), and they also had higher performance accuracy on the Taiwanese (M=11.7) than the American (M=10.0) interface (F=7.94, p<.01). In addition, t-test on overall preference in both American and Taiwanese groups were significant. Americans preferred the American (M=58.5) over the Taiwanese (M=53.0) interface (t=2.11, p< .05). And Taiwanese preferred the Taiwanese (M=58.7) over the American (M=46.9) interface (t=3.48, p<.01).

Qualitative interviews of six American and six Taiwanese participants revealed three themes: First, when searching, Taiwanese were explorative and relied on hierarchical relationships; while Americans relied on prior experiences and analytical categorizations. Second, both groups have higher affiliation with design features matching their preferences. Finally, matching design features with users' expectations and needs promotes positive perceptions and enhances interface usability.

Both quantitative and qualitative Results imply that user interface designers should consider cultural perspectives when designing interfaces for online learning systems. Further studies might consider the relative impacts of the navigation, information structure, layout, and visual design on a broad range of user differences might have on learning.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER I: INTRODUCTION

"Is it rational for us to shut our eyes to the role that culture plays in education and in the assimilation and association of new concepts and practices?"(Harrington, 1974)

The rapid advancing of information technology, as well as the inventing and developing of new media have changed people's lives in almost every aspect. With the popularizing of personal computer and the Internet, information technology nowadays has been considered as a cognitive tool or prosthesis, which transforms, augments and supports cognitive engagement among all kinds of learners (D. H. Jonassen, 1999). This wave changed the ways how information was transferred and distributed dramatically and consequently altered the way of teaching and learning. It has been said that the process of teaching and learning is a form of "information transfer" regarding communicating the knowledge between the instructor's and the learner's head. The new advancement in information technology brought forth the new possibilities in education, however, as the conditions of information transferring in the online environment is different from the traditional setting, a further scrutinizing needs to be made in order to understand the roles, possibilities and the influences of information technology, as well as new media in education.

Over the last decade the Sloan Foundation reported a phenomenal 17% annual growth in online course enrollment from 2002 through 2012, while the overall enrollment in higher education has shown only a 2.5% annual growth (Allen & Seaman, 2013). This includes the growth of fully-online courses, as well as blended courses that adopt a "flipped classroom" approach where content traditionally taught inside of classrooms is now being placed online.

As was true with the early internet development, most of the earlier developers of online educational content are from western cultures.   Thus, dominant approach of designs and content organization for online educational delivery systems have come from a western perspective.

According to a report of Global Industry Analyst, Inc. (2010) the US and Europe have the most long-standing history in developing eLearning content and dominate the global market with 70% of revenues.   However, under the current growth in eLearning content consumption (Docebo, 2014) the Asia Pacific region may soon surpass the US.   As an example, China is expected to have over 100 million online learners in 2016 (Research and Markets, 2014). With the high demand of packaged eLearning content, Asia is eagerly seeking to adopt existing eLearning content from the US and other more seasoned eLearning developers.   This globalization raises questions concerning directly adopting eLearning content and user interface design from one culture and inserting it into another culture.

With the great diversity in backgrounds, characteristics and user preferences, Burnham (2005) questioned the direct adoption of online instructional systems from one culture to another. Specifically Burnham argued that when applying an online learning system from the perspective of Western culture, we cannot assume that the user characteristics values, norms and ideology of target culture will be the same as the Western culture.   Thus researchers, designers and adopters of online learning are now understanding that eLearning content and interface design should accommodate diverse populations with differences in culture background, education levels, technology literacy, material resources, and physical limitations (Faiola, 2005).

Many investigators are now looking beyond computer science and drawing on research from diverse fields including anthropology (Horst & Miller, 2013; Park, 2012), psychology

(Bellamy, 1996; Carroll, 2003; S. Y. Chen & Macredie, 2002; Bonnie A Nardi, 1996; Reeves et al., 2004; Ritter & Young, 2001; Y. Rogers, 2004; Wright, Fields, & Harrison, 2000) and social theories (Bardzell & Bardzell, 2011; Bijker, Hughes, Pinch, & Douglas, 2012; Blomberg & Burrell, 2009; Paay, 2008; Pierce, Brynjarsdottir, Sengers, & Strengers, 2011).   While the awareness of the diversity of online learning population is increasing, little research has been conducted to understand how eLearning content and user interface design can accommodate cultural tendencies and customs that largely differ from the systems or technologies that are being adopted (Zahedi, Pelt, & Song, 2001).

The field of Human Computer Interactions (HCI) has been highly influenced by the information processing model of human learning which was fostered by George Miller's (1956) work on the magical number seven, plus or minus two.   Although it provides valuable guidance in HCI design, however, it is limited in the way that it oversimplifies the human computer interaction and failed to see that any information technology using behavior is conducted under a particular social, organizational, and cultural context, in relation to the goals, plans, and values of the user or in the context of development (Kaptelinin, 1996).   Recent research proposed a relative constructivist view and recognized that it is the interactions between the technology, environment, and characteristics of the individuals that determine individual behavior and learning outcome.   Based on assumptions of social constructivism, experts and literacy educators, amongst others in both academic and practical fields seized upon the promise of the information technology as a means of challenging the status quo and proposing a fundamental re-appraisal of education (Davies & Merchant, 2009; Gee, 2004; Knobel & Lankshear, 2009; Van Amelsvoort, 2009).

Social Constructivism, emphasizes the importance of culture and context in

understanding what occurs in society and constructing knowledge based on this understanding (M. McMahon, 1997).   From a Social Constructivism point of view truth or knowledge is relative instead of absolute.   Through the process of learning, learners arrive at her or his version of the truth; the truth, however, is influenced by his or her background, worldview, as well as the context in which the processes take place.   Historical developments and symbol systems, such as language, logic, and mathematical systems which are learned and inherited by the learner as a member of a particular culture are critical considerations in constructivism.   In addition, cultural rules and norms dynamically alter the way people in the cultural group perceive, recognize, and organize both the internal and external experiences, that is, the structural changes of human cognition functionality is stimulated and supported by socio-cultural experiences.   It is thus important to take into account the cultural background of the learner as this background may help to shape the knowledge and truth that the learner creates, discovers, and attains during the learning process (Wertsch, 1997)

Henderson (1996) suggested instructional design is culturally constructed, embedded with values, ideologies, and images of a particular cultural group, and the differences in languages and cultural traditions might strike online learners with alien cultural background (Spronk, 2004).   Meaning the design, which reflects the values, as well as image of specific culture might interfere and even inhibit the acceptance of users from alien culture and consequently impact the overall usability of the system.   We need to recognize that learning is socio-culturally-grounded and located within communities with particular cultures, values and expectations.   There are a range of issues that need to be considered in designing online learning system for cross-cultural users, including patterns of reasoning, perceptions, and communication; socio-cultural context, values and norms, languages, as well as aesthetic

4

preferences.

When attempting to apply an online learning system in different cultural settings, unavoidably the conflictions between ideology, symbolic system, cultural specific values, preferences, as well as social orientation, etc… would cause certain level of refusal and rejection toward the interface, and consequently the negative experiences of usage.   It is suggested that the positive experiences in using information technology is one of the most critical contributors that links to the successful implementation and adoption of an online learning system.   To study the influences of cultural differences in instructional design, there are several issues/facets need to be addressed including psychological, geographical, pedagogical and even genetic ones to fully understand the interaction between cultural factors and interface design/usage.   This study focuses mainly on psychological considerations in the design of a cultural-sensitive learning system interface with particular reference to the pragmatic application in the international setting.   However, this study is neither intending to understand how group differences shape the online communication experience per se, nor inquire about the interaction between instructional materials and learners.   Rather, the focus is on examining how the cultural factors influence individual's perception, preferences of interface, and consequently the usability of the interface across the users of different cultures.

Three major design considerations have been recruited in addressing the aforementioned factors, including 1) cognitive dimension in addressing the culturally different patterns on reasoning and perception; 2) behavioral dimension in addressing the socio-cultural norms, values and predominant propensities; and finally 3) cultural markers to address the issues of languages, symbols, and the aesthetic and design preferences.

Statement of the Problem

Using information technology in enhancing teaching and learning is a trend all over the world.   In most of the developed countries using technology to enhance teaching and learning has become an everyday activity; smart phone, personal digital assistant (PDA), computer, and Internet have changed the way most people communicate with each other in all aspects including the teacher-student and peer-peer communication.   The use of information technology allows students to be more active participants and collaborators rather than passive recipients in the process of learning, especially in the online learning setting.   However, while we supposed most of the students should and could be benefit from the integration of technology into teaching and learning, a fair amount of students seem not as favored as they are expected to be.

A large body of literature reported that attitude toward interface utilization is correlated with user characteristics/traits (Burton, Moore, & Holmes, 1995; D. H. Jonassen & Grabowski, 1993; Kirton, 2003; Kirton & De Ciantis, 1986; Mullany, Tan, & Gallupe, 2007; R. Riding & Grimley, 1999; R. Riding & Sadler-Smith, 1992; R. J. Riding & Douglas, 1993; R. J. Riding & et al., 1989; Weller & et al., 1994; Witkin, Moore, Goodenough, & Cox, 1977; Wolfe & ScienceDirect, 2001).   However, only few of them analyzed the phenomenon from a cultural perspective.   The foundational assumption behind the rationale of user analysis is that it would improve the technology utilization in the international setting, the point of which in this study is to improve the usability of learning system interface of diversified learning population in the online learning environment.

Most of the research in studying the usability of educational technology tools focused

mainly on the ease of use and usefulness point of view (Davis, 1993; Hubona, 1996; Igbaria, 1994; Thovtrup, 1991).   It is usually assumed that by making better policy and greater investment in promoting the tools the digital divide and inequality can hopefully be eliminated and amended.   However, Russo and Boor (1993), from an implementation point of view suggested a range of cross-cultural elements which include: text, number, date and time formats, images, symbols, colors, flow and functionality, that need to be considered in designing a cultural sensitive interface (as opposed to the internationalization approach).

The tradition of HCI is based on cognitive science which has a heavy focus on the perspective of information process (of human cognition).   This approach although is valid and important in designing online learning system, however, it only addresses cognitive aspects. In order to provide more effective and useful interface, it is suggested that emotional, as well as the psychological factors which are crucial causes that could intrinsically alter individual attitude toward the utilization and adoption of technology tools need to be placed on and included in the main design concerns.   From a cultural-historical perspective, this study aims at investigating how end users of different cultural background perceive and prefer differently in online learning system interface, their interaction with the interface and consequently the overall usability, task performance, and preference in the online learning environment.

Rational

The United Nations Educational, Scientific and Cultural Organization defined culture as "(T)he set of distinctive spiritual, material, intellectual and emotional features of society or a social group, and that it encompasses, in addition to art and literature, lifestyle, ways of

living together, value systems, traditions and beliefs" (UNESCO, 2001).   According to

UNESCO's definition, we can give a more tangible definition/boundary to "culture" as a set of

contexts which encircle and influence the value point a certain group of people, or as Tessmer

and Richey(1997) delicately put:

> (Culture is) a multilevel body of factors in which learning and performance are
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> embedded.... Context is not the additive influence of discrete entities but rather the
>
> simultaneous interaction of a number of mutually influential factors. These factors'
>
> physical, social, and instructional aspects interplay to influence learning (p. 87).

Based on Vygotskian perspectives of cultural-historical developmental theory, human

consciousness is largely determined by the cultural context in which the development takes

place. That is to say, from the cultural-determinist perspective, people in one culture are

predetermined to form an overall tendency or propensity of behaving, thinking, as well as

learning.

Social interaction plays a fundamental role in the development of consciousness. From

the instructional design perspective, since children learn through interaction, instruction

should be designed to emphasize interaction between learners, instructors, and learning tasks.

Hence, the priority is to find effective ways to facilitate the interaction and communication

between these agencies.   After the popularization of communication technology, it has been

considered as one of the most effective tool to connect the abovementioned three agencies

together.   The hurdles, however is the design of tools and technology usually reflects the

value, cultural points, as well as personal preferences of designers who and/or organizations

which develop it.   Unavoidably, the implementation of technology in drastic different

settings may encounter resistance because of end-users' perceptions, as well as preference of the system.

Although we are living in an era of globalization, however, we need to realize and appreciate the differences that exist among groups.   In an international setting, the design, integration and utilization of communication technology in learning environment need to be reviewed from a micro and emic perspective to see not only the technical and implementing issues but also the psychological and emotional issues that influence the technology acceptance of users.   There is no doubt that online learning provides a great opportunity and flexibility for individual control and direction of information and communication resources. To provide equal opportunity to and optimize the learning environment for the learners, we need to face the music that there is no one perfect system for all, and realize the necessity of design for differences and take account of the fact that not all learners respond to the system interface in the same manner.

Theoretical Framework

To enhance meaningful learning by designing user centered learning system is central to this study.   In particular, this writer intends to inquire about the relationship between the variations of user profile (in a collective sense) of different cultural groups, as reflected in the perception, as well as using behavior of websites interface, and the design approach utilized in developing the interface, and the overall usability issue of cross-cultural users.

The most influential theory associated with this process is the postmodernism. Postmodernism is considered as an umbrella term used in different way by different researchers.

The complexity and multifaceted nature of postmodernism makes "this term defies easy summary" (Taylor, 2004).   However, often time when the postmodernism lens is chosen, the research is usually committed in exploring the complex relationship of power, knowledge and the discourse created in the struggle between social groups.   This study is no exception, the main focus is placed on investigating the way (if there is any difference) people from different cultural groups, which have different preferred strategies of processing information and are influenced by different social rules and values, interact with online learning system interface in an cross-cultural setting.   This writer convinced the belief of fragmentation and plurality of postmodernism (Best, 1997) makes it proper for investigating this particular phenomenon.

Postmodernism rejects unifying, totalizing, and universal schemes in favor of difference, plurality, fragmentation, and complexity.   It suggests that all views are subjective, thus, no single view of reality should be taken as and represent the "Truth."   It is to say, knowledge, as well as perception is entirely socially and ideologically constructed. It embraces the idea of "relativity" and "reconstruction", as well as "uncertainty."   The truth is no longer fixed and absolute; the way people perceive the world is subjective.   Language, power, culture and belief interweave altogether forming an unstoppable force which influences and somehow governs the formation of the individual reality.

Another theory, which is considered to work like hand in glove with postmodernism and heavily influences this study, is the Socio-Cultural Activity Theory of Russian School. Departed from traditional psychological understanding of development as an individual accomplishment, Russian School viewed development as a sociocultural activity (Holzman, 2006).   Following Vygotsky's works, Leont've conceived the structure of activity and proposed a system of mediated agents.   Leont've's Activity Structure is further expanded by Engeström

which composes of the elements of subject, object, tools, rules, community, as well as division of labor.   In the activity structure, the relation between subject and object is mediated by the tools available; the relation between subject and community is mediated by rules, and the relationship between object and community is mediated by the division of labor (Kuutti, 1996).

Due to the fact that the tools which have been incorporated into the social system are created and transformed by humans during the development of the activity itself; the nature of any artifact can be understood only within the context of human activity—by identifying the ways people use this artifact, the needs it serves, and the history of its development (Kaptelinin, 1996).   Meaning, the tools would have influences over the interaction between the subject and the object, the mediation through tools is therefore not a neutral process (Holzman, 2006).   In an Activity Theory point of view, technology is construed socio-historically as communally constructed, involving numerous agents and constraints (Leitch, 2005).   The usability issues of an interface (as a cultural artifact) thus can only be understood under the specific context in which the interface has been used.

Research Question and Hypotheses

The purpose of this study is to inquire about the relationship between the variations of cultural preferences (in a collective sense) of different groups, as reflected in the perception, as well as using behaviors of websites interface, the preferences on interface design features, and the overall usability on the interfaces.   As mentioned prior, the interface design of online instructional system is considered to be largely shaped by cultural preferences of designers', meaning, users from different cultural backgrounds would respond differently to the interface,

11

and consequently have different level of task performance and preference on that system. The major research question of this study then is:

> *Does the interface designed (including the design of visuals, information architecture, presentation layout and navigation) which matches the cultural preferences of target cultural group result in different levels of usability (in this study, the effectiveness, efficiency, and desirability) of the target users from the one that mismatches their preferences?*

The main question can be further elaborated into two sub-questions:

Q1: Does the match of websites design features and users preferences influence users' task performance on information search related tasks in using the online learning system interface?

Q2: Does the match of website design features and user preferences produce different level of desirability of interface design in the online learning system?

The hypotheses that corresponded to these two research questions are listed as following:

H1: Information task performances of users would be different in both performance time and accuracy when exposed to interfaces of different design approaches (match or mismatch to their cultural preference).

H2: The website perceived usability questionnaire scores of users would be different when exposed to interfaces of different design approaches (match or mismatch to their cultural preference).

The research questions for the qualitative phase were formulated based on the results of the first, quantitative phase of the study. However, as the main purpose of this study was to understand the usability of website interface in a cross-cultural setting, the qualitative interview questions were focused on the internationalization usability test, which include the following issues:

- Satisfaction issue, the main focus was on knowing if the interface was pleasant to use. A user's perception of satisfaction can be influenced by navigation, information structure, as well as visual representation (such as graphics, layout, typography….). Users' satisfaction is a combination of all of these criteria.

- Desirability issue, main question was if the users preferred one website design to the other, as well as the underlying reasons.

Significance of the Study

When developing and designing online learning system interface, there are two important categories of factors that need to be considered, the internal and external factors of users. It is suggested that the former factors are under the control of instructional designers which in most cases, involves the way the systems are organized, structured, as well as presented by the designers. Contrary to the internal factors, the external factors are highly related to user experience which comprise of user learning traits, personal characteristics, as well as preferences. For any interface to work effectively and efficiently, the internal and external need to interact in a positive way. It is important to examine the relationship between external factors (of target users' psychology and emotion) and the internal factors (the

design approach) in order to ultimately discover if the interaction(s) of these two categories of factors (if there is any) have the potential for effecting learning result in an online learning environment.

It is particularly important to study the interaction between the external and internal factors in the setting where the interface is designed for cross-cultural and/or international users. Cultural sensitive design approach is a trend and hot topic not only in the industry but also in educational institutions.   This trend brings up the issues concerning the validity of localization design, the impact of cultural differences on users' behaviors in interaction, as well as how to incorporate and accommodate cultural differences in interface design (Singh, Zhao, & Hu, 2003).   Nisbett and colleagues (2001, 2003) suggested that people from different demographic regions who have different cultural-historical origins, living in different physical environment, with different social structure, as well as educational systems, definitely perceive objects and situations differently.   That is to say, for people from different cultures, when encountering the same situation, the cognitive strategies, as well as preferred skills chosen to apply in solving the particular problem would possibly be varied.   The variation in the culturally determined cognitive profile of interface designers, as reflected in the interface design is believed to have effects on online performance and preference of users from different cultural background(s).

It is also suggested that culture is a discernible variable in interface design and acceptance.   Since social, political and economic worlds of different groups are varied, the psychological factors which affect the interface design, utilization and adoption— attitudes, beliefs, values, etc. are without doubt varied, even though all human beings share the same basic cognitive functions.   Studies comparing cultural variables in terms of information

technology find significant differences in attitudes toward computers usage (Choong & Salvendy, 1998; Evers & Day, 1997; Magrid Igbaria & Moshe Zviran, 1996; Omar, 1992), this implies the advantages of websites designed using cultural sensitive approach might be recognizable and even measurable in the degree of efficacy, comfort, as well as preference of users' engagement in the online learning system.   Those culturally determined internal factors might interact with the external instructional controlled strategies to produce diacritical results across users/learners.

In order to help students become better online learners, we need to understand their ways in perceiving and conceptualizing information online.   It seems likely that learners would benefit more from the interface that is designed to cater their characteristic such as learning profile and preferences.   The overall experience, as well as results of learning can be promoted and improved by matching user characteristics with the interface and instructional strategies. As Cronbach and Snow (1977) suggested, optimal learning results when the instruction is matched with the aptitudes of the learner.   The key is to find out what combination of instructional strategies and learner characteristics would produce the most effective and meaningful learning (Ford & Chen, 2001).   When designing the online learning system interface for a specific group of users, as designers carry out the process, they need to understand the users'/learners' characteristics.   These characteristics include not only their learning profile, but also their culture profile, preferred cognitive skills, as well as personal preferences of the target audiences.   These variables need to be considered and examined in order to achieve optimal interactions, as well as learning results.

Definitions and Terms

Usability

Usability can be defined as how easy and pleasant the design features are to use, as Benbunan-Fich (2001) suggested, usability is the extent to which "how well and how easily a user, without formal training, can interact with an information system of a website." More specifically, in interface design, according to Nielsen and colleagues (2003), usability is "a quality attribute that assesses how easy user interfaces are to use." Usability also refers to methods for improving ease-of-use during the design process. In this study, the usability of the interfaces was investigated from three aspects: effectiveness, efficiency and the desirability of the interface.

Culture Profile

Culture profile can be defined as the characteristics of an entity determined by its culture. An entity, in most cases, is an individual; however, it can also be defined for a larger entity, such as an organization (organizational culture), group (professional culture), or even a region or a society (national culture). In this study, the term "culture profile" was denoted as a set of characteristics of a nation, in a collective sense, which composes of three set of variables: first, the cognitive dimension; second, the behavior dimension which reflect the socio-cultural values, as well as norms of a particular society, and finally, the visual identities that reflect the cultural preferences of a particular society, in order to guide the design and localization process of online learning system interfaces.

CHAPTER II: REVIEW OF LITERATURE

Several theoretical and practical approaches influenced this study; they could be divided into three major parts. The first part dealt with the issues of the influences of Constructivism as a model of instruction and learning in the postmodern era, which explored the issues of engaging and empowering learning experiences of learners with different cultural background and experiences in the online learning environment. The second part dealt with the idea of "context" in which mind, behavior and tools develop and interact with each other, and investigated the influence of socio-cultural factors on individual consciousness formation and the constraint, as well as empowerment of tools to individuals in different cultural settings. Finally, the third part explored the cultural-specific approach of website interface design with a focus on the comparisons of the differences in design practice and principles for addressing and accommodating the different preferences of users from different cultures.

Learning in the Online Environment

Information and Communication Technology and Constructivist Education

In *Democracy and Education*, Dewey (1916) identified both the "educative" nature of social communication and the "communicative" nature of school education. Dewey stated, "Schools are, indeed, one important method of the transmission which forms the dispositions of the immature.... Not only is social life identical with communication, but all communication (and hence all genuine social life) is educative..." (p. 6). He mentioned "all communication is like art. It may fairly be said, therefore, that any social arrangement that remains vitally social,

or vitally shared, is educative to those who participate in it…" (p. 4).   Dewey's philosophy of education established the foundation of the constructivism.   From the constructivist point of view, education and the process of learning are socio-culturally constructed and communicative in nature.

Constructivism, more specifically, Social Constructivism, emphasizes the importance of culture and context in understanding what occurs in a society and constructing knowledge based on this understanding (Derry, 1999; Mark McMahon, 1997).   Constructivism is closely associated with many contemporary educational theories, such as the socio-cultural development theory of Vygotsky (Vygotsky, 1980, 2012) and Bruner (J. S. Bruner, 1990; 2001), and the social cognitive theory of Bandura (1989), which focus on the tight relationship between individual and socio-cultural and even ecological environment.   There are reciprocal relationships between these actors.   Social constructivists consider that an individual is a part of the constructed environment, and the environment in turn is one of the characteristics that constitutes and shapes the development of an individual (Bredo, 1994; Gredler, 2005).

From a social constructivist point of view, truth or knowledge is relative instead of absolute.   Through the process of learning, learners arrive at his or her version of the truth, and the truth is influenced by his or her background, worldview, as well as the context in which the process takes place.   Historical developments and symbol systems, such as language, logic, and mathematical systems, which are learned and inherited by the learner as a member of a particular culture, are critical considerations in constructivism.   It is thus important to take the socio-cultural factors of learners into account throughout the learning process, as their backgrounds might shape the knowledge and truth the learner creates, discovers, and attains during the learning process (García, 2011).

From a constructivist point of view, "knowledge is built by the learner, not supplied by the teacher," according to Papert (1990), Constructivism connotes a flexible setting that foster and supports learning instead of imposing controls and instructional directiveness upon students. This style of teaching and learning posed new challenges on instructional design and classroom management; to create such learning environments seems intrinsically problematic, especially in a traditional classroom setting.   However, in a virtual environment, by using information and communication technology (ICT), the benefit of Constructivism can be exploited.   ICT tools can be considered as cognitive tools that make learners think harder about the subject matter being studied while generating thoughts.   When students use ICT, an intellectual partnership between the student and the tools is established where the tools amplify the student's thinking and make the learning process more personal and relevant to them.   However, in order to reap the supposed benefits of both the tools and the pedagogy and optimize the learning results, careful plan and design, including proper supports, guidance, resources and tools, are required.

ICT is the tool that is designed for the function of communication, and is intrinsically a suitable medium for the communicative nature of education.   Jonassen (2001) suggested that ICT tools such as computers and the Internet could enhance access to information and support explorations of knowledge, which can support students in meaning making and knowledge constructing.   From an educator's perspective, new ICT tools have opened the new opportunities in delivering instruction that can provide meaningful and authentic experiences to help learners in developing knowledge and skills in a way that does not force-feed them with abstract and discrete information (B. G. Wilson, 1996).   From a learner's perspective, ICT can be used in developing and facilitating critical thinking and higher-order learning.   ICT tools enable learners to represent and express what they know by functioning as creators of artifacts that could exhibit

the knowledge learnt in a personal, relevant and meaningful way (Salomon & Globerson, 1987).

Some people might argue that ICT as tools is neither good nor bad in education, and its use might produce both positive and negative effects depending on its consistency with the learning and teaching objectives and on the interaction between the education system and its environment (Bielli & Basaglia, 2003).   However, in many educational settings, ICT is becoming more a commonplace, and in some cases, the integration of ICT into a learning environment is becoming a major thrust.   From a instructor's perspective, integrating ICT into learning environment could provide instructors with the means to manage efficiently the diverse educational provision needed to optimize each individual student's learning outcomes (Fraser, 2003).   From the learner's perspective, ICT encourages and enables learners to work on an authentic, real world task, and allows learners to feel a sense of ownership in the learning process.   Through using ICT, Individual learners can provide their knowledge, combine and exchange with peers, experts or professionals to construct knowledge in a more meaningful and effective way.

Constructivist Learning Environments

Greeno (1998) offered the mission statement for constructivist learning, he stated:

We need to organize learning environments and activities that include opportunities for acquiring basic skills, knowledge, and conceptual understanding, not as isolated dimensions of intellectual activity, but as contributions to students' development of strong identities as individual learners and as more effective participants in the meaningful social practices of their learning communities in school and elsewhere in their lives. (p. 17)

In other words, instructional designers and teachers need to construct an environment for learners to develop individual competence through meaningful interaction and effective participation in both learning and social communities (B. Wilson & Lowry, 2000).

Constructivist learning environments can engage learners in knowledge construction through collaborative activities that embed learning in a meaningful context through reflection on what has been learned through conversation with others (D. Jonassen, Davidson, Collins, Campbell, & Haag, 1995).   The principles by which learning environments might be built should therefore focus on four general systems attributes: context, construction, collaboration and conversation.   Context includes features of the real-world setting in which the task to be learned might naturally be accomplished.   These features which are replicated as faithfully as possible in the learning environment may include the physical, organizational, cultural, social, political and power issues related to the application of the knowledge being learned.   The learning experiences can be encountered in the earning environments, as well as in the real world, and the knowledge that is created and learned is a product of the mind and results from the individual's experiences with and interpretations of the context (D. Jonassen, 1991).   We can only say a learning environment is constructivist when it allow learners to make their own meaning for what they experience rather than requiring them to learn the teacher's interpretation of that experience or content.

Although it is the students who construct and test their own conceptual understanding, the community of learners and interactions with different cultures and expertise have a notable bearing on the quality of learning (Brown & Campione, 1996).   It is important to provide a communicative and collaborative environment where learners can construct new knowledge and skills instead of passively absorb and manage already acquired knowledge.   Collaboration aids

in developing, testing and evaluating different beliefs and hypotheses within learning contexts. Through the process of articulating covert processes and strategies, learners are able to build new and modify existing knowledge structures.   Conversation is necessitated by collaboration, individuals and groups must negotiate plans for solving situated problems before initiating those plans.   This planning involves reflecting on what is known, what needs to be known, the viability of various plans, and their potential effectiveness.   Conversation is an essential part of the meaning-making process because knowledge, for most people, is language mediated.

The Shift of Roles of Instructors and Learners

Social constructivism emphasizes the importance of the learner being actively involved in the learning process.   Unlike the traditional educational viewpoints where the responsibility rested with the instructor to teach and where the learner played a passive, receptive role; the responsibility of learning should reside increasingly in the learners.   It's suggested that meaningful learning occurs when learners construct their own understanding instead of simply mirroring and reflecting what they read from the books.   From a social constructivist perspective, an instructor should be a facilitator rather than a teacher (Bauersfeld, 1995).   While a teacher gives a didactic lecture that covers the subject matter, a facilitator helps the learner to get to his or her own understanding of the content.   The emphasis thus turns away from the instructor and the content, and towards the learner (Gamoran, Secada, & Marrett, 1998).   This dramatic change of roles implies that educators nowadays need to display a completely different set of skills than a teacher (Brownstein, 2001), in addition, it heralded the possibilities of using ICT tools as facilitators in the process of learning.

Learning occurs after the learners initiate the learning process, and knowledge construction can start only with the learner articulating an intention to build knowledge.   ICT

tools can be used as engagers and facilitators of thinking and knowledge construction. However, to be a engager and facilitator, the tools need to equip certain characteristics, Jonassen and colleagues (1993) suggested, in a constructivist learning environment, students can only benefit from using technologies when the ICT tools can support:

(a) Knowledge construction (i.e. representing learners' ideas, understanding and beliefs, and producing organized, multimedia knowledge bases by learners);

(b) Explorations (i.e. accessing needed information, and comparing perspectives, beliefs and world views);

(c) Learning by doing (i.e. representing and simulating meaningfully real-world problems, situations and contexts, representing beliefs, perspectives, arguments and stories of others, and defining a safe, controllable problem space for student thinking);

(d) Conversing (i.e. collaborating with others, and discussing, arguing and building consensus among members of a community, and supporting discourse among the knowledge-building communities); and

(e) Reflecting (i.e. helping learners to articulate and represent what they know, reflecting on what they have learned, supporting learners' internal negotiations and meaning making, constructing personal representations of meaning, and supporting mindful thinking.

One crucial assumption regarding the nature of the learner concerns the level and source of motivation for learning. According to Von Glasersfeld (1989), sustaining motivation to learn

is strongly dependent on the learner's confidence in his or her potential for learning. These feelings of competence and belief in potential to solve new problems are derived from first-hand experience of mastery of problems in the past and are much more powerful than any external acknowledgment and motivation (Prawat & Floden, 1994). This can be linked to Vygotsky's "zone of proximal development," where learners are challenged within close proximity to, yet slightly above, their current level of development. By experiencing the successful completion of challenging tasks, learners gain confidence and motivation to embark on more complex challenges.

Karsten and Roth (1998) suggested that students' perceptions of their ability to use computers effectively in the future significantly improved as a result of their learning experience and actual ICT using skill in higher education. Since the aim of constructivist education is to help students to develop knowledge and understanding of the subjects, independence and self-reliance in their learning, in this digital age we need to help students to develop their competence and self-reliance on choosing suitable ICT tools to enhance and aid their learning. The process, however, relies on not instructors' didactic impartation of what to use for a specific task, but students' spontaneous decision of what, why, when, where and how to use certain ICT tools to solve problems and enhance learning.

Cultural Factors in Online Learning

Katz and Offir (1993) stated that the ICT has the potential of increasing the effectiveness of the learning process, and is able to supply both individualized and rapidly executed complex learning tasks. In addition, ICT can also present learners with instant, accurate evaluations and other educational outputs. Since the innovations of the mouse, keyboard, and monitor as human-machine interaction interface of Douglas Engelbart in the sixties, human-computer

interface and interaction design are always considered as cultural artifacts of Western civilization. ICT tools, in particular computer and online communication tools, as the inventions of Western culture, the functionalities although are universally appreciated, however the designing ideology behind these tools are dramatically different from the Eastern culture.

When attempting to apply tools in a drastically different cultural setting, unavoidably the conflictions between ideology, symbolic system, cultural specific values, preferences, as well as social orientation, etc… would cause a certain level of refusal and rejection toward the tools, and consequently the negative experiences of usage. It's suggested that the positive experiences in using ICT tools is one of the key characteristics that links to the successful lifelong learning (Ralph, 1999). That is to say, the positive using experiences of ICT tools would not only enhance learners' confidence in the learning process by acquiring the feeling of competence that motivate them to take control of their learning, but also enhance the overall learning results.

In designing an online learning system, the major factors that need to be considered are usually user characteristics and traits, which include gender, social economic status (SES), digital literacy, such as computer experience, skill competence, and self-confidence of using… etc. To study the issues of usability, system adoption, as well as using effectiveness in educational setting, the first thing we need to understand is learners' attitude and personality profiles (Kulik, Bangert, & Williams, 1983; Lau & Sim, 2008). Ahmed (2009) suggested the lack of knowledge and attitude towards technology tools are the major stumbling blocks for technology adoption. In the context of the online learning environment, a student's likelihood of using the system is jointly determined by their attitude toward using the tool, perceived of usefulness and perceived ease of use of the technology (Davis, 1989)

In a cross-cultural or international setting, however, to include the consideration of personal factors alone is insufficient in designing and optimizing an online learning system. Besides the attitude and personal characteristics factors, cultural perception is another important factor to consider in designing an online learning system.   From a within cultural perspective, Rogers (2010) emphasized the importance of the cultural or social norms of a given country to the acceptance technology among its people; he indicated that system norms were an important predictor of diffusion of innovations.   The norms, as Roger suggested, is "the established behavior patterns for the members of a social system."   The system norms, therefore, can become one of the barriers for the adoption of a tool, as the norms of a society or an organization usually tell people what they are expected to do in a given culture.

To see the cultural issues from a broader view—a cross-cultural perspective, not only the cultural propensity determines and influences the overall attitude and acceptance of technology, the confliction of socio-cultural norms, values, ideology etc… between the technology developers and receivers are also a critical factor that need to be considered in order to optimize the use of technology.   Since the use of technology is culturally constructed, embedded with values, ideologies, and images of a particular cultural group (Henderson, 1996), the differences in cultural traditions inevitably would strike online learners with an alien cultural background (2004).   That is to say the design, which reflects the values, as well as the image of a specific culture might interfere and even inhibit the acceptance of users from alien cultures and consequently impact the overall usability of the system.

According to a report of Global Industry Analyst, Inc. (2010) the US and Europe dominate the global e-Leaning market and account for over 70% of revenues.   The fastest growing market of consuming, however, is the Asia Pacific area.   With the drastic difference in

the cultural values, Burnham (2005) questioned the design of online instructional system, which is so grounded in Western culture, might be of less value for a different culture. He recognized that at the very least, "even though people of all cultures find themselves learning and teaching in formal instructional settings; who they are and what they bring to these settings can make large differences in how design is approached." That is to say, the uncritical assumption of homogeneity of online user characteristics needs to be overthrown; and the influence of Western culture, particularly the American white middle class culture (as the dominant online culture) needs to be critically examined, especially its influence on the culture of online academia.

Culture is both invisible and pervasive, affecting the belief systems, norms, and values of people who live in it (Hofstede, 1997) and set barriers between groups. Rogers and Wang (2009) stated, cultural factors play an critical role in determining the perception, attitude, as well as usability of the online learning system (P. C. Rogers & Wang, 2009). They synthesized previous research and suggested there are a range of cultural factors that needed to be considered in designing an online learning system in a cross-cultural setting, including: educational values, reasoning patterns, way of knowing, way of communication, general context and content, technological concerns and the language. These cultural factors have impact on everything from the usability of the system and perceived credibility of online instruction, to the relatedness and relevance to the life of intended audiences.

Henderson (1996) asserted "instructional design cannot and does not exist outside of a consideration of culture." As we intended to develop a constructivist learning environment, we need to recognize that learning is socially-grounded and located within communities with particular cultures, values and expectations. There is abundant literature showing that cultures have identifiable dimensions, goals, expectations and that variations in learning styles, modes of

communication and participation impact on learning (R. Lewis, Stoney, & Wild, 1998; McDonald, Loos, & Osanai, 1993; Catherine McLoughlin, 1999; Wild & Henderson, 1997). Culture awareness is indispensable in instructional design, however, it cannot be just considered as "another factor" to be programmed into the design (A.-Y. Chen, Mashhadi, Ang, & Harkrider, 1999); instead, it needs to be considered throughout the design process and underpin not only the analysis phase but all phases of the design process (Thomas, Mitchell & Joseph, 2002). Designers must consider their own thoughts, beliefs, attitudes, desires, and feelings toward the target cultures and introspect and reflect their personal experiences and be aware that they are not only interact with other cultures but design for and with other cultures.

Culture, Behavior, Cognition and HCI Design

Concept of Culture

Definition

Although the construct culture is central of this study as the object is to understand the influences of a culture as an attribute to users of online learning systems, and on the results of interface usability.   However, in this part of literature review, the discussion will only be made to the extent is that relevant to the scope of this study, meaning, relevant to the human computer interaction (HCI) study.   The section introduces some of the existing definitions of culture (as usually cited and used in the HCI research) to explain how HCI researchers dealt with the issue of cultural differences and interface internationalization/localization.

Culture is a nebulous concept, solely in the field of social science there are more than 200 definitions in the literature (Lonner & Adamopoulos, 1996).   Definitions of the concept of culture range from reflecting an anthropological viewpoint, to sociological and educational perspectives (Bate, 1994).   Anthropological refers to the behavioral customs, the manners, and the interests of society, while sociologists view cultures as socially determined ways of thinking and acting that people acquire as members of a society.   Generally speaking, culture is considered as a shared, learned, symbolic system of values, beliefs and attitudes that shapes and influences perception and behavior— an abstract "mental blueprint" or "mental code" which both constrains and enables human behaviors (Sewell, 1992).

That is to say, different societies with particular cultures would have particular "world views" or basic assumptions underlying them (Hofstede, 1983) which would have crucial

influences on the ways how people in the particular culture think, perceive, as well as behave. Every group carries a particular pattern of thinking, feeling, behaving which was accumulated through the lifetime, but mostly learned from the childhood.   These patterns, as Hofstede suggested, are acting as mental programs, and vary as much as the social environments in which they were acquired.   According to Hall (1989), even though there are different approaches and definitions for culture, there are general agreements on some characteristics of culture: first, it is learned; second, different facets of culture are interrelated; and finally, it is shared and defines the boundaries of different groups.

Within HCI research, researchers often adopt definitions that link culture to the way that capable to address the overt measurable behaviors that users interact with computers (Honold, 2000), thus the culturally determined patterns are usually the main focus of the researchers. Hofstede's (1983) definition of culture (as well as his cultural model) is one of the most oft-cited definition in the field of HCI design as he addresses the patterns of behavior differences (as well as the similarities) that could be applied for the practical use.   In his landmark book *Cultures and Organizations: Software of the Mind* he states, "Culture is the collective programming of the mind distinguishing the members of one group or category of people from others" (p. 627). Hofstede used a metaphor of pyramid (see figure 1) to introduce three levels of uniqueness on human mental programming which are personality, culture, and human nature respectively.   The pyramid model indicates that "Culture is learned, not inherited.   It derives from one's social environment, not from one's genes.   Culture should be distinguished from human nature on one side, and from an individual's personality on the other" (Hofstede, 1980).

Culture acts as mental software which mediates and determines the behaviors of people under the particular culture.   Hofstede's definition can be explained using Vygotskian socio-

cultural perspective of the "social formation of the mind."   However, Hofstede's study mainly

focuses on the behavioral aspects of cultures instead of mind, and is criticized of only dealing

with the superficial level of behaviors and treating behaviors as the "products" of a culture.

Figure 1: The Pyramid Model of Uniqueness on Human Mental Programming

Some researchers, although they agree with Hofstede's idea of cultural specific

behavioral pattern, however suggested the observable part of culture is only the "tip of an

iceberg" which is not adequate to address and explain the influence of culture on behavioral

differences.   According to Steward and Bennett (1995) culture can be categorized into objective

and subjective culture; objective culture is the visible, easy to examine and tangible aspect of

culture while subjective culture is "the psychological feature of a culture, including assumptions,

beliefs, values, and pattern of thinking."   Hoft (Hoft, 1995, 1996) furthered their idea and used

iceberg as a metaphor to demonstrate the idea of objective and subjective culture. She suggested the objective culture is the 10 percent of the iceberg on the surface which represents the visible cultural characteristics of the target group. As for the remaining 90 percent, it is the critical yet invisible part with the characteristics difficult to identify and study.

Hoft (1996) further elaborated the iceberg into three metaphorical layers: surface level, unspoken rules, and unconscious rules. The surface level is identical with Stewart and Bennett's (1995) objective layer of culture which includes economic system, social customs, political structures, arts, crafts and literature. The subjective culture of Stewart and Bennett's which includes values, assumptions, and patterns of thinking that affiliate with specific culture, is divided into two levels: unspoken rules and unconscious rules. The unspoken rules are the cultural characteristics which are somehow obscured and need to be understood under the context of situation, whereas the unconscious rules are the cultural characteristic out of the conscious awareness. As Hoft (1996) suggested, the unspoken rules and unconscious rules are the sources of the surface level (objective part of culture), it means the subject culture which includes psychological features, assumptions, values and needs, constitutes the underlying processes that define a group of people, while objective culture constitutes the appearance and/or the content.

Level	Characteristics	Examples
Surface	The cultural characteristics which are visible and easy to reach which are similar to Stewart and Bennett's objective layer of culture.	Number, currency, time, date formats, language….

Unspoken Rules	The cultural characteristics of this level are somehow obscured and one needs to understand the context of situation in order to understand the unspoken rules.	Business etiquette, protocol….
Unconscious Rules	The cultural characteristics are out of conscious awareness.	Nonverbal communication, sense of time, physical distance, rate and intensity of speed….

Table 1: Three Layers of Iceberg Model

The major theme in Hofstede's theory of culture is, culture can be modeled, measured, analyzed and put into practical applications.   While his theory comes in handy in design practice, however, this approach is often criticized to be oversimplifying the underlying emotional and psychological factors of human mental function.   To address the underlying psychological and emotional aspects—the 90 percent of invisible subjective culture.   A socio-cultural approach called cultural psychology (J. Bruner, 1990; Greenfield & Bruner, 1966; Harrison & Huntington, 2000; Ji, Peng, & Nisbett, 2000; Markus & Kitayama, 1991; Masuda, Gonzalez, Kwan, & Nisbett, 2008; R. Nisbett & Y. Miyamoto, 2005; Nisbett & Norenzayan, 2002; Nisbett, Peng, Choi, & Norenzayan, 2001; Norenzayan, Choi, & Nisbett, 2002; Peng & Nisbett, 1999; Shweder, 1991; Shweder & LeVine, 1984; Harry C. Triandis) is proposed.

Following the Russian school of cultural-historical psychology and Vygotskian tradition, social psychologists believe that thought always occurs in a pragmatic problem setting, including the cultural assumptions that are brought to the task (Nisbett & Norenzayan, 2002).   Cultural values could function as a pre-loaded set of beliefs and attitudes to which people obey and put

into operation in day-to-day life (DiMaggio, 1997); or as Bruner (1990) proposed, it could also function as a cognitive toolkit or a set of prosthetic devices by which human beings can exceed or even redefine the 'natural limits' of human functioning." Nisbett (2002) suggested, "Culture means of distinguishing between regional differences in cognitive style, that is, empirically well-defined differences in the perception and thinking of people with a background from majority cultures in different regions." Social psychologists considered that human behaviors are the reflection of culture values and societal norms and suggested culture and human mind are inseparable. In addition, they suggested that the way the mind works is grounded in the psychological theories, and is more cultural specific than universal phenomena. They opposed to the extreme formalist idea which assumes the independence of the relationship between socio-cultural environment and cognition (Faiola & Macdorman, 2008), and endorse the idea that there are no universal laws for how the human mind works and that psychological functions grounded in one culture are likely to be limited in applicability in other cultures.

From a utilitarian perspective, Honold (2000) combined the definitions of Soudijn Hutschemaekers and van de Vijver's (1990), Hofstede's (1980), Ratner's (1997), Boesch's (1991, 1996), Thomas' (1996), and Shore's (1996) and proposed an operational yet comprehensive definition of culture for the purposes of the HCI design:

1. Culture defines members of a group as distinct from members of other groupings.

2. Culture creates an orientation system and a field of action for these members.

3. Culture manifests itself in cultural models. These may be internal cognitions or external artifacts and institutions.

4. Cultural models may differ in their scope and therefore in their significance to a

34

culture.

5. Cultural models are acquired through interaction with the environment. Action and experience on the one hand and cultural models on the other affect one another through the processes of accommodation and assimilation.

6. Culture does not determine the behavior of individuals but it does point to probable modes of perception, thought, and action. Culture is therefore both a structure and a process.

Honold (2000) suggested that to understand the target cultural group is crucial especially it is artifacts (such as technical products) and institutions (such as an social and economic organization), because a system or product does not just exhibit technical features, but also has been developed on the basis of intellectual models that are implicit carriers of specific cultural orientation systems and schemes.

Despise the differences in approaches and focuses, abovementioned definitions have a similar claim—in Hofstede's term "programming of mind;" in Nisbett's term "distinguishing between regional differences," or as Honold suggested "manifests itself in models"—that culture can function as a pattern or scheme which is shared and determines individual social interaction in a great extent.   It is suggested that culture both forges and evolves with an individual's interacting with the social, historical, geographic, as well as ecological experiences throughout one's life.

Although culture is a multi-faceted yet nebulous construct that is almost impossible to have a comprehensive definition; in this study the construct culture is operationalized in a psychological sense and treated as an experimental variable.   Since cultural assignments cannot

be controlled, hence culture at its best only has the status of a quasi-experimental variable (Campbell and Stanley, 1963).   The purpose of this study is not to measure the differences of cultures, but to understand the influence of culture, as an entirety, to the acceptance of website interface.   The primary interest is in the fundamental psychological processes rather than in the cultural variables per se.   However, in order to understand the phenomenon under the cross-culture perspective, it is necessary to categorize culture as an independent variable.

Behavior—the Reflection of Socio-Cultural Values

Cultural behaviorists link cultural experiences to certain behavioral phenomenon, this approach is particularly popular and influential in the cross-cultural business management and HCI design.   Since culture is an aggregation, the use of cultural models provides a tool to study and classify a culture (Evers 2001).   Several cultural models have been developed and used in demonstrating the behavioral differences in different cultures.   Generally speaking, there are two major types of cultural models: typological and dimensional models.   Typological cultural models describe an ideal "type" that can represent and reflect the image of a culture, while dimensional models group together a number of phenomena in a culture.   Hofstede (1991) suggested that cultural dimension is the "aspect of culture that can be measured relative to other cultures."   In empirical study, dimensional models are often used, as it is rarely the case that a society completely correspond to one single ideal type.

It is suggested that the culturally specific behaviors are usually correlated to culturally specific value(s).   Hofstede (1989) broadly defined a cultural value as "a tendency to prefer certain states of affairs over others."   Nearly all cross-cultural studies in social psychology are at certain levels related to values.   It is suggested that value differences between cultures have

mainly been discussed within the framework of individualism vs. collectivism (Schwartz, 1992). Based on the dimension of individualism, along with other factors such as social orientation, ecology and environment, in which a specific society was developed, societies develop a set of values which determine and condition not only the propensities but also behaviors of its members.   The following section begins with Hofstede's cultural dimensions and introduces two other related dimension models that support and/or complement Hofstede's model.

Hofstede's Cultural Dimension:

The cultural dimensions of Hofstede's were derived mainly from an extensive organizational anthropology research of IBM Corporate in the late 1970s to early 1980s. Hofstede's work is no doubt the most notable and significant cross-cultural study on work-related values (Bhagat and McQuaid 1982), although it's often criticized by the assumption of "cultural homogeneity" of his approach and its lack of generalizability to both individual and national level; the rigorous design with systematic data collection process and coherent theoretical foundation make Hofstede's research one of the most widely used and also validated pieces of research among both academic and practice.

By conducting surveys and group interviews, Hofstede calculated the dimensional "scores" or "values" that could be used to compare/contrast the collective cultural characteristics/traits of different countries and regions.   Based on a large database of international employees in the IBM corporate, Hofstede's research has the most comprehensive sample of cultural groups.   Based on the societal orientations and environmental differences, Hofstede categorized cultural behaviors into five cultural dimensions; the scores of each dimension for different countries can vary greatly, thus it provides an extensive set of tools for creating hypotheses for comparative cross-cultural studies (Soares et al. 2007).   The five

cultural dimensions identified by Hofstede (1991) are:

A. Power Distance Index (PDI): Hofstede (2010) defined PDI as "the extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally." PDI scores suggest the degree of dependency or subordination of an individual on authority figures in the family and organizational context. In low PDI cultures such as the United States, Great Britain (and the white part of the commonwealth realm), most of the Germany speaking European countries/regions and Nordic countries, individuals tend to believe that equality and equal opportunity exist in the society. As for the countries on the opposite side of the scale, such as most of the East and Southeast Asian and South American countries, inequalities of power and wealth exist within the society and the less powerful accept this situation.

B. Individualism Index (IDV): Hofstede (2010) defined IDV as "(the dimension that) pertains to societies in which the ties between individuals are loose: everyone is expected to look after himself or herself and his or her immediate family." It can also be explained as the degree to which a group achievements are valued and emphasized in the society (Marcus, 2005). Soares et al. (2007) suggested, in societies with high IDV where individuality and individual rights are paramount, individuals look after themselves and their immediate family only; whereas in low IDV (collectivistic) societies, the concept "individual" is closely tied to the "group," which means individuals, from birth onward, are closely integrated with the strong and cohesive group that keeps providing protection for them in exchange for unquestioning loyalty (Hofstede, 2010).

C. Masculinity Index (MAS): This index is defined as the degree to which the gender

roles are distinct.   For the male role, it is expected to be assertive, tough and focused on material success, whereas the female role, the quality of modest, tender and concerned with quality of life are expected (Hofstede, 2010).   Societies with high MAS index value the 'masculine' characteristic such as assertiveness and competitiveness and honor those who aspire after wealth and power; whereas a low MAS index typifies societies with that nurturing and caring 'feminine' characteristics and that seek of balanced relationship between individuals and society.

D. Uncertainty Avoidance index (UA): This dimension is defined by Hofstede (2010) as "the extent to which people feel threatened by uncertainty and ambiguity and try to avoid these situations."   UA index indicates the extent to which the members of a culture feel either uncomfortable or comfortable in unstructured and/or novel situations.   Countries with high UA tend to avoid the uncertain situation by using laws, rules, safety/security measures; this kind of society often believes in absolute Truth, and maintains rigid codes of belief and behavior and are intolerant of unorthodox behavior and ideas.   On the opposite side of the dimension, the low UA cultures tend to maintain a more relaxed attitude and often are linked to the idea of openess and innovation.

E. Long-term orientation index (LTO): LTO is the fifth dimension which was added in 1991 after the original report was published in 1987, also known as "Confucian work dynamism."   This dimension can be seen as Hofstede's effort to distinguish the difference in thinking between the East and West culture, and as he suggested, can be used as a factor to predict the economic growth.   Hofstede (2010) suggested LTO "stands for the fostering of virtues oriented towards future rewards, in particular perseverance and thrift."   Using Michael Bond's research on Chinese Value Survey (CVS) which produced four dimensions, three

(Integrity and Tolerance, Loyalty to Ideals and Humanity, and Moderation and Moral Discipline) of which across twenty countries were significantly correlated with the three dimensions produced by IBM survey (PDI, IDV, and MAS). However, the fourth dimension produced by CVS—the Confucian Ethos—was not correlated with UA or any other indexes, thus, it's been added as the fifth dimension in Hofstede's model. It can also be defined as "the extent to which a culture programs its members to accept delayed gratification of their material, social, and emotional needs."

In the 2010 updated version of *Cultures and Organizations—Software of the Mind*, Hofstede expanded the original study and compared 76 (in some dimension, 93, and was 53 originally) countries, and added yet another new dimension—Indulgence VS. Restraint (IRV). The IRV Based on the Happiness, or subjective well-being (SWB) of Minkov's World Values Survey (2010) can be explained as the extent to which a culture programs its member to "allow relatively free gratification of basic and natural human desires related to enjoying life and having fun" (Hofstede, 2010, p. 281). Hofstede (2010) suggested that IRV is correlated to the general norm of society, personal feeling, as well as health.

Hall's Cultural Factors:

In addition to Hofstede's model, there are several different models have been proposed. Hall's cultural factors, different from the focus of Hofstede's, are built for analyzing and interpreting intercultural communicational behaviors. He proposed two important cultural dimensions: the High-Low Context (HC-LC) and the Polychromic-Monochromic Time Orientation (PT-MT) dimensions (Hall, 1989), which are two of the most oft-cited indexes in the field of HCI. Hall emphasized the idea of "Contexting," which can be explained as the framework, background, and surrounding circumstances in which communication or an event

takes place, he suggested that:

High context transactions feature pre-programmed information that is in the receiver and in the setting, with only minimal information in the transmitted message.   Low context transactions are the reverse.   Most of the information must be in the transmitted message in order to make up for what is missing in the context.   (Hall, 1976, p.101)

He further stressed:

High context or low context refers to the amount of information that is in a given communication as a function of the context in which it occurs.   A highly contexted communication is one in which most of the meaning is in the context while very little is in the transmitted message.   A low context communication is similar to interacting with a computer—if the information is not explicitly stated, and the program followed religiously, the meaning is distorted.   In the Western world, the law is low context, in comparison with daily transactions of an informal nature.   People who know each other over a long period of years will tend to use high context communication.   (p. 229)

Gudykunst et al. (1996) after observing these two different styles of communication, concluded that HC communication is indirect, ambiguous, maintaining of harmony, reserved and understated.   By contrast, LC communication is identified as direct, precise, dramatic, open, and based on feelings or true intentions.   Hall (2000) suggested meaning and context are inextricably bound up with each other, hence, in order to understand the essence of the communication, the context and meaning need to be analyzed with the words used (code). When the communication is conducted, it is not only the verbal, non-verbal and para-verbal communication that comes into play; the physical, time, and situation relationship— the

contextual information all play crucial parts in delivering the information.

As for the second index—Polychronic vs. Monochronic—Hall defined this time variable as the orientation with which an individual deals with tasks.   The Polychronic individuals are characterized as "many-things-at-once" orientated, the opposite side—the Monochronic individuals—prefer the "one-thing-at-a-time" approach.   However, as Hall mentioned, cultures are not always exclusively polychronic or monochronic, an individual might employ polychronicity or monochronicity when dealing with different tasks with different natures, depends on the emergency and priority.   Table 2 gives a brief overview of the two different time concepts, and their resultant behaviors.

	Monochronic Culture	Polychronic Culture
Interpersonal Relations	Interpersonal relations are subordinate to present schedule	Present schedule is subordinate to interpersonal relations
Activity Co-ordination	Schedule co-ordinates activity; appointment time is rigid.	Interpersonal relations coordinate activity; appointment time is flexible
Task Handling	One task at a time	Many tasks are handled simultaneously
Breaks and Personal Time	Breaks and personal time are sacrosanct regardless of personal ties.	Breaks and personal time are subordinate to personal ties.
Temporal Structure	Time is inflexible; time is tangible	Time is flexible; time is fluid
Work/personal time separability	Work time is clearly separable from personal time	Work time is not clearly separable from personal time
Organizational Perception	Activities are isolated from organization as a whole; tasks are measured by output in time (activity per hour or minute)	Activities are integrated into organization as a whole; tasks are measured as part of overall organizational goal

Table 2: Monochronic and Polychronic Cultures (adapted from: Victor, 1992, p.234)

Western cultures, which Hall (2000) identified as 'low-context', are thought to have a tendency to generally concentrate on one activity at a time—the "monochronic orientation." Among such cultures, time is seen as comparable to money, in that it may be saved, budgeted, and spent.   By contrast, Hall postulated that "polychronic orientation" is found in "high-context" cultures such as those which exist in the Middle East, Southern Europe, and Central and South America.   In these countries, individuals are more likely to engage in two or more activities during the same time block.   Flexibility in time use and changes of activity are common and expected, thus during a block of time there can be many activities included within, and people are expected to flow comfortably from one activity to another (Barber & Badre, 1998).

Although Hall never really created a clear and complete model, his theory keeps influencing cross-cultural communication studies.   Hall suggested researchers exam the factors of context, sense of space, time orientation, information flow, as well as action chains in order to analyze and understand communication behavior in a cross-cultural setting.

Trompenaars' 7D of Culture:

Trompenaars and Hampden-Turner (1993), examining data collected from 15,000 managers of 28 countries, explained cultural differences from the perspective of individuals' tendency in solving problems (Hoft, 1996).   He proposed seven major cultural differences which are: 1) Universalism vs. Particularism, 2) Individualism vs. Collectivism, 3) Specific vs. Diffuse, 4) Neutral vs. Affective, 5) Achievement vs. Ascription, 6) Sequential vs. Synchronic, and 7) Internal vs. External.   His model is called 7D model because there are seven proposed dimensions in it.   The first five dimensions deal with the problems that come from relationships with other people.   The last two dimensions explain how a culture deals with the passage of

time and its relationship with the environment, respectively.   The following section introduces the seven dimensions of Trompeanaars.

A: Universalism vs. Particularism: This refers to how a culture rates the importance of rules relative to the importance of relationships and vice-versa.   Universalism dictates that the law should be prioritized over relationships.   Whilst Particularism juxtaposes this position by believing that relationships between people should take precedence over rules, as they only "codify" how people interact with each other.

B: Individualism vs. Communitarianism: This refers to whether a member of a culture prefers to be a member of a group or remain an individual.   Individualism has foundations in individual happiness and fulfillment for one's self.   Whilst Collectivism dictates that the actions of the individual should be undertaken with the best interests of the group at heart.

C: Affectivity or Neutrality: In an affective business culture, workers are encouraged to show their emotions, as they are impossible to hide.   In a neutral culture, emotions are unnecessary and risky - if shown overtly, and they should be controlled to a minimum amount as to avoid emotion overriding logical thinking.

D: Specific vs. Diffuse: This dimension measures the degree of involvement individuals are comfortable with in dealing with other people.   In specific-oriented cultures professional position is segregated out of personal life, and insulates the "work relationship" from other dealings.   It also suggests Specific cultures are more direct using clear descriptive words, frankness and facts, while diffuse cultures prefer indirect communication that may carefully use contextual clues to convey understanding.

F: Achievement vs. Ascription: In this culture, Trompenaars looks at how people receive

status.   In an Achieved culture, people are given status by their accomplishments, which must be proven over and over to continuously be pushed up an organizations ladder.   An Ascripted culture assigns status by a workers age, gender and so on.   This method of receiving status can be viewed as less democratic than that of the Achieved culture.

G: Sequential vs. Synchronic: This dimension is related to how individuals in a culture completes tasks either sequentially or synchronically.   How organizations decide is dependent on the cultural specific perception regarding the concept of time, either as flexible or rigid.

H: Inner vs. Outer Directed: This dimension is related to how individuals in a culture view the environment, whether they can control the environment, or be controlled by the environment.   In an Inner-Directed culture, it is believed that although the environment is powerful, it still can be controlled, whereas the Outer-Directed culture sees control in a more holistic view.

Comparison

Although many labels are used in different models, as Tara and Rowney (2009) suggested, these different labels are often overlapped and can be grouped into major categories. In comparing the abovementioned three oft-cited models, we can find some overlapping, as well as complements in the proposed dimensions.   Overall, this researcher suggested four major themes which can categorize the dimensions/factors in these three models: 1) interpersonal factors, 2) motivational factors, 3) time factors, and 4) environmental factor (see table 3).   The interpersonal category includes:

- Hofstede's three dimensions: Power Distance, Individualism, and Masculinity;

- Hall's Hi-Low Context; and,

- Trompenaars' five dimensions: Individualism, Achievement-Ascription, Universalism, Neutral-Emotional, as well as Specific-Diffuse.

In the interpersonal factors, it is clear that Trompenaars' Individualism dimension is virtually identical to Hofstede's, as they both indicated the degree to which individuals tie/integrate to the society.   Furthermore, the Achievement vs. Ascription dimension, which describes how status is accorded appears to be linked to Hofstede's power distance index, although is not completely match.   Hofstede's Power Distance dimension can fit in both interpersonal and motivational categories.   Power Distance Index suggests the degree to which individual in a society accept the unequal power distribution.   From the interpersonal perspective, it can explain how an individual deals with ranking and authority-subordinate relationship.   From the motivational perspective, Power Distance indicates the level of acceptance an individual has to hierarchical order and class divisions.

The dimension of Universalism vs. Particularism, which is defined as the preference of depending on rules or relationships to deal with interpersonal relationships, could be partially fitted into Hofstede's dimension of uncertainty avoidance in the motivational category, and to some extent also fits into the Individualism dimension in the interpersonal category.   The degree to which an individual relies on rules indicates the fear of exceptions that could lead to the breakdown of the system and unforeseen results.   Furthermore, the degree to which individuals depend on rules in handling relationships implies how individuals judge other's behavior depend on universal rules or the closeness of relationship.   Universalism is often linked to individualist cultures such as the U.S., Canada, the U.K, New Zealand, Australia, and Switzerland, since these individualist cultures usually rely more on formal laws, while Particularism is often linked to collectivist cultures such as Latin-America, and Asian countries

where relationships and harmony are valued more than rules.

Hofstede's dimension of Masculinity can be fit into both interpersonal and motivational categories as it suggests not only the value differences within and between genders, but also the degree to which societies value material achievement.   In the interpersonal category, the Hofstede's Masculinity dimension can be linked to Trompenaars' Neutral-Emotional dimension as it deals with the degree to which individuals relate self to others.   The degree of masculinity and femininity decides not only the communication approach but also the degree to which emotion expression is accepted by the society.   From the motivational perspective, the degree of masculinity indicates the degree to which the society emphasizes ambition, acquisition of wealth, and differentiated gender roles.   In neutral societies, such as the U.K., Sweden, the Netherlands, Finland, and Germany, emotions are considered to be messy interferences in achieving objectives.   For these masculine cultures, objective achieving is considered more important than the emotional nature of the interaction (Vanka & Klein, 1995).

The Specific-Diffuse dimension of Trompenaars' deals with the issues of how deep people get involved with other's life space.   This dimension does not directly link to any of Hofstede's dimensions.   As for the Hi-Low context factor of Hall's, it mainly deals with the issue of interpersonal communication/interaction style, thus it is classified in the interpersonal category.

In time orientation category, Hofstede identified the dimension of Long-Term Orientation which deals with cultural differences on the value of future, thrift and persistence.   This factor does not relate to the time factors identified by Hall and Trompenaars.   There is, however, a similar theme in Hall and Trompenaars' theories; they both identified a time factor that indicates

the preferences, as well as orientations individuals deal with tasks, in Hall's term Polychronic vs. Monochronic, and in Trompenaars' term Sequential vs. Synchronic.

Trompenaars identified an environmental dimension—Inner vs. Outer directive which is not related to any dimensions that are proposed by Hosftede and Hall.   This dimension explains how people view and deal with their external environment.   Inner-directed people tend to believe that they can control their own destinies, whereas outer-directed people are those who feel that life's outcome is not under their control.   These dimensions are similar to the constructs of internal and external locus of control of Rotter's (1966).   Most individualist cultures are characterized as inner-directed, while most collectivist cultures are characterized as outer-directed (Beugré, 2007).

It is important to note that cultures/countries, even extreme in their scores on the dimension are not locating on the opposing end of the dimension(s).   The using of scales and scores is meant to indicate the relativity instead of a dichotomy relationship.   Each of the dimension can be conceived as a gradient on which the relativity of culture value (in a collective sense) has been measured.   It is also crucial to know that although these dimensions mainly measure the behavior outcomes of individuals, they represent not the superficial behavior differences but rather the fundamental differences in human personality normally developed subconsciously under the influences of socio-cultural norms and values.   As Hall suggested, people within a culture would be predominantly at some position on the spectrum and that this position was culturally learned and preferred (Sun, 2001).

Models⟍ Categories	Cultural Dimension of Hofstede's	Cultural Factors of Hall's	Cultural Dimension of Trompenaars'
Interpersonal factors	Power Distance		Achievement-Ascription
	Individualism		Individualism Universalism
	Uncertainty Avoidance		Specific-Diffuse
		Hi-Low Context	
Motivational factors	Masculinity		Neutral-Emotional
	Uncertainty Avoidance		Universalism
	Power Distance		Achievement-Ascription
Time orientation	Long Term Orientation		
		Polychronic-Monochronic	Sequential- Synchronic (M-P time)
Environmental factors			Inner-Outer Directive

Table 3: Comparison of Hofstede's, Hall's, and Trompenaars' Cultural Models

These dimensions as Hofstede (2010) stressed, can only be considered as a referential framework that can be used to assess a given culture in guiding the process of decision making. There are other factors need to be taken into consideration, hence these dimensions cannot be used to predict individual behaviors and personalities.   Within behavioral approach, although shows its value on the cross-cultural computer mediated communication (CMC) and HCI research, behavior can only be understood by taking into account of the human mental process under the specific context where the behavior is conducted.   We cannot predict how human beings respond to stimuli as an intentional system.   Greene (1995) argued, to a significant degree, human behaviors are unpredictable because the process of mind is imperfectly rational. Picard (1997) also suggested that emotions play an essential role in decision-making, learning, and other processes that directly influence the mechanisms of rational thinking.   To study the

cross-cultural HCI, the behavioral approach alone is inadequate. To analyze how and why people from different cultures respond to the same stimulus differently, researchers need go further and peer into the "black box" of human thoughts in order to understand how different experiences and interactions people had influence the way they think and learn.

Culture and Cognition

Cognition Development

From a Piagetian perspective, the mechanism of cognition development is through internalizing (accommodation, assimilation and equilibration) experiences into individual cognitive structure and/or schemata. He suggested that through processes of accommodation and assimilation, individuals transform and replace the pre-existing cognitive structures in order to adapt to the new environment. In addition, through equilibration, an individual can balance between applied cognitive structure (assimilation) and change their behavior accordingly for the new environment (accommodation). From this perspective, an individual creates interpretations of the world based upon their past experiences in and their interactions with the world they live. How an individual construes the world and their existing metaphors, is at least as powerful a factor influencing what is learned as any characteristic of that world (Cunningham, 1992; Mark McMahon, 1997).

While Piaget did count for the social transmission and mediation of knowledge, the interplay between social life and cognitive development processes was not a main focus (or at least have not been explicated) in his theory. Social constructivism that calls for the attention of the importance of culture, language and history in cognition formation. Influenced strongly by Vygotsky's work, social constructivism favored the concept of learning as a social construct

which is mediated by language via social discourse and interaction. Vygotsky (1978) suggested the central fact about human psychology is the process of mediation, through mediation individual can get to a higher order of truth that has also been socially tested (Derry, 2002). From Vygotsky's perspective, learning is not a purely internal process, nor a passive shaping of behaviors, rather, it is a process of enculturation through the process of social interaction. It not only views each learner as a unique individual with unique needs and socio-cultural backgrounds, but also considers that each learner is a complex and multidimensional composition of multiple emotional and socio-cultural constructs.

Culture Cognition—a Cognitive-Constructivist Approach

Derived from Vygotskian research, the cognitive-constructivist approach acknowledges knowledge structures as being embedded in a cultural context and thus as being culturally bound. Spering (2001) suggested, cognitive constructivist approach focuses on the context and cultures in which the knowledge structures is embedded; etic, as well as emic constructs are used to comprehend the role of knowledge structures. Cultural differences thus arise from differing implicit theories, such as mental models and the like, which are understood as context-sensitive. The major theme of Vygotsky's theoretical framework is that social interaction plays a fundamental role in the development of cognition. Vygotsky's work provides a rich source of ideas about ways to reconcile the study of culturally organized experience with the study of cognition and cognitive development (Wertsch, 1985). Vygotsky proposed that:

> (A)ny higher cognitive function appears twice, or on two levels: first, on the social level, and later, on the individual level; first between people as an inter-psychological category and then within the individual child as an intra-psychological category… all the higher functions originate as actual relations between human individuals" (Vygotsky, 1978, p.

51

57, cited in Berry et al., 1992).

Vygotsky further suggested the origins of individual mental functioning are socially construct; that is, an individual can only acquire higher mental functions that are already in the socio-cultural context. Hence, human behavior is usually "culturally mediated" (Berry, 1992). The tight connection between the social organization of behavior and the individual organization of thinking is further emphasized in Vygotsky's theory of Zone of proximal development (ZPD) which claims:

> (T)he levels of generalization in a child correspond strictly to the levels in the development of social interaction. Any new level in the child's generalization signifies a new level in the possibility for social interaction. (Vygotsky, 1956, cited in Wertsch, 1985, p. 96)

Following this train of thought, social interactions play a crucial role in cognition development, and the ZPD is where culture and cognition meet, blend and create each other.

Nisbett and Norenzayan (2002) propose six fundamental rules regarding the development of human cognition. They believe:

- Some cognitive content is universal;

- Universal content of these and other kinds place constraints on the diversity of human thought, as well as the range of cultures possible;

- Some cognitive processes normally regarded as basic are highly susceptible to change even for adults;

- Cultures differ markedly in the sort of inferential procedures they typically use for a

given problem;

- Cultural differences in cognitive processes are so tied to cultural differences in basic assumptions about the nature of the world;

- Cultural practices and cognitive processes constitute one another.

They suggested that thinking develops in a cultural context, and the function of human mental processes is, to a great extent, affected by the socio-cultural environment (Nisbett & Norenzayan, 2002). From an eco-cultural perspective there are two basic assumptions of cognition formation. The first assumption is the "universalist" assumption which suggests that all human societies exhibit commonalities (cultural universals) and that the basic psychological processes are shared, species common characteristics of all human beings. The second assumption is the "adaptation" assumption which suggests that behavior is differentially developed and expressed in response to ecological and cultural contexts. That is to say, people everywhere are likely to possess similar cognitive structures such as the ones that realize exemplar-based categorization, inductive and deductive reasoning, long-term memory, covariation detection, etc. However, without denying the existence of these universal processes, under different cultures and environments, the cultural variations do have effects on shaping cognition of individuals. As Grosser and Lombard (2008) suggested, since society differs in the cultural practices that they promote, affording differential expertise in the use of a cognitive strategy, or differential knowledge about a domain, the result is that "a given cognitive process may be equally available in principle, but differentially accessible in different cultures."

Culture Cognitive Styles

When the term cognition is used, it is usually referred to the processes human beings

engage in planning, analyzing, considering probabilities or solving problems.   The idea of cognitive styles was originally proposed by Allport (1937), and this notion referred to a person's way of thinking, perceiving, remembering and problem solving (Y. Liu & Ginther, 1999). Cognitive styles are suggested to be fundamental as they develop early in life and are pervasive given their effect on social behavior, decision making, and learning (Rezaei & Katz, 2004). Cognitive style is a basic concept in studying the individual's manner of dealing with perceptual and intellectual task (Smith, Dunckley, French, Minocha, & Chang, 2004).   With the relative stability and consistency of the dimension over time and across situations observed in various studies, it has come to be regarded as a personality variable (Cassidy & Eachus, 2000).

As aforementioned, while Piagetian formalism suggests that cognition development is universal across cultures, there are great amount of evidences that reveal the fault of emphasizing on genetic epistemology.   Cultural differences in behavior studies (Hall, 1960, 1969, 1989, 2000; Hofstede, 1983, 1987, 1997), cognitive studies (Ji et al., 2000; Masuda et al., 2008; R. Nisbett & Y. Miyamoto, 2005; Nisbett & Norenzayan, 2002; Nisbett et al., 2001; Norenzayan et al., 2002; Peng & Nisbett, 1999), and neural studies (Chiao, Cheon, Pornpattananangkul, Mrazek, & Blizinsky, 2013; Han & Northoff, 2008; Hedden, Ketay, Aron, Markus, & Gabrieli, 2008) have found cultural context and cognition development are entwined and inseparable.

Although cognitive styles is suggested to be related to social interactions regulating people's beliefs and value systems (Kozhevnikov, 2007), only few dimensions have been linked to the construct of culture and been investigated under cross-cultural setting.   In the following section, two cognitive dimensions which are oft-cited and have been tested in the cross-cultural setting: *field dependence-independence* (FD vs. FI) and *holistic-analytic* cognitive dimensions are introduced.   The rationale of introducing and comparing these two dimensions is: first, these

two dimensions are both developed under the context of information process theory; second, both dimensions are suggested to be directly related to human perception; and finally, these two dimensions are suggested to be closely related to each other (Ash, 1986; Brumby, 1982; Entwistle, 2013; D. H. Jonassen & Grabowski, 1993; Riding & Cheema, 1991).

Field Dependence-Independence Cognitive Style

Using the "Embedded Figure Test" Witkin et al. (1977) identified one of the most well-known cognitive styles in the field of education— field independence (FI) versus field dependence (FD).   Generally speaking, the FI-FD dimension hinges upon the extent to which an individual perceives analytically (or relationally).   On the perceptual level, FI individuals are able to analyze and structure perceived information and experiences into a new framework, FD individual, by contrast, tend to be determined and governed by externally imposed framework (Witkin, Moore, Goodenough, & Cox, 1977).

The central attribution of the field dependence, as Witkin et al. (1977) states, is "the extent to which the person perceives analytically."   Based on the hypothesis: "members of societies with a strong emphasis on conformity would possess relatively field-dependence cognitive style," in a series of cross-cultural research, Witkin found that the extent of field dependence is associated with ecological setting, familial and communal systems, cultural norms and societal/institutional orientation (e.g., Witkin, 1967; Witkin et al., 1974; Berry, 1976, 1979, 1980; Witkin & Goodenough, 1977; Witkin, Goodenough & Oltman, 1977).   FD has been linked to authoritarian patriarchal societies (Eastern origin) where individuals tend to have a greater social orientation—the tendentiousness in taking account of external social referents in defining their attitudes and feelings (Castaneda, Ramirez, and Herold, 1972).   By contrast, FI cognitive style has been linked to more liberal societies and is considered to be a result of

socialization practices with an emphasis on individual freedom and self-reliance (Tsikriktsis, 2002).

Many studies identified the connections between FI-FD dimensions and learning. Generally speaking, FI individuals are likely to learn more effectively under conditions of intrinsic motivation such as self-directed learning, which are influenced less by social reinforcement (Samule Messick, 1976; Wolfe & ScienceDirect, 2001).   Jonassen and Grabowski (1993) concluded that field independence is the strongest predictor of divergent tasks in a course, including media using skills, in addition, field-independent individuals are better at transferring rules to new contexts, as well as generating rules to solve novel problems (see table 4 for the comparisons for the characteristics of FI and FD individuals).

	Field Independent	Field Dependent
	Impost organization on unstructured field	Take organization of field as given
	Greater use of mediational processes such as analyzing and structure	Less effective use of mediational process
	An active hypothesis-testing role in learning	A passive, spectator role in learning
	Learning curve is discontinuous in that there is no significant improvement in learning of a new concept until the appropriate hypothesis is found, then sudden improvement	Learning curve is continuous in that gradual improvement is seen as relevant cues are sample
	Less dominated by the most salient cues in learning	More dominated by salient cues in learning
	Use structures and reorganize materials for more effective storage and retrieval of information	Use existing organization materials in cognitive processing
	Internally defined goals and reinforcements	Externally defined goals and reinforcement
	Prefer to learn general principles and acquire them more easily	Prefer to learn specific information and acquire it more easily
	Intrinsic or task-oriented form of motivation	Extrinsic forms of motivation
	Learn better on learners-central task	Learn better with socially relevant information

Table 4 Comparisons on Characteristic of Field Dependent vs. Independent Learners

<u>Holistic-Analytic Cognitive Style</u>

In a similar vein with Witkin's FI and FD dimension, Riding and colleagues (1991) used a different tool—Cognitive Styles Analysis (CSA)—to identify cognitive styles.　They suggested that the various style labels could be accommodated within two fundamental style dimensions—the Holist-Analytic versus Verbal-Imagery.　Riding defined the Holist-Analytic dimension as whether an individual tends to organize information in wholes or parts, and the Verbal-Imagery dimension as whether an individual is inclined to represent information during thinking verbally or in mental pictures.　Riding and Douglas (1993) found that a text-plus-picture mode in computer-based instruction was more effective in facilitating the learning of individuals with an imagery style than was a test-plus-text mode.　Riding and Sadler-Smith (1992) investigated the interaction between mode of presentation and style in their effect upon learning performance.　They employed computer-based instructional materials in varieties of modes of presentation (verbal or visual) and organization of contents of instruction (step, size and absence or presence of advance organizer).　They concluded that cognitive style, mode of presentation and type of advance organization have important effects upon learning performance in media-mediated learning environment.

Cognitive style usually denotes a tendency to which an individual behaves in a certain manner in personality dimension which influences attitudes, values, and social interaction. Analytical thinkers group objects together in accordance to a specific rule whereas holistic thinkers classify information based on a contextual or a functional relationship (Singh & Pereira, 2012).　Nisbett, Peng, Choi, and Norenzayan (2001) concluded that East Asians are more holistic, attend to the entire field and assign causality to it, they tend to make relatively little use

of categories and formal logic, and rely on dialectical reasoning; whereas Westerners are more analytical, pay attention primarily to the object and the categories to which it belongs and use rules and include formal logic, to understand its behavior.   Norenzayan and Nisbett (2000) reported that the ways of causal reasoning of East Asian and American differs significantly and influenced heavily by the respective culture-specific mentality (e.g. holistic vs. analytic).

Domain	Analytic Cognition	Holistic Cognition
Origin	Grecian Philosophy /Liberal	Confucianism/Authoritarian
Attention	Field Independent Narrow Focus on salient objects with intent to manipulate them	Field dependent Broad Focus on relationship of elements, background
Categorization	Taxonomic, focus on a single dimension or shared property	Thematic, focus on functional relationship or overall events
Attribution	Dispositional Traits and attributes of individuals determine events	Situational External forces, context, and situation determine events
Reasoning	Analytic Use of formal logic Trends continue	Dialectical Middle way philosophy Trend reversals are likely

Table 5: Analytic vs. Holistic Cognitive Patterns

Cognitive Styles and Information Processing

A series of studies (e.g., Ash, 1986; Brumby, 1982; Entwistle, 1981; Jonassen & Grabowski, 1993; Riding & Cheema, 1991) noted that the field dependency dimension of Witkin is closely related to the holistic dimension of Riding as they both use bi-polar dimension to distinguish the preferred way of individual in gathering, processing, and evaluating information. Field-dependent individuals typically prefer holistic approach in dealing with tasks and seeing a global picture and ignoring the details.   Conversely, field-independent individuals prefer

analytic approach in dealing with tasks, they tend to discern figures as being discrete from the background thus they focus on the individual object and details.   These differences on perception, as well as cognitive skills/strategies utilization are suggested to be correlated to socio-cultural values and norms (Lo & Gong, 2005).   Research employing the constructs of individualism-collectivism and social orientations have shown that a variety of cultural values are related to cognition development, performance and behavior.

A few studies have been conducted to clarify the mechanisms of cognitive styles in the context of an information processing approach (Kozhevnikov, 2007).   Several early studies reported that the difference between FD and FI individuals might be related to differences in encoding processes, and this became especially apparent when a large amount of information had to be analyzed or integrated (Davis & Cochran).   Miller (1987, 1991) links cognitive style (particularly the holistic-analytic dimension) to memory, attention and reasoning processes.   He (1987) proposed a hierarchical "model of individual differences in cognitive processing" in which a vertical dimension was added to the horizontal holistic-analytic dimension to represent different stages in cognitive processing (Kozhevnikov, 2007), such as perception (pattern recognition and attention), memory (representation, organization, and retrieval), and thought (reasoning and thinking).

Miller (1987) distinguishes the perception stage into two interrelated processes: *patterns recognition* and *attention*.   In the process, the human mind receives the information (stimuli) from the outside environment and tries to recognizes and categorizes the received information by comparing it to the stored memory by using the preferred strategy— to match incoming information and the mental representation (holistically) or differentiate the incoming information with the mental representation (analytically).   In selective process of attention, he suggested,

holistic people tend to have a broader attention on contextual information and relationships and respond to non-salient information; conversely, the analytic people tend to have confined attention and place their attention(s) on salient/required information/cues and ignore the irrelevant cues.

In the memory stage, the dimension of holistic and analytic can be used to understand how information is represented, organized and retrieved.   Miller (1987, 1991) suggested that semantic memory is organized in the form of conceptual networks.   The structure or complexity of hierarchical conceptual model is considered to be related to the degree to which an individual can differentiate or integrate concepts, which is correlated to not only the prior knowledge of an individual but also the stylistic differences of cognitive preferences.   In memory retrieving, Miller suggested, holistic people tend to utilize "divergent" strategies which are broad and associational rather than logical and use vague search criteria, while analytic people tend to use "convergent" strategies which apply a narrow, deductive, logical and specific search criteria in locating information.

In thought/reasoning stage, the incoming stimuli/information along with the stored information in memory is transformed and manipulated in pursuit of a goal—either to make judgments, inferences, or to draw implication.   The stylistic differences in reasoning are connected to the inductive inferences which include classification, analogical and judgment (Anderson, 1980; Pellegrion & Goldman, 1983; Miller, 1987).   Miller (1987) suggested, the degree to which an individual thinking inductively is influenced and determined by the holistic and analytic dimension.

Miller's model is intended to explain the hierarchical classification of cognitive styles in

terms of both their relations to each other and relations to the process of cognitive control and regulation. Information process is particularly important, as the main focus of the study was placed on overall usability of the localized interface which involved the users' perception, as well as interaction—the ways that an individual controls, reasons and organizes information. Although Miller did not connect the construct of culture with the cognitive style, the way he integrated cognitive style (particularly holistic and analytic dimension) and information processing provides a standpoint for this author to investigate how cultural factors influence the human information processing and consequently the way how individual interacts with online learning system interface. The cognitive repertoire of an individual includes a series of complex factors, which determine an individual's reaction to a given stimulus situation (i.e., using interface). As Nisbett et al. (Nisbett & Norenzayan, 2002; R. E. Nisbett & Y. Miyamoto, 2005; Norenzayan et al., 2002) suggested, certain cognitive strategies and tendencies are more likely to be developed and encouraged under certain socio-cultural environment than in others. In a collective sense, it is suggested that the differences in preferred cognitive strategies across cultures which include different tendencies on information processing might be great enough to surpass the ever-existing individual differences within cultural groups (Segall, Campbell, & Herskovits, 1966).

An Integrated View—Cultural-Historical Activity Theory

Vygotsky's Cultural-Historical Activity Theory provides a framework to synthesize and explain the complexity of human-environment relationship/interaction. Vygotsky (1962) who was against artificial separations between mind and behavior and between mind and society, endeavored to develop "a theoretical perspective that would allow a unified analysis of behavior and consciousness while recognizing the unique socio-historical nature of the human mind"

(Minick, 2005, p 52). The fundamental postulate of this approach is that human psychological functions differ from other animals in the way that they arise from practical activity, and are culturally mediated and historically developing (Cole, 1996).

Structure of Activity

Based on Vygotsky's work on social constructivism, Leont'ev conceived the concept of "activity" which can be defined as "a purposeful interaction of the subject with the world, a process in which mutual transformations between the poles of 'subject-object' are accomplished" (Leont'ev, 1974, cited in Kapetelinin & Nardi, 2006). Human activities, according to Leont'ev, are composed of four elements: subject, object, actions, and operations. Leont'ev further elaborates, a subject is a person or a group engaged in an activity; an object (can be a need, or desire) is held by the subject to give the activity a specific direction and motivate the subject. These elements can be further organized into three hierarchical layers. In the center of the hierarchical structure is action; under an activity there can be multiple actions oriented towards intentional goals. Usually, goals are functionally subordinated to other goals, which may be subordinated to still other goals, and so forth (Kaptelinin, 1996). On the highest level of the hierarchy is the overall objective—the motive (a goal not subordinated to any other goals). Motive can be seen as the overall object of the activity that the subject ultimately needs to attain. On the opposite side of the hierarchy lies the operations—the lower-level units which implement the actions. Operations are routine processes (usually unconscious) carried out automatically in delivering goal-oriented actions. They are oriented toward the conditions under which the subject is trying to attain a goal. Following the structure, we can say activities are driven by motivations, performed through certain actions which are directed at goals and which, in turn, are implemented through certain operations (Kaptelinin, 1996).

Furthermore, the structure of activity is not static but dynamic, meaning the relationship among activities, actions, and operations can change (according to the condition) over time. In activity theory, all levels can move both up and down. An operation can become an action when "conditions impede an action's execution through previously formed operations" (Leont'ev, 1974, cited in Nardi, 1996)—likewise an action can become an operation through internalization, and an operation can become an action through externalization (Bødker & Grønbæk, 1991). However, we need to notice that the motive, although it might be modified during the process, it is essentially remain fixed, only goals, actions and operations change as conditions change (Bonnie A. Nardi, 1996b).

Object-Orientedness

Every activity is directed toward something that either objectively or ideally exists in the world. Leont'ev noted every motive is an object, and the idea of an object is not limited to physical, chemical, and biological properties of entities. Socially and culturally determined properties also can function as objects in the structure of Activity Theory. Moreover, an object can be transformed and/or modified during the course of an activity. However objects do not change instantly; there is some stability over time, and the change in object might change the nature of an activity. In addition, the human activity is guided by anticipation. This anticipation is a motive of the activity, the goal of the action and the oriented basis of the operation, respectively. When the activity is performed there is a feedback mechanism which compares the result of the activity with the prediction and any incongruence gives rise to the situation.

Mediation

The concept of mediation of culture is in the core of Vygotskian socio-historical theory

which suggests that the mental processes can only be understood if one looks at the cultural artifacts (tools or signs) that mediate them.   Vygotsky believed that cultural artifacts influence how higher functions are developed and acquired and they are simultaneously ideal (conceptual) and material.   Moll (1992) suggested, cultural artifacts "are ideal in that they contain in coded form the interactions of which they were previously a part. They exist only as they are embodied in material."   For example, to acquire higher mental functions, young children must possess the basic language skills as it is one of the most important tools for organizing thinking.   A great deal of higher mental function development takes place under the influence of language (one of the most common cultural artifacts).   The system of culture and norms are learned and programmed into the brain through the mediation of language and influence the way an individual comes to recognize the surrounding environment, the way an individual deals with emotion, and even the way an individual orients spatially.

Internalization and Externalization

Lomov (1982) suggested that activity has an internal and external side and they are related without any gap to each another.   The distinction of internal and external activity might seem to counter the idea of inseparability of thought and action; however, Kaptelinin and Nardi (1996) propose two dimensions in distinguishing these two processes.   They suggested:

The first distinction is between mental processes and external behavior.   Here, internalization is the transformation of external activities into internal activities, while externalization is the transformation of internal activities into external activities.   And the second distinction is between individual and collective phenomena.   In this distinction, internalization is the individual appropriation of socially distributed activities, and externalization is the distribution of activities from the individual to their social

environment.

It emphasizes that internal activities cannot be understood if they are analyzed separately from external activities, because they transform into each other. Kaptelinin and Nardi (1996) further suggested:

Internalization provides a means for people to try potential interactions with reality without performing actual manipulation with real objects (mental simulations, imaginings, considering alternative plans, etc.). Externalization transforms internal activities into external ones. Externalization is often necessary when an internalized action needs to be "repaired," or scaled. It is also important when a collaboration between several people requires their activities to be performed externally in order to be coordinated.

According to Vygotsky, internalization is social in nature. The concepts of "internalization" and "zone of proximal development" are the best examples of how mediation takes place. Externalization is the opposite of internalization; mental processes manifest themselves in external behavior performed by individual; these behaviors then would be verified/approved or corrected/disapproved by the members of society. Psychologists of the Russian school suggested that the mind is activity—an internal activity—which is a derivative of external activity. The internal mental activity reflects the same structure as external activity, meaning, mental processes are formed in accordance with the same principles as those governing the construction of an act; a mental act is thus a specific model of the material act (Lomov, 1981).

Development and Context

In Activity Theory, development is not only an object of study, it is also a general research methodology (Kaptelinin and Nardi, 1997).   In Activity Theory, the focus is placed on the developmental change of participants in the context in which the developmental processes take place.   Activity theory requires that human interaction with reality should be analyzed in the context of development.   The activity itself is the context.   Context is constituted through the enactment of an activity involving people and artifacts.   Context is both internal to people and at the same time external. The crucial point is that in Activity Theory, external and internal are fused and unified (Nardi, 1997).

Activity Theory as a Theoretical Framework for Studying HCI

In the field of HCI design (or say, all kinds of design) designers always struggle to understand and describe "context," "situation," as well as "practice" of tool using in a meaningful fashion.   As Nardi (1996a) appeals: we have recognized that technology use is not a mechanical input-output relation between a person and a machine; a much richer depiction of the user's situation is needed for design and evaluation.   In order to come to an adequate understanding, as well as provide a richer depiction of the interaction between human and computer interface, the only way is to reconstruct the overall activity of computer use (Kaptelinin, 1996)

A key attribute of Activity Theory is its focus on the dialectic analysis on the interaction between subject and tools (mediated artifacts) which have been shaped by activity.   Leont've conceptualizes human activity as an ongoing circle, which he referred to as "ring structure," a combination of three code terminating elements—subject, activity, and object; where the subject is not primary and where the object completes the circle by influencing the subject (Hashim &

Jones, 2007).   Morf and Weber (2000) provide an example for the ring structure: " the object which a tool maker in Paleolithic era held affects her mental representations (her plan, her goal) as much as those representations affect the changing object. Reciprocal relationships prevail." Tools, thus, cannot be deemed as just materialistic devices, they are exteriorized forms of mental processes manifested in constructs, whether physical or psychological (Fjeld et al., 2002).

The value of Activity Theory stems from the analysis of the individual, in pursuance of their activity and objective through an examination of their tools and its mediation through rules, community and history (Hashim and Jones, 2007).   The assumption of the Activity Theory is the artifact "attains its qualities of function, aesthetics, and ethics as it is integrated into the actual activity; only in practice does it become a tool.   In other words to become a tool is to become part of someone's activity" (Christiansen, 1996).   That is to say, the usage of a computer (or any other information technology tools), as one of the mediating tools or "artifacts," then needs to be understood and analyzed under the activity system and the context.

For Activity Theory, "contexts are neither containers nor situationally created experiential spaces.   Contexts are activity systems.   An activity system integrates the subject, the object, and the instruments (material tools, as well as signs and symbols) into a unified whole" (Engeström, 1993).   An activity is carried out within a specific social context, be it a society, a community or an organization.   As the climates, established practices, as well as cultures of the institution are different, the contexts are definitely varied.   And since the contexts are different, the way in which an activity, even with the very same composition of subject, object, and tools, can fit into the context is definitely different.

In order to study the HCI from a socio-cultural perspective, we have to understand the

context in which the computer and information technology tool is used in crucial, as it is suggested that the perception, as well as the use behavior of tool would be largely influenced and/or determined by the overall social context. As formulated by Bødker (1991), users are acting "through the interface." Therefore, the subject matter of HCI should not be a closed system of "user-computer" but should include the meaningful context of the user's goals, environment, available tools, and interactions with other people.

In Vygotsky's theoretical analysis, activity is considered in terms of general social activity, as one of the main assumption of this study is that socio-cultural factors determine the (psychic) development of the individual; the emphasis of the role of external properties of social interaction in human development of Vygotsky's approach makes it appropriate for this study. However, the activity structure of Engeström's (1987) is used since he calls for the attention of larger social context. Engeström's (1987) modified and expanded the original activity structure of Leont've and adds two additional units of analysis: first *rules*, which are sets of conditions that cover both explicit and implicit norms, conventions, and social relations within a community which can help to determine how and why individuals may act, and are a result of social conditioning. The second unit is *division of labor*, which refers to the explicit and implicit organization of the community as related to the transformation process of the object into the outcome (Kuutti, 1999). These two elements affect a new plane of reality known as the community, "through this, activities and subjects are anchored, and can be analyzed" (Hyland, 1998; Verenikina, 2001).

In the structure of activity, an activity is undertaken by a subject, and driven by a motivation to act on an object in order to achieve an outcome. This process is mediated by tools in collaboration with the community. Tools can be physical artifacts (such as technology,

pens, paper) or mental (such as signs, language, experience).   This process of activity" takes place against the backdrop of rules and norms and a division of labor" (Engeström, 1987; Allen, et al., 2011).   From the Activity Theory point of view, the HCI study should not be limited in information processing (although it is still very important); instead, it should consider human interaction with computers as a multilevel hierarchical structure (Kaptelinin, 1996), and the focus should be placed on the higher-level events.   From an Activity Theory's point of view, HCI can be understood as "embedded in meaningful context, not limited to information processing, and operative at several levels, which have to be integrated" (Kaptelinin & Nardi, 2006).

Design for Differences

Based on the framework of Activity Theory, interface users—the subjects of the sense-making/problem solving activity—take an active position in selecting and interpreting information from computerized systems based on their existing mental model and biases. Subjects bring a set of personae which affect how they approach the activity, their previous experience, cognitive skills, personality and culturally determined traits (Hasan & Gould, 2001). From Activity theory's perspective, socio-culture context, mind and behaviors are inseparable. In order to provide a unified analysis of behavior and consciousness while recognizing the unique socio-historical nature of the human mind, in this study, "cultural dimensions" were used to not only demonstrate but also explain how cultural specific norms, values and rules influence individual behaviors (as reflect in the interaction with interface). Cognitive styles were also used to understand the differences of individuals in different socio-cultural context how they perceive, as well as process the information (as present on the computer interface). Both cultural dimensions and cultural cognition were used as referential tools in guiding the design and construction of website interfaces in enhancing the usability and accommodating the cultural preferences of different cultural groups. Furthermore, a third variable—visual identity—is used in optimizing the usability, as symbols, images, icons, as well as colors are part of the "cultural artifacts" which reflect the regional and social variation.

DuPraw (1997) proposes six fundamental patterns of cultural differences— ways in which cultures, as a whole, tend to vary from one another— which include: communication style, attitude toward conflict, approaches to completing tasks, decision making style, attitude toward disclosure, and approaches to knowing. These differences not only cause people from

different cultures act and think differently, but also cause the difficulties on communicating and understanding people from other cultures.   The key notion is that each group possesses a collection of experiences constructed over time and embed in consciousness that makes them who they are and influences how they communicate.   These experiences are imbued with cultural values and culturally-patterned ways of thinking, interacting, and responding to each episode differently (Faiola & Matei, 2002).

In the past two decades, there are a few basic principles that have been proposed, including simplicity, consistency and clarity, along with the aesthetic values which provide easy and effective guidance for HCI design.   However, the idea of "one design for all" is challenged by the rising awareness of the differences on online user characteristics.   Interface as tool in supporting human computer interaction or as media in supporting communication, needs to be designed to fulfill its intended functionality—aiding and enhancing the process of communication.   Due to the varied cultural patterns, experiences, and preferences, in a cross-cultural setting, cultural factors are one of the most important elements needed to be verified before proceeding to the design and implementation.   Since the way of communication, as well as information acquisition are determined (or at least heavily influenced) by culture, considering and including cultural factors such as norms, values, individual and social roles etc… in design process is needed in order to enhance the overall functionality, usability, and quality of the design (Erişti, 2009).

Based on the socio-cultural and socio-historical lens of Activity Theory, in designing "product," designers need to first analyze the environment(s) in which the product will be used—i.e., the human activity systems.   The focuses usually are placed on the interaction of human activity and consciousness within its relevant environmental context (D. H. Jonassen, 2001).

The usability of the interface emerges from (or is the outcomes of) the interaction between the users (subject) and the artifact (tool) in achieving predetermined goals (object), instead of being the precursor to it.   To optimize the usability the interface should attempt to reflect/mirror the activity structures, symbol systems, socio-cultural rules, and community expectations that performers must accommodate while acting on the object of using the interface.

Although culture is neither substantial nor stable, but in order to understand the influences of cultures to individual behaviors, researchers proposed several models to put the abstract construct into application.   In the field of HCI, researchers, particularly those who aim at designing adaptive user interfaces, had proposed several design models in investigating and addressing the influences of culture in human computer interaction and consequently usability of the interfaces.   The following section introduces three models that are frequently used in guiding the HCI design practice.

Cognitive Model

Cognitive styles are considered to be an individual and non-changing characteristic that could provide an important element for designing more individualized interfaces and helping the individual deal with information overload (Webster, 2001).   In their classic research in cognitive styles and learning, Wikin et al. (1977) reported that the influences of cognitive style on learning achievement depends on three elements: (a) the nature of the learning task; (b) the suitability and compatibility of tools to learners, as well as learning tasks; and (c) the capacity in assisting the learner to adapt to different learning requirements.   That is to say, the match of cognitive styles, learning tasks and tools is critical for successful learning/instruction.

Comparing the perceptual differences of East Asian and Westerners, Masuda and Nisbett (2001) revealed that East Asians (more specifically, Japanese) place more focus on the detailed relationship between the field and the objects compared to their Western counterparts (Americans) which concentrate their interests more on the individual objects. They concluded that East Asians focus on the field and relationships that can be categorized as holistic (or field-dependent) style, whereas Westerners are more analytic, mainly focus on objects and tend to detach objects from the field (field-independent). Nisbett and Norenzayan (2002) proposed that cognitive processes differ according to holistic and analytic perspectives. They stated that cultural differences in cognitive processes are tied to cultural differences in basic assumptions about the nature of the world thus East Asian and Western differ greatly in their way of perceiving and reasoning.

The cognitive style dimension refers to a student's manner of processing information. Many studies have investigated the interaction of cognitive styles with the perception and utilization of interface. Jonassen and Wang (1992) reported that field-independent processors generally prefer to impose their own structure rather than follow the structure imposed externally. They concluded that field-independent learners are better hypertext processors, especially as the form of the hypermedia becomes more inferential and less overtly structured. Burton, Moore, and Holmes (1995) revealed that field-dependent learners prefer a slower pace, recall fewer cues, and are more passive in a multimedia environment. Weller et al. (1994) summarized that field-independent students learn more effectively from hypermedia-based instruction than field-dependent students.

It is crucial to understand the interaction between user cognitive styles and website characteristics in order to optimize the usability of interface. Braun et al. (2009) suggested that

a website characteristics can be described as the basic "look and feel" of an entire website, and a cognitive style is a user's preferred method to process information.   They suggested that to match the characteristics of websites with users' cognitive styles could optimize the utilization of the website.   Mampadi et al. (Mampadi, Chen, Ghinea, & Chen, 2011) in a similar vein proposed an "adaptive approach" in optimizing the usability of online learning system.   They suggested that adapting a hypermedia learning system to an individual's cognitive style can improve his/her learning performance and perceptions.   Webster (2001) also suggested that cognitive style is an important factor in designing individualized interfaces.   The development of agent-supported interfaces and learning environments could help supporting students in an online learning environment.

Cross-cultural communication (CCC) studies have made strong links between culture factors, cognitive styles and user preferences, and provide a framework for the HCI research. CCC studies focus on the design aspect of ICT tools and suggest that any type of information production design is shaped by the specific cultural-psychological thinking style of the designer (Faiola & Matei, 2002).   That is to say, there is a two-way interaction between cognitive styles and interface.   In one way, the cognitive style of the designer is the determinant which influences and shapes the way the interface is designed; in another way, the cognitive style of the user is also a determinant that directly affects the acceptance of interface.   The conflictions in cognitive styles between designers and users could affect users' response to interface and content created by designers of different cognitive style, and consequently impact the acceptance, performance and preferences of users in using the interface.

Dong and Lee (2008) based on Nisbett's cultural cognition theory, conducted an investigation on the different perception of East Asians (Chinese and Koreans) and Westerns

(Americans) in online interface.   They concluded: the overall perception differences are corresponding to the culturally determined cognitive preferences (of holistic and analytic). Furthermore, they suggested that interface designers should be aware of the cultural cognitive differences among different cultural groups, and the design should be customized in order to cater to the specific style to promote the overall usage of the system.   They further suggested that for holistic cultures, the design should show the overall context of the website and take into account of the (harmonious) relationship between foreground, background, as well as the content areas.   As for analytic cultures, they suggested that categories and navigation items need to be named as clearly as possible, and efforts should be made in designing and comparting the individual content elements.

A great number of studies have been conducted in investigating the influences of cognitive styles in multimedia learning.   Liu and Reed (1995) and Ford and Chen (2000) investigate the influences of field dependency dimension in navigation strategies and suggested there are significant differences between FD and FI learners.   They report that FI learners tend to utilize an analytic approach in locating a particular item (e.g., using index); while FD learners tend to prefer using a more holistic approach (e.g., using site map) to understand the "whole picture" of the context.   Martin (1993) reports that FD learners prefer a deductive method of sequencing, while FI learners prefer to use an inductive approach.   Chen (2000) explains that learners of varied cognitive styles might be more or less likely to impose certain kinds of mental models on the learning materials.

Chen and Macredie (2002) suggested FI students tend to be more analytical, imposing their own structure on learning materials, and take a more active approach in their actions. Conversely, Ford et al. (1994) conclude that FD students prefer to work under an imposed

75

structured system and tend to take a relatively passive approach toward a task and have more

difficulties in detecting the individual object from the whole.   Their findings are coherent with

Witkin's that the material that lacks inherent structure might cause more difficulties in processing

for FI people who are less skilled on restructuration.   Chang (1995), Andris (1996), Reed and

Oughton (1997), Palmquist and Kim (2000) all suggested that FD individuals do not impose a

structure on the learning materials and tended to follow the structure prescribed by the

designer(s), and thus prefer well-structured systems.

Chen and Macredie (2002) suggested that students with different levels of field

dependency have different preferences in navigation tools; FD learners tend to adopt a more

passive approach and prefer structural information and need extra guidance (Witkin &

Goodenough, 1981).   Conversely, FI leaners feel more comfortable with free exploration and

jumping from one point to another in pursuit of their goal, because they are more likely to

provide organization for ambiguous information and to restructure new information (Witkin &

Goodenough, 1981).   Although the navigation strategies were preferred differently, field

dependents and field independents did equally well on learning tasks.   Both Liu and Reed

(1994), Frey and Simonson (1994) reported that despite of the different navigation strategies

utilized, there were no significant interactions between cognitive styles, and learning

achievement on a post test.

In the interface design perspective, foci have been placed on the design of navigation,

learner control, as well as information structure.   In designing navigation for a learning system,

it is suggested that navigation aids, such as historical cues and breadcrumb need to be provided

in helping users (especially for FI users) to trace their paths and avoiding disorientation in

exploring the system (Dong & Lee, 2008).   Furthermore, FD people tend to take more linear

steps compared to FI people in a hypermedia learning environment. FI people compared to their FD counterparts, have more advantage in using an open and less-structured system interface. Restricted environment which imposes linear, guided and sequential navigation structure to users, in certain cases, might be beneficial for both FI and FD people in more complex learning tasks (S. Y. Chen & Macredie, 2002). However, it is suggested, FI students might find the restricted environment hinders the exploration and hampers the overall preference, as well as desirability of the system interface.

Table 6: Design Suggestions for Different Cognitive Styles

Dimension Design	Field Independence/Analytic	Field Dependence/Holistic
Presentation	Using clear defined compartments, emphasizing the design of individual content elements.	Showing context and overall hierarchical, emphasizing the harmonious relations of components.
Navigation	Analytic approach (categorical). Open structured with logical categorization.	Holistic approach (hierarchical). Structured, broad-before-deep approach to show the overall context. Provide supportive information and navigational tools.
Information Structure	Non-linear structure emphasize on well-defined categories. Open-Structured	Linear and hierarchical structure. Imposed-structured
Learner Control	Active	Passive

Behavioral Model—Cultural Dimensions

Cultural models are another set of variables that are often used in cross-cultural hypermedia design process. Among the various proposed cultural models, Hofstede's (1980, 1987, 1991, 2010) model, which contains five different dimensions of culture, appears to be the most oft-cited and effective one in guiding the process of design. In his model, five culturally distinctive dimensions have been identified, including Power Distance (PD), Collectivism vs. Individualism (IDV), Femininity vs. Masculinity (MAS), Uncertainty Avoidance (UAI), and Long and Short Term Orientation (LTO). As aforementioned, these dimensions can serve as a set of extensive tools for creating hypotheses for comparative cross-cultural studies (Soares et al. 2007).

In the field of HCI design, a great number of cross-cultural comparative research has been conducted using Hofstede's model (Marcus, 2001; Marcus & Gould, 2000; Schwartz, 1994; Singh et al., 2003; Zhao, Massey, Murphy, & Fang, 2003). Marcus and colleagues (2001) based on Hofstede's model examined and compared website examples collected from all over the world. They pointed out that the conceptual differences of the websites designed/developed under different cultures and emphasized the influences of cultural in design practice. They suggested that the aspects of design can be heavily influenced by the cultural specific values. Although these propositions have never been verified, they are generally considered as practical and applicable guidelines in international website design.

Power Distance:

According to Hofstede, PD refers to the extent to which less powerful members expect and accept unequal power distribution within a culture. Hofstede suggested, Low PD

78

individuals tend to view subordinates and supervisors as close together and more interchangeable.   They perceive the society is flatter in hierarchies and there are less differences in social status.   Based on this definition, Marcus et al. proposed PD might influence user preferences on information structure, user control and content design.   For high PD cultures, in information structure, a tall hierarchical mental model should be applied, the information should be highly structured, and the expected social roles should be used to organize the content. Restrictions need to be applied in user control, and the content design needs to be emphasized on social norms, orders, authorities, and use a strong/prescribed way in delivering information. Conversely, for low PD cultures, a shallow mental model needs to be utilized and information should be low-structured.

<p style="text-align:center;">Collectivism vs. Individualism</p>

Hofstede (2010, p. 92) defines individualism is the societies in which the ties between individuals are loose.   It means everyone is expected to look after himself or herself and his or her immediate family.   It can also be explained as the degree to which the group achievements are valued and emphasized in the society (Marcus, 2001).   In HCI design, Marcus et al. suggested this dimension is correlated to the content design.   For individualist society, content should be motivated and emphasize personal achievement, and the image of success should be demonstrated through materialism and consumerism.   Furthermore, an argumentative/engaging style of writing which emphasizes on novelty, change and the importance of individual should be utilized.   As for collectivist society, they suggested to use a harmonious approach in content design.   The value of tradition and group achievement should be displayed.   This dimension also is reflected in the image selection of the website.   For different cultures, images of individuals versus images of groups and the extent to which emphasis is placed on individual

<p style="text-align:center;">79</p>

versus group should be different.

Femininity vs. Masculinity

This index is defined as the degree to which the gender roles are distinct.   Generally speaking, most of the cultures consider that assertiveness, competitiveness, and toughness are the masculine characteristics; whereas, family and people orientedness, and tenderness are the characteristics of femininity.   Furthermore, Hofstede distinguished the dimension of Femininity and Masculinity by the degree to which competitiveness is valued in the society.   Marcus et al. suggested this dimension focuses on the balance between roles and relationships.   For the high-masculinity cultures, focus should be placed on traditional gender/family/age distinctions.   And the "competitiveness" of high masculinity cultures would prefer high learner control and open, non-restricted navigation design compared to less masculine cultures.   In content design, attention could be gained through games and competitions.   In addition, graphics, sound, and animation could be used just for utilitarian purposes and functionality without too much aesthetic consideration.   In opposition, for low-masculinity cultures, the design should underplay the gender differences and emphasize on the harmonious relationship instead of competition.   In addition, the attention could be gained through poetry, visual aesthetics, and appeals to unifying value.

Uncertainty Avoidance

UA dimension indicates the extent to which the members of a culture feel either uncomfortable or comfortable in unstructured and novel situations.   Marcus et al. suggested uncertainty avoidance might produce contrary aspects of user-interface and web design.   High UA cultures prefer simple and clear metaphors, limited choices, and restricted amounts of data,

thus the content should be simple and straightforward and avoid ambiguity.   Navigation for High UA cultures should be designed with structure and guidance to prevent uncertainty and disorientation.   Mental models, cues, and help systems should be applied to not only implicate the possible actions but also reduce the user errors.   Furthermore, labeling, grouping system, color and typography strategies which can provide clear structure of information should be applied in designing high UA website.   For the low UA cultures a relatively complex structure with open and non-linear navigation could be utilized that encourage free exploration for users. Furthermore, Gudykunst and Kim (1984) suggested the communication strategies for reducing uncertainty might vary across cultures.   They found people in high context cultures tend to look for the environmental, socio-relational, and perceptual context for information to reduce uncertainty, whereas in low-context cultures people tend to rely on verbal information seeking strategies, usually by asking questions.

Long and Short Term Orientation

LTO stands for the fostering of virtues oriented towards future rewards, in particular perseverance and thrift.   Marcus et al. suggested high LTO cultures would value the content that focuses on practice and practical values.   The low LTO cultures, however, would value the content that focuses on truth and certainty of beliefs.   Furthermore, for low LTO cultures, the design should provide immediate responses/results.

High Context vs. Low Context

Although Hofstede's cultural model provides a foundation in conducting cross-cultural HCI design, Hofstede's five dimensions do not cover all the aspects that HCI researchers are eagerly seeking in explaining the different perceptions and preferences of users from varied cultures.   A great number of studies suggested that (1) communication style, (2) time perception, and (3) locus of control are factors that also need to be considered in designing cultural-sensitive hypermedia learning system.

The most oft-cited research on communication style in HCI research is Edward Hall's research in high vs. low context communication (HC vs. LC).   Hall (Hall, 1976, 1989; Hall & Hall, 1990) suggested that context is a crucial factor in understanding each other in the communication process.   Hall proposed in LC cultures people tend to keep personal space and have clear division of individual self and the group (individualism); thus, content design requires directed, detailed and explicit (preferably writing) information.   HC cultures, conversely, often have a closely knitted relationship network (collectivism), since much information is already shared among individuals; informal and indirect information that is based on symbols or pictures is preferred in content design (Chang, 2011).

Based on Hall's research, Choe (2002) found the link between thought patterns and context reliance and suggested people in HC cultures often rely on logic and rationality and believe that truth can be reached and discovered through linear search, whereas people in LC cultures, believe that truth will manifest itself through non-linear discovery processes without employing formal rationality (Chang, 2011; Choe, 2002; Würtz, 2005).   The differences in thought patterns between HC and LC cultures are clearly reflected in the information structure, as well as navigation design.   In LC cultures, people tend to have linear thought patterns, thus information should be arrange in a more restricted/structured way and navigational guidance and

82

supportive tools should be provided in avoiding disorientation.   Whereas in HC cultures, people prefer to explore and discover the truth by non-linear discovery processes, and a non-linear structure is considered to be ideal.

Context reliance also influences the information transparency in HCI design, in LC cultures the details and explicit information should be provided and the use of links should promote the exploration and employ a process-oriented design which makes it possible for visitors to locate information needed immediately.   For LC cultures, a goal-oriented approach is suggested to be an ideal design.   LC cultures are considered to rely heavily on using context in communication, however, detailed information might be missing in the design due to the high context reliance, and thus redundant cues might be needed in order to provide assists and guidance for users.   Furthermore, for HC cultures, contextual information is wildly used and expected to be understood by the readers, the content writing should emphasize on flowery and ornate prose, subjects instead of actions, theoretical implications, and follows an inductive logical structure.   The differences between writer responsibility and reader responsibility might explain the different preferences in writing styles in different.

Time Perception

Both Hall (1976) and Trompernaars (2003) recognized that there are distinct cultural differences in the perceptions regarding the passage of time.   Hall (1976) suggested the cultural tendency of time perception can be fitted and categorized on the monochromic-polychromic spectrum.   Monochromic cultures have the tendency of doing one thing at a time in a planned sequential order, which are also labeled as linear cultures.   While polychromic cultures are often attempting many tasks simultaneously with less procedural order and plan, and they are also

labeled as simultaneous cultures.

Hall and Hall (1991) postulated that people of monochromic cultures tend to break a job into sequential pieces that can be easily followed and processed. This implies that in content design, compartmentalization of information helps Monochromic people to concentrate, categorize and classify. In addition, partitioning and setting priority are ideal ways to organize information and tasks. Clarity can be achieved by allowing more space among compartmentalized information (Chang, 2011). By contrast, in polychronic cultures, people used to deal and handle multiple tasks simultaneously, and tend to embed and overlay multiple pieces of information in one message. That is not to say that clarity or compartmentalization are not important for polychronic cultures. However, as Hall and Hall (1991) suggested, polychronic cultures usually are high-context cultures, thus people in polychronic cultures usually are able to focus on information that specific and useful to them.

Inner Directedness vs. Outer Directedness

Based on Rotter's (1966) research on internal versus external locus of control (LOC) Trompernaars and Hampden-Turner proposed another cultural dimension: Inner Directedness versus Outer Directedness. Some researchers have pointed out that the concept of locus of control is culturally specific and largely reflecting the central values of Westerner thought, such as those of individualism, independence and autonomy (Marks, 1998). Wang (1991) found that Chinese college students exhibit more external locus of control than their American counterparts (Gan, Shang, & Zhang, 2007). It is suggested that inner-directed people believe in personal judgment and tend to make decisions based on it. Conversely, outer-directed people tend to seek outside information and make decision based on it.

Green et al (Green & Fisher, 2010; Green, Jeong, & Fisher, 2010) found the effects of locus of control (LOC) on interface performance.   They investigated the effects of LOC on both procedural and inferential learning in a visual analytic interface versus a holistic mapping interface.   They concluded that for different learning purposes, different interfaces design approaches should be applied.   The holistic mapping interface was found to be more effective in procedural leaning, whereas the visual analytic interface was more productive for inferential learning.   They further suggested learners with external LOC compared to those with internal LOC responded to inferential tasks more quickly.   This effect, particularly, was more prominent in using the analytic visual interface.   Conversely, in using holistic mapping interface in answering procedural questions, the internal LOC participants out-performed their external LOC counterparts.   Cassidy and Eachus (2000) argued external LOC learners tend to have the tendency to use "surface" strategies as oppose to the "deep" tendency of internal LOC learners. Furthermore, internal LOC learners prefer more learner control and using advanced control options, while external LOC learners prefer situations in which less learner control is involved and has a clear imposed structure to be followed.

Visual Identity Model

Another cultural sensitive design approach is the visual identity model.   As Kondratova and Goldfard (2005) suggested, this approach is aimed at developing interfaces that "look and feel" like they belong to a specific culture.   Although the "look and feel" might seem superficial in HCI design, previous studies have established that the surface level features are not merely aesthetically pleasing; they indeed cause perceptions across linguistic and cultural boundaries (Fink & Laupase, 1999).

Barber and Badre (1998) coined the idea of "cultural markers" and suggested that the use of cultural markers/attractors—the design elements and features that are prevalent, and possibly preferred, within a particular cultural group—might be able to enhance the acceptance, as well as usability of the website for the local users. They proposed 16 different categories of cultural markers that can be further grouped into four major classes: color, images, text, and layout. These visual components are proven to play a critical role in cross-cultural HCI design, and several aspects have been taken to investigate this phenomenon. Overall, it is suggested the cultural norms, values, traditions, as well as customs are the major factors caused the different visual perceptions of the design (Fernald & Morikawa, 1993; Masuda et al, 2008).

In addition, Masuda and Nisbett (2001) analyzed the differences from a cultural cognition approach and suggested the different patterns of attention (analytic vs. holistic) are the main cause that vary the degree to which people (of different cultures) see visual images contextually. The predisposition of context dependency might produce different preferences and perceptions on visual stimuli and works of art (Masuda et al., 2008).

Language and Text

Language is probably one of the most prominent concerns in designing cultural-sensitive websites. It is suggested that the culture-specificity of cognitive and textual structures might cause the different preferences in writing styles (e.g. Kaplan 1980, Clyne 1981, 1987, Galtung 1985, House 1997, Kachru 1983). Gudykunst et al. (1996) suggested that cultural differences in the individual level factors such as self-construal and values might influence the degree of context dependency of individuals and consequently their preferred communication styles. As mentioned prior in the high-low context dimension, the context dependency of different cultures

might cause different preferences in writing styles.   While the LC cultures prefer explicit and clarity, HC cultures prefer complexity and implicit.

The language issue, not only reflects on the writing style of text but also involves the presentation of textual information.   In cross-cultural website design, a prominent issue is the direction of the text.   Another issue involves the use and design of typography.   Typography refers to the art and techniques of arranging types in order to present textual information.   The arrangement of type involves the selection of typefaces (fonts), point size, line length, leading (adjusting line spacing), tracking (adjusting spacing between of letters uniformly) and kerning (adjusting spacing between characters individually).

Color

Colors have different meanings in different cultures, and cultural meaning can be reflected in a web site through the use of colors.   Boor and Russo (1993) compared the meanings of five elementary colors—red, blue, green, yellow and white—in different cultures and concluded that even the same color has different meanings in different cultures.   Colors might impact users' expectations about the design features such as navigation, links and the meaning of the content.   They suggested for Chinese, red symbolize happiness or festival, blue usually stands for heavens and clouds, green also has the similar meaning of blue that represents the idea of heavens, yellow signifies wealth and power and is the color of emperor, and white is the color of death and also have the indication of purity.   While these colors are also commonly used in United States, they have very different meanings, in the United States, red usually indicates danger or the color of stop (as in traffic sign), blue signifies masculinity, green represents safety or go (as in traffic sign), yellow symbolizes cowardice and temporary (as in

traffic sign), and white has the meaning of purity.

Based on Hofstede's cultural model, Kondratova and colleagues (Kondratova & Goldfarb, 2006; Kondratova et al., 2005) analyzed 36,000 websites from 36 countries—using computer applications such as Google API and Image Color Analyzer—found that white, black, different shades of grey, different shades of blue, and light yellow are commonly used across all countries.   They labeled these colors as "international color," and suggested that these color can be used in designing an international interface.   Their findings correspond to Madden, Hewett and Roth's (2000) which also indicated that blue, white and black are colors that are internationally beloved.   However, in designing a localized or cultural appropriate system, they suggested a palette of cultural specific colors should and need to be added, accompany with the international colors, to enhance the local acceptance.

Madden et al (2000) also suggested the use of color combination is a critical issue that need to be considered in designing a culturally relevant interface.   They suggested that different combinations of colors might evoke different reaction from people of varied cultures. Furthermore, the preferences of matching/pairing colors are also culturally different.   In a similar vein, Surya and Klein (1995) from an application approach suggested the acceptance of products in international market could be effected by the color selection of designers if designers were unaware of culture specific meanings associated with the colors and made the color decision based only on aesthetic reasons.   However, instead of comparing the same palette of colors across cultures, they organized different palettes of cultural-specific colors based on the different traditions and customs of 18 different countries and developed a computer application—ColorTool.   This application is aimed at helping designers to inquire about, specify, and evaluate color choices and combination for products designed to be marketed in

specific markets.

Surya and Klein (1995) proposed a Chinese palette which includes 7 colors that have the cultural specific meaning for Chinese: white, black, red, yellow, blue, green, and brown.   White, as suggested represents the West (the direction), autumn, metal, and mourning.   Black signifies the North, yin, winter, water, and the funerals.   Red represents the sun, the phoenix (fortune), fire, summer, the south, joy, good fortune and happiness.   Yellow was the symbol of earth and was emblematic of the Yin principle.   Tradition says that if clouds were yellow, prosperity would follow.   Blue represents the heavens, the east, clouds, spring, and wood (as one of the five elements).   Green takes the same symbolism as blue, with which it is interchangeable. And finally brown was the color of the Sung dynasty.   The combinations of colors also have specific cultural meaning for Chinese: blue on black signifies an evil spirit whereas the reverse indicates lower class.   Both white and black on yellow has Buddhist religious associations, however yellow on black indicates the decease of an elder.   White on black signifies a historic event. Gold on yellow signifies special happiness; red on yellow is considered royal; blue on yellow represents old mourning while the reverse represents a divine element.   Black on red signifies happiness and this combination are commonly used on wedding invitations.

Visuals

Kress and Leeuwen (1996) suggested, visual design expresses the meanings belonging to and structured by cultures.   For different societies and cultures, there are different forms of visual communication, and the same symbol might present quite different meanings in different cultures; which means, what an image says is culturally specific, and there are no universal understanding and consensual ways of designing visuals.

Visuals include icons, logos, pictures, graphics, photographs, videos, animations, and simulations, which are major components in website design and can be used to mirror the cultural specific image and deliver cultural meanings and information. Sun (2001) used interview to investigate and gather users' perceptions, as well as opinions regarding the design of multilingual website. He suggested that the use of cultural relevant images and metaphors increases the feeling of "comfortable" of the users that ease their tension in navigating and enhance the accessibility of the website.

Singh and Pereira (2012) suggested that icons are a cultural artifacts with very specific cultural meaning that might only can be understood in a particular setting. Thus, when icons are used in cross-cultural websites, special attention is needed to know the appropriateness of the usage and whether the icons can be understood in the local/target culture.

Another issue in choosing visuals is the aesthetic preferences of different cultures. The aesthetic preference is embedded deeply in a person's cognition and conditioned by cultural and personal experiences. Berleant (1970) suggested, the sense of aesthetic is culturally determined, and the influences of cultural differences on aesthetic preferences reflect not only on the creation practice of artists, but also the preferences of the publics. Masuda and colleagues (2008) found that due to the cultural, societal, philosophic and historic developmental differences, Western and Eastern cultures have evolved quite different ways in perceiving the world around them, and consequently difference sense of aesthetic. Influenced by the holist world view, East Asians are more sensitive to context in artistic and representational domains; while Westerns are more objective oriented and focus on the detailed depiction of the particulars, since the Western civilization was highly influenced by the analytic philosophical tradition (Masuda et al., 2008). That is to say, in designing visual components for Eastern Asians, a

90

context inclusive approach, which place attention on context need to be adopted, whereas for the Westerns, more focus should be placed on the objects and detail depictions.

I addition, the preferences on styles of visual design are also influenced by cultures. For some cultures, a realistic form of art with concrete display is preferred; whereas, in other cultures an expressionist, and/or modernist form is preferred. The selection and design of visuals should take not only the functionality and purpose of the websites, but also the preferences of the target cultural group into account in order to maximize the effectiveness of the visual components.

Layout

Layout is also a part of visual design that deals with the arrangement and style treatment of the elements and/or content on a web page. It is the equivalent of the composition in art works which provides the overview and makes the primary impression of the piece to the viewers/users. Since the aesthetic preferences are culturally determined, the design of a good layout, like designing visuals, needs to take the cultural variation and preferences of the target groups into account in order to accommodate their aesthetic preferences. Erişti (2008) suggested, by carefully designing and arranging components such as positioning, flow directing, balancing (symmetrical asymmetrical) etc., cultural properties can be reflected in the layout of a web page. However, a well-designed layout should not only reflect the cultural properties of the target group, the arrangement also need to be done in the way that can facilitate the readability of the structure, content, and information access of a web page (Yu & Roh, 2002).

CHAPTER III: METHODOLOGY

Overview of the Study

This research was based on an ongoing instructional system design project. The main purpose of that particular instructional system is to provide a content delivery platform for several blended-learning courses. This study is aimed at investigating the interactions between the cultural preferences of two different cultural groups, American and Taiwanese respectively, and website interface design features, the main foci, thus, were placed on the usability issue of the frontal design features of the system interface. Usability, as Benbunan-Fich, (2001) suggested is the extent to which "how well and how easily a user, without formal training, can interact with an information system of a website." The foci, thus, included the effectiveness, efficiency and desirability of the design. As Bevan et al. (1995) suggested, the perceived usability of the system is "determined not only by the product, but also by the context in which it is used." The measure of usability in this study, then, is considered as part of the outcome of an "activity" which user and interface interact with each other in a particular socio-cultural environment (see Figure 2).

This research was comprised of three major phases. In the first phase—the design phase, an instructional website was designed/constructed by an American designer using the "biased" approach which referenced from a website design of a major consumer electronics company, the components to be designed in this phase included: (1) navigation, (2) information structure, (3) layout representation, as well as, (4) visual materials design/selection. After

finishing the website, five educational technology related lessons were created by the designer

using the cultural biased design approach which is consonant with the prevalent style, as well as
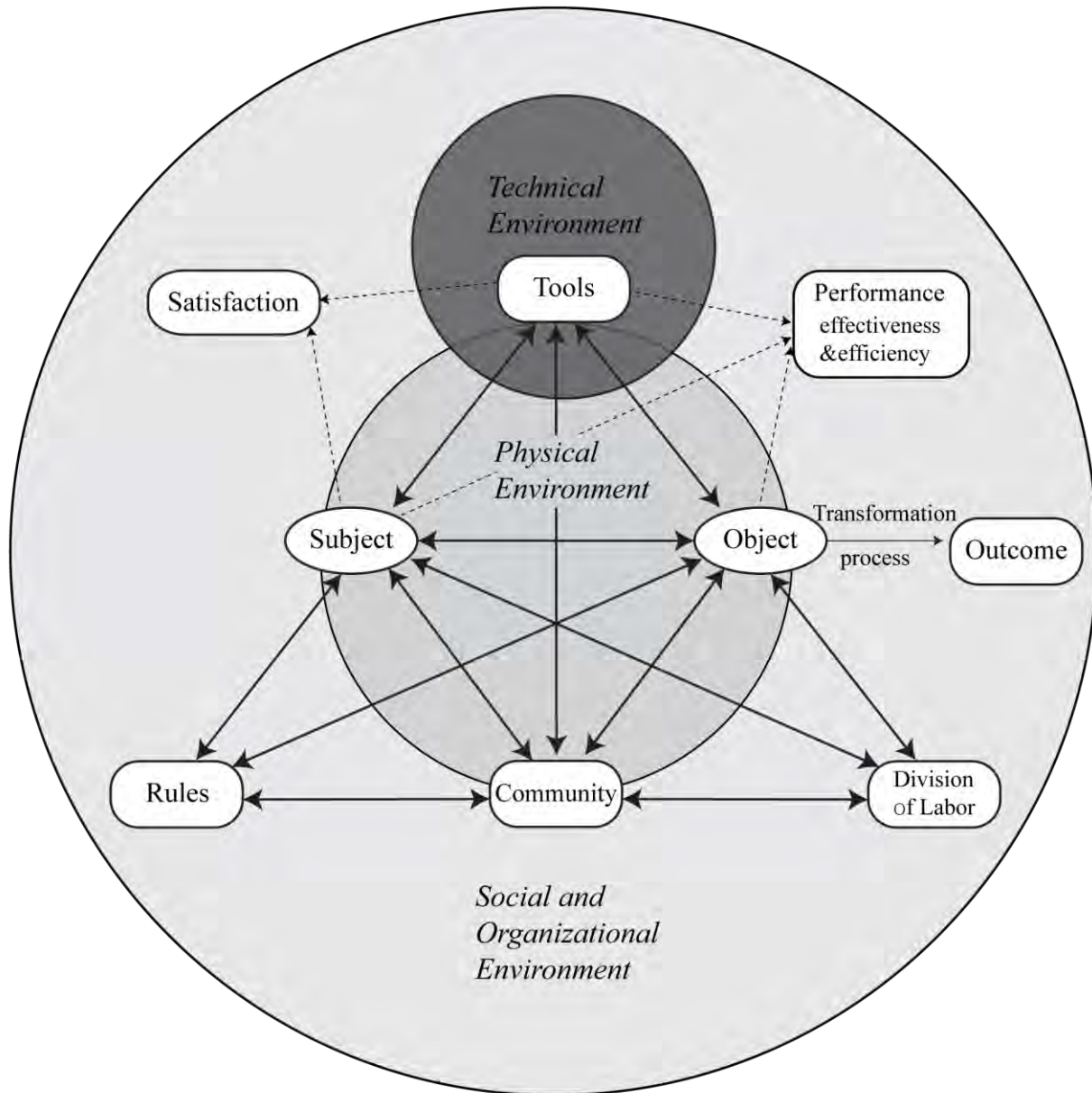
Figure 2: Usability Measure in Activity Structure

user preferences of the United States.   For the lessons, a sub (local) navigation is designed for

the specific need of lesson-level navigation.   For the consistency per se, the design of

information structure, as well as layout representation of the lessons, although some minor modifications were applied, were the style of the main structure of the course.   There were two major components, visual and textual, in the lesson content.   For the visual part, each lesson included: (1) a series of images which present the abstract and/or concrete idea of the specific lesson; (2) a pictorial icon that represent the overall idea of the specific lesson, and (3) a series of illustrations/images that corresponding to the instructional content.   As for the textual part, the main components included: (1) the lesson goal(s); (2) preview and preparation; (3) instruction (includes text base and some might include multimedia instruction); (4) activities (includes the description of in-class activities and assignments), (5) resources; (6) rubric/assessment, and (7) assignment examples.

After the design of American website structure with English content (AE) was done, a duplicate was made to create a version with Chinese content (AC).   In this copy, the structure, visual/layout representation, and image selections, etc. were retained; the only difference is the language of the content, which was replaced by the Chinese translation of the original English content.   The American website structure then went through a localization/redesign process and was transformed into a Taiwanese structure in order to optimize the usability for the specific context of Taiwan.   In the localization process, the overall website structure, as well as visual representational components were "localized" based on the inherent cultural profile of Taiwanese, meaning, the styles of website structures, information organization, navigation, layout presentation, visuals, as well as image selections were redesigned/selected based on the local customs, practice, as well as preferences of Taiwanese users.   The finish product was a Taiwanese website structure with Chinese content (TC).   The Taiwanese website then was duplicated and textual content was stripped away and replaced with the English content to make

94

the fourth website, a Taiwanese structure with English content (TE).

Four websites were created in this phase: first, a website with American structure and English content (AE); second, a website with American structure and Chinese content (AC); third, a website with Taiwanese structure and Chinese content (TC), and finally, a website with Taiwanese structure and English content (TE).   In addition, the AE and TC sites both went through alpha and beta tests to see, not only if the websites can deliver the content effectively, but also the ability of the designs in mirroring/reflecting the local preferences of the specific national group. Changes were made to fine-tune both designs.

In the second phase—the test phase, two groups of participants (Taiwanese and American) were recruited to test the websites designed in the previous phase.   The access to the websites were controlled, in each group participants were randomly assigned to use different websites/systems; in the Taiwanese group, participants could only access either TC or AC website, and in the American group, participants were assigned to use AE or TE website. However, they were not provided with the information of the design style, and were only exposed to one website because of the concern of multiple treatment interference.   All of the participants (in both groups) were asked to finish a performance test including five tasks that different in depth and complexity in order to detect the variations of task performance and subsequently, the affinities of design and user preferences/characteristic.   Participants were also asked to take an after task survey which included a perceived usefulness (desirability) questionnaire, a self-rated web based digital literacy survey and a series of demographic information questions.

Finally, in the comparison phase, two new groups of participants, Taiwanese and

American respectively, were recruited, which were comprised of different members from the previous phase, in order to avoid the multiple treatment issue. The participants were exposed to both website designs that have the content composed in their native languages, i.e., the Taiwanese participants were exposed to both TC and AC sites, and American participants were exposed to both AE and TE sites. All the participants were first asked to conduct two tasks (one for each website), with similar depth and complexity with the two websites they were exposed to, in a think-aloud fashion. The using behaviors, as well as responses were recorded. After the tasks were performed, participants were encouraged to explore both websites, and a semi-structure interview was conducted in investigating their experiences in using the two websites. During the interview, the websites to be compared were shown on the monitor side by side in order for the participants to compare and contrast when needed.

This study utilized both qualitative and quantitative measures to gather information from participants in order to understand the influences of cultural preferences on the usability of websites designed using a biased or localized approach. This chapter first presents the research design follows by hypotheses; design and implementation of the instructional websites, then the details of data collection procedure, measurement instruments, data analysis methods for both the quantitative and the qualitative phases, and finally the procedures for human subject protection.

Research Design

As abovementioned, a mixed methods research design was employed in this study, which is a procedure for "collecting, analyzing and "mixing" both quantitative and qualitative data at some stage of the research process within a single study, in order to understand a research

problem more completely (Creswell, 2002).   Both surveys and interviews were employed to investigate the perception, preference, as well as the performance on the online learning system interface(s).   The rationale for mixing in this study is that neither quantitative nor qualitative methods are sufficient by themselves to capture the whole picture and details of the situation, such as a complex issue of the interaction between cross-cultural users and interface design, which need to be analyzed both qualitatively and quantitatively.   Furthermore, a sequential explanatory mixed-methods research design was chosen because multiple methods could work together to provide a more complete understanding of the research problem (Creswell, 2007). As Campbell and Fiske (1959) suggested, the use of a mixed methods approach can "ensure the variance was reflected in the trait and not in the method" (Creswell, 1994).

The sequential explanatory mixed-methods design of this study consists of two distinct phases: quantitative followed by qualitative (Creswell et al., 2003).   In this design, the researcher first collects and analyzes the quantitative data.   Follow by the qualitative data collection and analysis to help explain, or elaborate on, the quantitative results obtained in the first phase.   The second, qualitative phase was built on the first, the quantitative phase, and the two phases were connected in the intermediate stage in the study.   The rationale for this approach is that the quantitative data and their subsequent analysis provide a general understanding of the research problem (Ivankova, Creswell & Stick 2006), the qualitative data and their analyses refine and explain those statistical results by exploring participants' views in more depth (Creswell et al., 2003; Rossman & Wilson, 1985; Tashakkori & Teddlie, 1998).

The strengths and weaknesses of this mixed-methods design have been widely discussed in the literature (Creswell et al., 2003; Creswell, 2005; Creswell, Goodchild, & Turner, 1996; Green & Caracelli 1997; Moghaddam, Walker, & Harre, 2003).   Its advantages include

97

straightforwardness and opportunities for the exploration of the quantitative results in more detail.   This design can be especially useful when unexpected results arise from a quantitative study (Morse, 1991).   The limitations of this design, however, are lengthy time, and feasibility of resources to collect and analyze both types of data (Ivankova, Creswell & Stick, 2006).

Although the paradigm-method fit issue has prompted considerable debate regarding the philosophical basis of mixed methods research; however, based on the Deweyan approach of pragmatism this writer considered that the mixed methods approach in the field of education is unproblematic or at least is applicable.   The pragmatist approach embraces "what works," uses diverse approaches, and value both objective and subjective knowledge (Cherryholmes, 1992), instead of sticking at the metaphysics and ideology.   As Teddlie and Tashakkori (2009) argued, "among other things, the research question should be of primary importance; even more important than either the method or the theoretical lens, or paradigm that underlies the method."

Pragmatism rejects traditional dualisms and embraces more moderate and commonsense versions of philosophical dualisms based on the practical values of problem solving.   It acknowledges the existence and importance of the natural/physical world, but at the same time recognizes the emergent social and psychological world that includes language, culture, human institutions, and subjective thoughts (Johnson & Onwuegbuzie, 2004).   In a mixed methods approach, researchers build the knowledge on pragmatic grounds (Creswell, 2003; Maxcy, 2003), they choose approaches, as well as variables and units of analysis, which are most appropriate for finding an answer to their research question (Tashakkori & Teddlie, 1998).   In a pragmatist perspective, a mixed methods approach works because quantitative and qualitative methods not only are compatible but also complement each other.   Thus, it is suggested that by mixing, both numerical and textual data are collected sequentially or concurrently, researchers

can better understand the research problem (Migiro and Magangi, 2010).

Furthermore, it's suggested that postmodernism and methodological triangulation come together in their common emphasis on the value of documenting multiple perspectives (Fielding, 2009). From a postmodernist perspective, the phenomenon or the reality is socially constructed with multiple dimension and inter-connection which need to be analyzed from multiple angles. This "intertextuality" suggests that everything is related in an absolutely interactive way (Tyler, 1986). To incorporate multiple perspectives (by employing a mixed methods approach) helps researchers observe the phenomenon multiperspectively. As Sokal and Bricmont (1998) suggested, "by using single perspective, explanatory variable or method would inevitably cause the tunnel vision and compartmentalizing the analysis." By employing different methods in analyzing the phenomenon, researchers are able to capture the different aspects of reality and see the interconnection between the phenomenon observed and the others. Since "postmodernism is oriented toward methods that apply to a broad range of phenomena, focus on the margins, highlight uniqueness, concentrate on the enigmatic" (Rosenau, 1992, p. 117), to employ a mixed methods approach can be an ideal way to address the complexity of the real world and to achieve the "analytic density" (Fielding, 2009).

Design and Implementation of Websites

Construction of the Websites

Design Strategies for American Structure

An English instructional website with an American design/structure (AE) was built as a prototype for the other three websites in this study. The frontend components (the observable

99

part of the design from users' end) of the website, which included: (1) navigation structure, (2) information structure, (3) page layout/presentational design, (4) visuals (logos, icons, typography, and images/graphics), were the main focus of this study as they are the observable elements suggested to be able to represent the cultural profile of the website design.   The design of the AE structure, although was not entirely based on the cultural profile of Americans, however was based on a major US consumer electronics company and done by an American designer; as Faiola and Macdorman (2008) suggested, the design (of the website) affiliates with and is influenced by the specific culture the designer attaches to, thus, it is assumed that the design could represent or at least reflect the American style.   However, an "audit" was conducted to see not only the practical usability issue of the website structure (in the sense of accessibility) but also the affinity of the website design features with the cultural preferences of Americans in order to provide design suggestions for the further improvements and modifications.

A static/fixed layout design approach was adapted as it is considered as one of the best strategies to present the design features as the way it is intended to be seen.   The design of the website followed the Hyper Text Markup Language 5 (HTML 5), Server Side Includes (SSI), and Cascading Style Sheets (CSS3) standard.   Under the HTML5 protocols, the design approach was to break the website into individually standing elements—navigation, layout, content (visual and textual).   The concept is using CSS to control the presentation semantics (the look and formatting) of the markup document, and SSI to arrange/organize the presentation/layout and content.   For example, in most of the webpages of the websites, three elements are used to control the overall presentation of the page, 1) page_layout.shtml: controls the presentation/layout of the page; 2) style.css: controls the formatting style of the textual and

visual elements, and; 3) content files (in .shtml format) include the actual content corresponding to the particular webpage.

Structure and Navigation design for American Structure

The information structure, layout, as well as semantic presentation of American structure were vastly different from the Taiwanese structure; the design strategy conceived was to divide a webpage into individually standing components in order to provide more flexibility for restructuring and modification. The website was intended to be used for blended learning courses, during the analysis and design phases the group identified the essential elements for a course, and the course content was divided into seven major elements, which included: (1) introduction of the course; (2) syllabus; (3) lessons for the course; (4) resources; (5) evaluation/assessment; (6) online communication/cooperation area, and (7) finally the affiliated program. Those elements were considered to be the main components of the course; consequently, they were reflected in the design of navigation as the seven navigation items. These units then were ranked (by their significance from high to low) and sorted as: 1) about (introduction of the course), 2) syllabus, 3) lessons for the course, 4) resources, 5) evaluation method, 6) online cooperation, and 7) affiliated program, and the ranking also reflected on the sequence by which the unit appears on the navigation bar from left to right.

Layout and Presentation Design for American Structure

An information block module was used in the American design to present and organize information by its properties and relationship. Previous studies (Bar-Yossef & Rajagopalan, 2002; Gupta, Kaiser, Neistadt, & Grimm, 2003; Kovacevic, Diligenti, Gori, & Milutinovic, 2002; Lin & Ho, 2002; H. Liu, Xie, Ma, & Zhang, 2002; Song, Liu, Wen, & Ma, 2004) showed that the approach of partitioning a web page into multiple segments or blocks helps users to

differentiate the function, as well as the level of importance of information and it facilitates information search and accessibility and consequently the task performance of users.   The design prototyping was mainly done by an American designer, by first classifying the property of information and the functions of blocks, and second, visualizing the appropriate way in presenting the page.   In addition, both textual and visual elements were used in presenting the functionality of blocks in order to enhance the performance and usability of the website.

Content of Instructional Material

The contents of the website were instructional in nature.   Five lessons related to "integration of technology in K-12 education" were developed for this study, which included: (1) Information Retrieving; (2) Image Manipulation; (3) Digital Storytelling; (4) Educational Data, and (5) Online Communication.   The main purpose of these lessons is for the target leaners, students in pre-service teacher education program, to understand both the theoretical foundation and practical applications of educational technology in the K-12 setting.

The contents of lessons were based on the instructional notes, as well as materials from previous courses offered in the University of Kansas.   Since a modularized approach was employed, these notes and materials were organized in order to reach design consistency, as well as instruction coherency.   The modularized approach divided "lesson" into individually separate components, which can be classified into two major categories: visual, and textual.   The visual category included the components of: (1) lesson icon; (2) representative pictures/illustration for the lessons; (3) pictures/illustrations that corresponding to the instruction, and (4) assignment examples (depends on the format of the assignments, some examples might be fall under the other category).   As for the textual category, the components included: (1) lesson goal(s) and preparation; (2) instruction; (3) activities; (4) resources list; (5) assess rubric, and (6) assignment

examples (depends on the format of the assignments, some examples might fall under the other category).

The design/selection of visual components is vital in this study as visual components are directly relevant to perception (Denis, 1990, p. 108), and cultural identity (Hall, 1994). The use of visual components was aimed at making the abstract concepts more perceivable and understandable. The visual component, although speaks a thousand words, however, may present quite different meaning to different users. In the design/selection process, the American designer designed and chose the visual components from royalty-free image databases that the designer considered as not only able to deliver the meaning/concepts but also culturally relevant to the target group. Group discussions with specialists were conducted to identify and evaluate the meaning of the pictures/illustrations, as well as the appropriateness of using in order to reach the "representational insight." The visual components include lesson icons which were pictorial images (50 pixels by 50 pixels in dimension) that used to represent/reflect the conceptual meaning for each of the lesson. In addition, in each lesson, 10 to 12 pictures/illustrations were chosen to illustrate both the concrete and abstract meaning of the concept. Depending on the length of the instruction, a series of pictures/illustration were designed/selected to provide dual representations of the instructional materials.

As abovementioned, the content of lessons is based on the instructional notes, as well as materials offered previously, thus, it is composed in American English. The organization and development of textual content were done by an American editor, furthermore, a consistent structure, as well as style of writing were applied across the lessons selected. In addition, although the content has been classified into two different categories, however, the development of the textual and visual (and in some cases the multimedia) components were proceeding

simultaneously and jointly.   Taking diversity into account, in order to cater for different learning preferences, the content was presented not only in textual form, but also through visual presentation to cater the different cognitive abilities (Riding and Cheeman, 1991).

Website Structure Localization

Based on the socio-cultural and socio-historical lens of Activity Theory, in designing a "product," designers need to first analyze the environment(s) in which the product will be used—i.e., the human activity systems.   The foci usually are placed on the interaction of human activity and consciousness within its relevant environmental context (D. H. Jonassen, 2001). Since the usability of the interface emerges from (or is the outcome of) the interaction between the users (subjects) and the artifact (tool) in achieving a predetermined goal (objects), instead of as a precursor to it, to optimize the usability, when designing an interface, the designers should attempt to reflect/mirror the activity structures, symbol systems, socio-cultural rules, and community expectations that performers must accommodate while acting on the object of using the artifact, during the design process.

After the American structure was completed, a series of localization processes were applied to transform and localize the American website into the Taiwanese one.   The localization process, as Sun (1996) suggested is a set of strategic processes to design usable interfaces that can be easily accessed and understood by the local users.   The foci of the Taiwanese design, like its American counterpart, was put on the frontend components.   A new layout, as well as style were contrived using the culture profile of Taiwanese.   The Taiwanese structure also was controlled using HTML5, CSS3 and SSI.   A specialist audit also was conducted to see not only the actual effectiveness of the website usability but also the affinity of

the website design with the Taiwanese preferences.

Although it's suggested for different cultural groups, designers should employ different content development strategies in order to optimize the content-users interaction.   However, as the main purpose of this study was to investigate the interaction between cultural preferences (of the users) and the interface design, thus, the main focus was to develop "interfaces" corresponding to the cultural profiles of different ethnicity groups instead of providing culturally appropraite instructional content.   In this study, both American and Taiwanese systems utilized the same content (although were composed in different language), however, not only for the prior mentioned reason, but also for the purpose of controlling the condition of content-user interaction.

Localization Strategies for Taiwanese Users

Design decisions directly determine the perception of meanings, both intended and unintended, of the end users.   In order to design the user interface of the website that is culturally optimized, it is necessary to first understand what are the expectations of the users in the particular target cultural or sub-cultural group (Smith et al., 2004).   For the purpose of this study, the cultural profile of Taiwan was conceived based on previous research.   The collective profile included the following variables: (1) cognitive dimensions; (2) selective behavioral patterns (as the reflection of socio-cultural norms and values) of respective country using cultural dimensions; and (3) visual identity (the cultural marks and preference on symbolic representations).   The combination of using these three components was aimed at optimizing the interaction between the individual and interface.

Cognitive Dimensions

Cognitive dimension in this study was denoted as the tendency or preferred strategies an individual takes in processing information, applying knowledge, and changing preferences. The Wholist-Analytic cognitive dimension was used in this construct. It's suggested (Riding and Cheema,1991; Rayner, 2000) although various labels have been used in identifying and addressing individual's preference for processing information either in complete wholes or in discrete parts; however these labels could be unified into one—the Wholist-Analytic dimension. The Wholist-Analytic dimension has been proved highly related to the cultural environment in which individuals are placed, and it is suggested this dimension is highly correlated to the social orientation, as well as the political environment. In addition, it is often used in guiding the design of navigation system (Dufresne and Turcotte, 1997), information structure of the website, and the design of the content. Table 7 lists the design guidelines that were suggested by previous researchers in addressing and accommodating the cognitive tendency of wholists and analytics.

Cultural Dimensions

A selection of cultural dimensions were chosen and used as a set of referential tools in the process of design and localization, as these dimensions were suggested to be the reflection of societal norms and values through the consciousness of individuals. Three dimensions, Power Distance, Individualism vs. Collectivism, and Uncertain Avoidance of Hofstede's were employed; in addition to Hofstede's dimensions, the dimensions of High and Low Context (communication) of Hall's was also incorporated in developing the cultural profile. The above-mentioned four dimensions were used as the second set of valuables for the cultural profile as they reflect the specific societal values toward relationship, motivation, concept of time and the attitude toward the larger ecology/environment which overall determine (or at least condition)

106

the consciousness of individual in a specific environment.

Table 7: Design Guidelines for Holistics v.s. Analytics.

Strategies / Dimensions	Wholistic	Analytic
Navigation	- Emphasizing the hierarchical relationship. - Show the overall context of the system. - Subject categories/navigational items to be presented on the basis of relevancy. - Provide supportive navigational tools.	- Emphasizing the task/action attributions. - List all possible items in navigation. - Subject categories to be arranged by the functional attributions or alphabetically.
Information Structure/Presentation	- Showing context by listing sub-categories. - Emphasizing the harmonious relations among components (Dong, 2008). - Using deeper hierarchical structure and imposed sequences. - External/imposed structure presented by the system.	- Emphasizing on the individual functionality of objects. - Providing multiple paths for information. - Using shallow hierarchical structure and presenting possible options at one time/in one page.
Layout	- Contextual design focus on the harmonious relationship among objects and background.	- Emphasizing on the objects and accentuate their functionalities.

The rationale of employing only the abovementioned four dimensions: (1) Power Distance; (2) Individualism vs. Collectivism; (3) Uncertain Avoidance, and (4) High and Low Context was these dimensions were not only directly related to the culturally specific ways how individuals communicate to each other but also can be translated directly into practical designing guidelines/principles.   In addition, as the main focus of the study was to investigate the usability issue, in particularly the effectiveness and efficiency on how a particular interface design approach in facilitating information transformation from the CMC perspective, other cultural dimensions were excluded in hopes of avoiding the dimension to dimension interactions and having a more controlled condition in which the focus can be placed on phenomenon intended to be uncovered.

In Hofstede's research, Taiwan has a relative high Power Distance score (58) which means that people accept a hierarchical order in which everybody has a place which needs no further justification.   In the individualism dimension, Taiwan has a very low score (17) which means it is a typical collectivistic society, where people have close long-term commitment to the "member" group.   Taiwan scores 69 on the Uncertain Avoidance dimension which means Taiwanese tend to follow rules, seek for clear guidelines, and have the propensity of avoiding unfamiliarity and risks.   It is also suggested that Taiwan is a high context culture in which a great deal of commonality of knowledge and views is assumed to be shared by the members of the society, so that less is spelled out explicitly and much more is implicit or communicated in indirect ways.   Table 8-11 summarize the interface design guidelines that corresponding to those abovementioned dimensions.

Table 8: Design Principles for High V.S. Low Power Distance Cultures.

Strategies / Dimensions	High Power Distance	Low Power Distance
Navigation	- Emphasizing on hierarchical relationship. - Using sub-menu.	- Emphasizing on the attribution of individual object. - Alphabetical arrangements on navigation items. - Allow free exploring.
Information Structure/Presentation	- Deep hierarchical. - Information should be highly structured - Using external/imposed structure - Compartmentalizing information and assigned priority.	- Open and simple information structure. - Providing more exploration options.
Layout Design	- Formal/academic layout. - Authority and organization oriented. - Using logos and pictures of the institute.	- Informal layout.

Table 9: Design Principles for Collectivism V.S. Individualism Cultures

Strategies / Dimensions	Collectivism	Individualism
Navigation	- Emphasizing on hierarchical relationship. - Contextual Relationship navigational design.	- Emphasizing on the functionality of individual object. - Task/action oriented design. - Allow free exploring
Information Structure/Presentation	- Using hierarchical/relational organizational scheme. - Provide relationship cues. - Prescriptive path.	- Using objective organizational scheme. - Emphasizing on functionality.
Layout Design	- Paralleling submenu with content.	- Using information blocks.

Table 10: Design Principles for High V.S. Low Uncertainty Avoidance Cultures

Strategies / Dimensions	High Uncertainty Avoidance	Low Uncertainty Avoidance
Navigation	- Local and contextual navigational system (McCool, 2006). - Navigation schemes to prevent users from lost (Marcus, 2000).	- Open access design which allows free exploring.
Information Structure/Presentation	- Highly structured and organized. - Providing relationship cues. - Imposed structure and prescribed paths.	- Less structured and provides leeway for exploration.
Layout Design	- Applying local predominate design - Consistent layout throughout the system.	- Using creative and novel design. - Providing diverse page layouts.

Table 11: Design Principles for High V.S. Low Context Communication Cultures

Strategies / Dimensions	High Context Communication	Low Context Communication
Navigation	- Local and contextual navigational system (McCool, 2006). - Using sidebars and menus (Würtz, 2005).	- Task-oriented navigation design. - Show possible actions in navigation.
Information Structure/Presentation	- Providing contextual and relationship cues. - Using sidebar and/or sub-menu. - Using a "local/consensual" way in information structure.	- Clear and shallow information structure. - High transparency, provide available options at one time/in one page. - Using a "logical way" in organizing information.
Layout Design	- Allowing more space among information/paragraph (Change, 2011). - Contextual menu.	- Using information blocks, provide both visual and textual information.

Visual Identity

Kondratova and Goldfard (2009) suggested, the use of visual identity is aimed at developing an interface that "look and feel" like it belongs to a specific culture. Although the "look and feel" might seem superficial in HCI design, however, previous studies have established that the surface level features are not merely to be aesthetically pleasing, they indeed cause different perceptions across linguistic and cultural boundaries (Fink & Laupase, 1999). Barber and Badre (1998) coined the idea of "cultural markers" and suggested that the use of cultural markers/attractors—the design elements and features that are prevalent, and possibly preferred, within a particular cultural group—might be able to enhance the acceptance, as well as usability of the website for the local users.

Barber and Badre (1998) proposed 16 different categories of cultural markers, that can be further grouped into four major classes: color, images, text, and layout. These visual components have been proved to play critical roles in cross-cultural HCI design, and several aspects have been taken in investigating this phenomenon. Overall, it is suggested the cultural norms, values, traditions, as well as customs are the major factors that caused the different visual perceptions of the design (Fernald & Morikawa, 1993; Masuda et al., 2008). Masuda and Nisbett (2001) analyzed the differences from a cultural cognition approach and suggested the different patterns of attention (analytic vs. holistic) is the main cause that vary the degree to which people (of different cultures) to see visual images contextually. The predisposition of context dependency might produce different preferences and perceptions on visual stimuli and art works (Masuda et al., 2008). Table 12 summarizes the cultural preferences of Taiwanese and Americans on visual designs.

Table 12: Visual Design Principles for Taiwanese and Americans

Components \ Countries	Taiwan	America
Images	- No problem with seeing English text and Western figures in the images. - Soft line with more detail depiction and using not-so saturated colors in illustrations. - Care about the quality and execution of illustrations. - Prefer images incorporate a great deal of context (Masuda et al., 2008).	- Using culturally appropriate components. - Using less text in the Images. - Prefer pictures in which context is subordinate to salient, discrete objects (Masuda et al., 2008).
Icons	- Prefer more detail depiction on icon design using harmonious colors. - Thematic design, balance among icons and background.	- Prefer more vibrant colors and focus on the salient objects on the icons. - Thematic design, make icons stand out.
Typography	- More tracking and leading space for readability. - Left or justify alignment	- More tracking space. - Left alignment with equal word-space.

Translation

Due to the culture-specificity of cognitive and textual structure, it's suggested there is cross-cultural difference in thought and writing patterns; however, as the scope of this study is to investigate the interaction between interface and users instead of learning results, the learner-content interaction is not at the focus. Moreover, the purpose of this study is to investigate the interaction between the users and interface instead of learning result of users, meaning, the tasks designed to evaluate the user performance on information searching instead of evaluating the degree of cognitive learning, thus, the concern of content interaction was excluded in this study. However, literal word-to-word translation would not have worked properly; therefore, the emphasis was placed on retaining the essence of meaning of source language in the target language.

As far as languages are concerned, there are no two words in any two different languages that are completely identical in meaning. As translation involves at least two languages and since each language has its own peculiarities in phonology, grammar, vocabulary, ways of denoting experiences and reflects different cultures, any translation involves a certain degree of loss or distortion of meaning of the source text. Nida (1964) suggested two approaches in achieving translation equivalence— formal and dynamic or functional equivalence. Formal equivalence focuses attention on the message itself, in both form and content. It requires that the message in the target language should match as closely as possible the different elements in the source language (p.159). Dynamic equivalence is based on the principle of equivalent effect, where the relationship between the receptor and message should be substantially the same as that which existed between the original receptors and the message (p. 159). Although, it is impossible to establish absolute identity between the source text and the target text, however, it is

possible to establish equivalence between the source text and the target text on different linguistic levels and on different degrees (Le Meiyun 1989).

As the focus of this study, the textual components of both Chinese and English versions were intended to be as similar in both form and content as possible; thus, the translation is intended to reach the level of formal equivalence. The original translation was done by an experienced translator who is fluent in both English and Chinese. After the translation was done, a back-translation process was conducted to translate the translated text (Chinese content) back into English, the language of the original text, by a second experienced translator who is also fluent in both Chinese and English. The main purpose of back-translation is to check on the accuracy of the original translation by reversing the "process" or "operation" to see if there is any distortion or misrepresentation in the original translation. The back-translation then was compared with the original English text by a native English speaker, and modifications and corrections were made based on the review of native English speaker reviewer in order to rectify the ambiguity and misinterpretation in the Chinese translation.

Quantitative Research

Research Hypotheses and Variables

The purpose of this study was to inquire about the relationship between the variations of cultural preferences of different groups, as reflected in the preferred design features of websites, and the overall usability of interfaces designed using different approaches—matching vs. mismatching of the cultural preferences in design features. A great numbers of research suggested, the different design approaches of online instructional system interface might cause

different perception of users from different cultural backgrounds, and consequently have different responses, level of task performance and preference toward that interface. The major research question of this study then is:

Does the interface design (including the design of visuals, information architecture, presentation layout and navigation) which matches the cultural preferences of target cultural group result in different levels of usability (in this study, the effectiveness, efficiency, and desirability) of the target users from the one that mismatches their preferences?

The main question can be further elaborated into two sub-questions:

Q1: Does the match of website design features and users preferences influence users' task performance on information search related tasks in using the online learning system interface?

Q2: Does the match of website design features and user preferences produce different levels of desirability of interface design in the online learning system?

The hypotheses that corresponded to these two research questions are listed as following:

H1: Information task performances of users would be different in both performance time and accuracy when exposed to interfaces of different design approaches (match or mismatch to their cultural preference).

H2: The website perceived usability questionnaire scores of users would be different when exposed to interfaces of different design approaches (match or mismatch to

their cultural preference).

Although culture is a multi-faceted yet nebulous construct that encompasses the life of any individual, however, in this study the construct of culture was operationalized in a cognitive psychological sense and treated as a variable.   Since cultural assignments cannot be controlled, culture at its best only has the status of a quasi-experimental variable (Campbell and Stanley, 1963).   The purpose of this study is not to measure the differences of culture, but to understand the influence of culture as an entirety, to the acceptance of interface.   The primary interest is in the fundamental psychological processes rather than in the cultural variables per se.   However, in order to understand the phenomenon under the cross-culture perspective, it is necessary to categorize culture (group) as a variable.

Aptitude-treatment-interaction (ATI) theory (Cronbach & Snow, 1977) suggested that the matching of individual characteristic of learners and instructional treatment is critical in instructional design.   It is suggested that instructional treatments supported by design features related to learner's characteristic might enhance the learning achievement of learners (Trompenaars, 2003).   A positive relationship between the learner characteristics and instructional treatment dyad is assume, and three dependent variables which are related to the usability factors were assessed in the quantitative phase; (1) task performance time, (2) task performance accuracy, and (3) website perceived usefulness measure.

Furthermore, demographic information, such as gender, age, academic degree, year of enrollment, number of courses taken online, and perceived information literacy also were collected during this phase, this information might function as moderator variables which might affect the direction and/or strength of the relation between an independent and a dependent

variable and account for the "interaction effect between an independent variable and some factor that specifies the appropriate condition for its operation" (Baron & Kenny, 1986, p. 1174).

Target Population and Sampling

Convenience sampling was used in the quantitative phase. Participants were undergraduate students who, at the time this research was conducted, were enrolling in a university. For the American groups, participants were composed of English native speakers in a public Kansas university. Recruiting information was disseminated through social-networking websites, as well as posted in traditional bulletin board across the campus, invitation Emails were sent to students who responded to give them more detailed information, the participation is strictly voluntarily. For Taiwanese participants, subjects were composed of Native Chinese speakers who enrolled in a public university as undergraduate students in the Southern part of Taiwan. Recruiting information was disseminated by faculty members in that particular university who have personal connection with this researcher and offering classes in that university, invitation Emails were sent to students willing to participate in this study to give more detailed information. The participation, however, was strictly voluntary.

Instruments

Three surveys were used in the quantitative phase to collect the responses of participants: task performance survey, The Post-Study System Usability Questionnaire (PSSUQ), and Survey Measures of Web-Oriented Digital Literacy.

The task performance level (including performance time and accuracy) was intended to measure the level of task performance by using 5 different tasks which vary in complexity. The task performance measure was not aimed at assessing complex result of cognitive learning,

instead was intended to understand/measure the extent of interaction between the design approach and user dyads.

The construct of desirability/satisfaction was measured using the PSSUQ. The PSSUQ is currently a 19-item instrument for assessing user satisfaction with system usability (See appendix III). Each item is a statement and a rating on a seven-point Likert-type scale from 7 for "Strongly Disagree" to 1 for "Strongly Agree." The scale, however, was reversed in this study; in the modified version, 1 was for "Strongly Disagree;" and 7 for "Strongly Agree." Participants completed the questionnaire at the end of a task performance survey. Completing the PSSUQ allows participants to provide an overall evaluation of the interface they used. Moreover, the term "system" or "computer system" in the questions were replaced with "interface" to fit for the scope of this study.

The instrument to measure perceived digital literacy is Survey Measures of Web-Oriented Digital Literacy developed by Hargittai (2003) of Northwestern University. The original survey includes seven self-reported knowledge items that are proved to be highly related to the actual web-oriented digital literacy. Each item is a statement and a rating on a five-point Likert-type scale from 1 for "have no understanding" to 5 for "have a full understanding. For the consistency of scaling per se, the Likert scale was modified from a five-point to a seven-point scale. The seven knowledge items are: MP3, preference setting, refresh or reload, newsgroup, PDF, advanced search, and download, respectively. However, the item newsgroup was removed from the survey, since the younger generation no longer use and familiar with it. Moreover, this survey was included in the section of demography information.

Data Collection Procedure

The procedure of single-administered survey was used to collect data in the quantitative phase, and each participant only took the survey once. Data were collected by means of tracking: (1) time of execution in each task; (2) the overall accuracy of the tasks (the aggregated scores), and (3) post-task questionnaire data, including the aggregated scores of PSSUQ, Survey Measures of web-Oriented Digital Literacy, as well as a series of demographic information.

An online survey tool, Qualtrics, was used in the quantitative phase. The survey page was preloaded/opened for the participants, while the participants were seated, they were advised to wait for further instruction. The survey administrator then explained how the survey would be done, and demonstrated how to finish a sample task (differ from tasks included in the task performance survey). When the participants were instructed to start the survey, they were first prompted to look at an information statement page to which the purpose of the study, university policies, contact information, as well as consent information were introduced to the participants. When the participants clicked on the agree/proceed button they were considered to agree with the information stated and consent to participate in this study, and were then prompted to the first task in the task performance survey.

The task performance survey consisted of five major tasks. Participants' responses on each task were timed and recorded individually. The PSSUQ and the Survey Measures of Web-Oriented Digital Literacy were administered right after participants finished the task performance survey. Five demographic information questions about participants' (1) age; (2) gender; (3) year of study; (4) ethnicity, as well as (5) native language were also collected for the purpose of this study. In addition, although different language versions (English and Chinese) were

provided, participants in both conditions were exposed to the same list of tasks/questions.

Data Analysis in Quantitative Research

Human performance is commonly measured in terms of training time, speed, accuracy, as well as satisfaction (Bailey, 1996). When dealing with software and interfaces, the success of the design is usually measured in terms of how quickly (the time) and accurately (the accuracy) users are able to obtain the information, and the level of enjoyment/affiliation of users to the interface in completing their tasks. Based on this rationale, in this study the independent variable of this study was the matching condition (of user cultural preferences and the design features); and the dependent variables of this study were task performance time, task performance accuracy and interface desirability. Multivariate Analysis of Variance (MANOVA) and Independent-Samples *t* Test were used to analyze the data in order to test two quantitative hypotheses. Furthermore, an alpha value of .05 was set to test the hypothesis and indicate statistical significance.

The first hypothesis is:

> *Information tasks performance of users would be different in both performance time and accuracy when exposed to interfaces of different design approaches (matching or mismatching to their cultural profile).*

In this hypothesis, the procedure of Multivariate Analysis of Variance (one way MANOVA) was conducted to see the interactions between the factor (the matching condition: matching vs. mismatching) and the two independent variables, performance time and accuracy.

Follow-up analyses were conducted to access whether there are differences among the matching conditions on the population means for the performance time and the accuracy. Both performance time and accuracy on tasks were analyzed using analysis of variance (ANOVA), to see if there were interactions between the matching condition (independent variable) and the performance time (dependent variable 1), as well as performance accuracy (dependent variable 2). In addition, for the follow-up analyses, the Bonferroni adjustment—to test each ANOVA at the .025 level (.05 divide by 2)—was used in order to control for Type I error. Table 13 summarizes the variables in the hypothesis 1.

Table 13: Variables in H1

Variable	Definition
Matching Condition	The factor here is the group, there are two levels to the factor: matching (=1), and mismatching (=2).
Performance time	Performance time is the total time spending on solving the tasks
Performance accuracy	Performance accuracy is the total correct scores on the tasks, and ranges from 0-6.

The second hypothesis is:

> *The website perceived usability questionnaire score of users would be different when exposed to interfaces of different design approaches (matching or mismatching to their cultural preference).*

For this hypothesis, the procedures of Independent-Samples *t* Test was conducted to evaluate if the matching condition produced different levels of desirability of interface (for users)

as opposed to a mismatching condition.   Table 14 summarizes the variables in the hypothesis 2.

Table 14: Variables in H2

Variable	Definition
Matching Conditions	The independent variable here is the matching condition, This variable distinguishes between two treatment conditions: matching =1, and mismatching =2 (of cultural profiles and design).
Perceived usability	Perceived usability is the total scores on the PSSUQ, which ranges from 19-113.

Validity and Reliability

The Post-Study System Usability Questionnaire (PSSUQ)

Lewis (1993) in the IBM technical reported the coefficient alpha analyses of the PSSUQ, it showed that the reliability of the overall summative scale (OVERALL) was .97, and ranged from .91 to .96 for the three subscales (SYSUSE=.96, INFOQUAL=.91, and INTERQUAL=.91). In all cases, coefficient alpha exceeded 0.89 indicating acceptable reliability; therefore, the overall scale, as well as the three subscales in the PSSUQ have excellent reliability. Furthermore, Lewis (1993) also reported the validity information of PSSUQ.   He reported, the correlation analyses support the validity of the scales.   The OVERALL scale correlated highly with the sum of the After-Scenario Questionnaire (ASQ), a scenario-based usability study. Ratings that participants gave after completing each scenario $r(20)=.80$, $p=.0001$.   OVERALL also correlated significantly with the percentage of successful scenario completion $r(29)=-.40$,

p=.026.   The SYSUSE r(36)=-.40, p=.006, and the INTERQUAL r(35)=-.29, p=.08 correlated with the percentage of successful scenario completion.

Survey Measures of Web-Oriented Digital Literacy

Based on the comparison of actual web-skill and the self-reported survey data, Hargittai (2003) created a composite index including seven knowledge items: MP3, preference setting, refresh or reload, newsgroup, PDF, advanced search, and download.   The index variable yielded correlation coefficients of .537 (p=.000) and -.540 (p=.000) for successful completion of all tasks and for total time searching, respectively.   Hargittai suggested this is the best possible index based on the finding from his study, and the index has a Cronbach's α of .89 (Hargittai, 2003). Furthermore, Hargittai calculated the predictive power of the seven-item composite variable based on the most highly correlated survey measures of skill; the seven-item composite variable yielded an adjusted R^2= .321, Hargittai suggested this is the best predictor of actual skill in using information and communication technology and web-oriented digital literacy.

Qualitative Research

For the qualitative part of this study, the main focus was placed on understanding the underlying issues of how the interface design, using either the culture sensitive or culture biased approach, influences user's perception, satisfaction, as well as motivation regarding the experiences using the different interfaces.   In this part of qualitative study, participants were asked to use websites with content composed of their native language; i.e., the Chinese native speakers were exposed to both TC and AC sites, and American native speakers were exposed to both AE and TE sites.

The participants first were asked to utilize both interfaces to finish two different tasks, one for each interface, which similar in difficulties and complexities using a think-aloud method, that is, verbalizing their thoughts as they conduct the information seeking tasks. Each participant's think-aloud process was video and audio recorded; the performance time, as well as accuracy were also recorded by using the online survey tool Qualtrics. After finishing the tasks, websites to be compared were shown on the monitor side by side for the interviewees to compare and reference. A semi-structure interview was conducted in order to understand individual participant's using experiences regarding the two different interfaces. The research sub-questions for the qualitative phase were formulated based on the results of the first— the quantitative phase of the study. As the main purpose of the qualitative part is to understand the experience of users in a cross-cultural setting, the interview questions were mainly focused on the preferences issues, which included the aspects of satisfaction and desirability.

For the satisfaction issue, the main focus was on knowing if the interface was pleasant to use. A user's perception of satisfaction can be influenced by navigation, information structure, as well as visual representation (such as graphics, layout, typography….). Users' satisfaction is a combination of all of these criteria. As for desirability issue, the main question was if the users preferred one website design to the other, as well as the underlying reasons. Production Reaction Cards developed by Benedek and Miner (2002) for Microsoft in testing software interface desirability was incorporated in the interview process. This instrument was composed of 108 adjectives, and mixed of both positive and negative descriptions, which participants could use to describe their experiences on using the user interfaces. During the interview process, participants were asked to select three to five adjectives from the lists which they thought could best describe their experiences of interacting with the interfaces, in addition, they were

encouraged to elaborate the reasons the adjectives were chosen.

Sampling

Purposive sampling method was used in the qualitative phase; the reason to use purposive sampling is it allows researchers to focus on people who would be most likely to experience, know about, or have insights into the research topic (Mack, Woodsong, MacQueen, Guest, & Namey, 2005). In the qualitative phase, the sample participants were selected explicitly to encompass instances in which the phenomena under study are likely to be found (Zach, 2006). This approach of sample design is consistent with the strategy of homogeneous sampling, in which the desired outcome is the description of some particular group in depth (Patton, 1990).

In addition, the sample selection was specific on both size of each subgroup, as well as the representability of each sample. As culture in this study was considered as an independent variable in investigating how individuals in different cultural groups interact with interface, the criteria of selection were seeking participants who fulfill the requirements preset. For the American group, we sought for participants who were undergraduate students in a public university in the state of Kansas who preferably never took any Asian language(s) classes. For the Taiwanese group, participants who were undergraduate students in a public university in the south part of Taiwan were sought for.

In the multiple-case studies design, there are no hard-and-fast rules about how many cases are required to satisfy the requirements of the replication strategy. Yin (1994), however, suggested that six to ten cases are sufficient, if the results turn out as predicted and were able to "provide compelling support for the initial set of propositions." Yin went on and suggested that, since the multiple-case studies approach does not rely on the type of representative

sampling logic used in survey research, "the typical criteria regarding sample size are irrelevant" (p. 50). Instead, sample size is determined by the number of cases required to reach saturation, that is, data collection until no significant new findings are revealed. In the qualitative phase twelve participants, six for each cultural group, were recruited. Since the status of information "saturation" was reached by the number, the recruitment thus was stopped.

Data Collection

The multiple case studies design was employed for collecting and analyzing the qualitative data. The case study is "an exploration of a 'bounded system' ... a program, an event, an activity, or individuals" (Creswell, 2012) through detailed, in-depth data collection involving multiple sources of information and rich in context (Creswell & Maietta, 2002; Merriam, 1988). In this study, the multiple cases study serves the purpose was to illuminating a particular issue (Creswell, 2012), such as user interface experiences in the cross-cultural setting. A multiple case study design enables the researcher to explore differences within and between cases. By doing this, researchers are able to replicate findings across cases and to "provide compelling support for the initial set of propositions" (Yin, 1994).

A "case" is defined as a single task performance observation and the subsequent in-depth interview with a participant. Data were collected over a two-month period. The interview protocols, which included ten open-ended questions focusing generally on the user experiences, in particularly on the satisfaction and desirability issues, were pilot tested on two students selected from the Taiwanese group, but who were then excluded from the full study. Each question was mapped to address one or more of the perspective of interests. After the interview with each participant was conducted, the results were transcribed and analyzed before the next

interview was scheduled.   Debriefing with the participants was conducted to obtain information on the descriptive clarity of the interview questions, as well as the relevancy to the study scope. Furthermore, prior to the interview/observation, participants were explained the procedures, time frame, as well as the information regarding the videotaping of think aloud process and the tape-recording and verbatim transcribing of interview.   Interviewees were offered an opportunity to review and, if necessary, correct the contents of the interview after it was transcribed.

Data Analysis

In the qualitative phase of the study, the multimedia and textual data obtained through the observations and interviews were coded and analyzed for themes for further analysis.   As Merriam (1998) suggested, data collection and analysis in qualitative research should proceed simultaneously.   The analysis of the qualitative data thus began at the time that observation and interviewing were conducted.   Notes from observations and interviews were used to identify important statements in helping the process of coding.   The coded themes of the transcription were compared to the research questions and hypotheses in order to fine-tune and refine the focus.

The data analyses of this study were performed in two levels—"within" and "across" case respectively (Stake, 2013).   In the within-cases level, the qualitative data analyses followed the following procedures: (1) transcribing the data; (2) exploring of the data by reading through the transcripts and writing memos; (3) coding the data by segmenting and labeling the text; (4) developing themes by aggregating similar codes together; (5) connecting and interrelating themes; and (6) constructing a narrative (Creswell, 2002).   Common codes and formatting were implemented in order to make the cross-case data comparable.

In the cross-cases level, all the cases were analyzed for themes that are either common or different.   This helped to show the extent to which the identified internal and external factors have similar or different effects on the study participants as related to their experiences in using the interfaces.   Using Microsoft Word processor, cross-case comparison meta-matrices were created and tactics such as partitioning and clustering were used to search for patterns.   As Miles and Huberman (1984) suggested, plausible explanations and metaphors will emerge as the variables are related, split and factored.   In this phase, the researcher builds a logical chain of evidence and interprets the meaning of the cases and report the "lessons learned" (Lincoln & Guba, 1985).

A priori code list derived from prior studies and research questions was used to help the process of analysis, however, notes, memos, as well as transcriptions were all carefully analyzed to identify emerging codes.   Visual devices such as matrices and concept maps constructed from the data were used to illustrate relationships, patterns, evolving conceptual framework, as well as paradoxes.   Microsoft Word was used in aiding the process of data analysis, the function of highlight, tracking changes, referencing, table creating/sorting, as well as formatting (bolding, italicizing, underlining…) were used for the purposes of coding, retrieving, inspecting, and creating hierarchies of code categories.

Credibility Issues

To validate the findings, i.e., determine the credibility of the information and whether it matches reality (Merriam, 1988), three primary forms were used in the qualitative phase of the study: first, triangulation—converging different sources of information, more specifically, the recording/videotaping, as well as the task performance time and accuracy in a think-aloud

process were used to validate the information obtained during the interviews and vice versa. It is suggested that the information collected from interview and observation complement each other. Maxwell (2005) suggested, while interviewing is often an efficient and valid way of understanding a participant's perspective, observation enables researcher to draw inferences about this perspective that could not obtain by relying exclusively on interview data; conversely, interview can provide additional information that was missed in observation, and can be used to check the accuracy of the observation. Second, member checking— getting the feedback from the participants on the accuracy of the identified categories and themes; and finally, providing rich, thick description to convey the findings (Creswell, 2003; Creswell & Miller, 2002).

Research Permission and Human Subject Considerations

Prior to conducting this study, the proposal and the consent forms were sent to the Human Subject Committee at the University of Kansas. The researcher also sent an application of project approval to both the participating schools in United States and Taiwan. The participating school in Taiwan does not have special human subject protection requirement, the only thing the school required for approving the conduct of study was the writing approval of the cooperated faculty members which was requested and sent to the particular school before the study proceeded.

Due to the nature of this study, participants could be adolescents (under 18 years old), although adolescents are not specifically mentioned in the federal code protecting human participants, they are included with children as "minors." Children are considered vulnerable in part because of the legal limitations on their autonomy, but also because of their presumed

reduced capacity to understand and fully participate in the informed consent process. Hence,

prior to conducting survey, each participant was checked for their age and no one in either group

was under the age of 18.

CHAPTER IV: RESULTS

Overview of the Study

This study was interested in the specific relationship between the cultural preferences and the measure of interface usability, which includes effectiveness, efficiency and the desirability of the system interface design.   In particular, the focus was placed on the extent to which the cultural-sensitive design approach enhances the usability of a system interface.   In order to investigate the usability of interfaces from the perspectives of two distinct cultures, American and Taiwanese respectively, without the interference of the language barrier, the content was provided in both English and Chinese.   Four systems were generated for this study, American interface with English content (AE), American interface with Chinese content (AC), Taiwanese interface with English content, (TE) and Taiwanese interface with Chinese content (TC).   The participants were only exposed to the system(s) composed with the language of their native, i.e., American participants would use only AE and/or TE systems, and the Chinese participants would only access to the AC and/or TC systems.

In the quantitative phase, American participants were randomly divided into two groups, one group was asked to utilize AE system, and the other was asked to test the TE system.   Their Taiwanese counterpart went through the same process; the only difference is one group was asked to utilize the AC system, and the other the TC system.   The sample for the quantitative phase consisted of 120 participants; 59 of them are Native-English Speakers (NES) and 1 of them is Native-Spanish Speaker from the US, and 60 of them are Native-Chinese Speakers

(NCS) from Taiwan.   All participants in this phase were asked to respond to five information search tasks (task performance survey) by utilizing the system interface assigned to them, following by The Post-Study System Usability Questionnaire (PSSUQ), Survey Measures of Web-Oriented Digital Literacy, and a series of demographic questions.

An online survey tool, Qualtrics, was chosen for the quantitative phase.   The survey page was preloaded/opened for the participants, while the participants were seated, they were advised to wait for further instructions.   The survey administrator then explained how the survey would be done, and demonstrated how to finish a sample task (different from tasks included in the task performance survey).   When the participants were instructed to start the survey, they were first prompted to look out an information statement page to which the purpose of the study, university policies, contact information, as well as consent information were introduced to the participants.   When the participants clicked on the agree/proceed button they were considered to agree with the information stated and consent to participate in this study, and then prompted into the first tasks (in the task performance survey).

The task performance survey consists of five major tasks.   Participants' responses on each task were timed and recorded individually.   The PSSUQ and the Survey Measures of Web-Oriented Digital Literacy were administered right after participants finished the task performance survey.   Five demographic information questions about participants' (1) age; (2) gender; (3) year of study; (4) ethnicity, as well as (5) native language were also collected for the purpose of this study.   Single-administered survey was used to collect data in the quantitative phase. Although different language versions (English and Chinese) were provided, participants in the each condition were exposed to the same list of tasks/questions.

The main independent variable of this study was the matching condition (of user cultural profile and the design); the main dependent variables of this study were (1) task performance time, (2) task performance accuracy and (3) interface design desirability. To answer the first hypothesis, a Multivariate Analysis of Variance (MANOVA) was conducted to investigate the interaction between the factor (match condition) and two independent variables (performance time and accuracy). For the second hypothesis, Independent-Sample t test was used to evaluate the relationship of the independent variable (match conditions) and the dependent variable (perceived usability). The findings suggested that there were interactions between the independent variable (match condition) and the dependent variables (task performance time, accuracy and the desirability).

After the data of the quantitative phase were collected and analyzed, interview protocols were formed in accordance with the initial findings of the quantitative phase. Twelve participants, six from the American group and six from the Taiwanese group, were recruited for the observation and the in-depth interview. Each participant was asked to utilize both systems with content composed of their respective native language. The qualitative phase was aimed at investigating the culturally different perceptions and preferences of participants toward interface design; the process consisted of a think-aloud observation in which the participants were asked to verbalize their thought while performing information search tasks using both systems, follow by an semi-structured in-depth interview to probe their attitudes, experiences, feelings, and preferences toward the two systems provided. All observations and interviews were conducted in a computer lab and were audio and video recorded. Data were collected and interviews were transcribed and analyzed for the guiding questions. The main themes described (in a culturally determined perspective) how (a) participants perceived design components and overall design

differently, and how that resulted in (b) the different levels of performance in interface usage, and that (c) culturally aware design approach could be a functional solution in improving the usability of an interface.   The findings suggested that the use of cultural profile in interface design might increase not only the perceived usefulness and preferences of users toward an interface but also the overall usability of an interface.   In addition, the results of the qualitative phase were structured by the major themes instead of corresponding to the main research protocols in order to present a thematic structure of the findings.

This research utilized a sequential explanatory mixed-methods design, meaning the collection and analysis of quantitative data were first conducted, followed by the collection and analysis of qualitative data to explain and elaborate on the quantitative findings/results.   The following section is arranged in accordance to the sequence of research design, first presents the findings of quantitative findings, and follows by the qualitative findings.

Findings in the Quantitative Phase

Description of Participants

Demographics

The sample in the quantitative phase consisted of two distinct ethnic groups, American and Taiwanese respectively, with total 120 participants: 59 Native English Speakers (NES), one Native Spanish Speaker, and 60 Native Chinese Speakers (NCS).   All of the participants were college students enrolled in a university when the study was conducted: 14 (11.7%) of them were reported to be freshman, 44 (36.7%) were sophomore, 43 (35.8%) were junior, 16 (13.3%) were

senior, and 3 (2.5%) of them reported to be in a university for five years or more (see table 15).

In addition, the age of the participants was ranging from 18 to 26 years old with a mean of 20.92

(see table 16).   Overall, 63 (52.5%) of them were male and 57 (47.5%) were female (see table

17).   Group-wise, there were 30 (50%) male and 30 (50%) female in the American group, the

Taiwanese group had a gender ratio of 33 (55%) male versus 27 (45%) female (see table 18).

The information of ethnicity and native language was used to verify the cultural heritage of the

participants.   For the Taiwanese group, all the participants reported to be Chinese/Taiwanese

with Chinese as their native language; their American counterpart, however has a more diverse

composition, with 55 White (91.7%), two African American (3.3%), and three Hispanic

American (5%) in the group (see table 20).   Moreover, 59 out of 60 participants in the American

group reported to have English as their native language, however, one of the participants in the

American group reported to have Spanish as their Native language (see table 21), thus was

excluded from further analyses.

Table 15: Overall Grade Distribution in the Quantitative Phase

Grade

		Frequency	Percent
Valid	Freshman	14	11.7
	Sophomore	44	36.7
	Junior	43	35.8
	Senior	16	13.3
	Fifith or more	3	2.5
	Total	120	100.0

Table 16: Overall Age Distribution in the Quantitative Phase

Age			
		Frequency	Percent
Valid	18	9	7.5
	19	16	13.3
	20	31	25.8
	21	24	20.0
	22	17	14.2
	23	12	10.0
	24	7	5.8
	25	1	.8
	26	3	2.5
	Total	120	100.0

Table 17: Overall Gender Distribution in the Quantitative Phase

Gender			
		Frequency	Percent
Valid	Male	63	52.5
	Female	57	47.5
	Total	120	100.0

Table 18: Group-wise Gender Distribution in the Quantitative Phase

Group-wise Gender

Country			Frequency	Percent
America	Valid	Male	30	50.0
		Female	30	50.0
		Total	60	100.0
Taiwan	Valid	Male	33	55.0
		Female	27	45.0
		Total	60	100.0

Table 19: Overall Ethnicity Distribution in the Quantitative Phase

Ethnicity

		Frequency	Percent
Valid	White	55	45.8
	African American	2	1.7
	Chinese	60	50.0
	Hispanic or Latino	3	2.5
	Total	120	100.0

Table 20: Group-wise Ethnicity Distribution in the Quantitative Phase

Group-wise Ethnicity

Country			Frequency	Percent
America	Valid	White	55	91.7
		African American	2	3.3
		Hispanic or Latino	3	5.0
		Total	60	100.0
Taiwan	Valid	Chinese	60	100.0
		Total	60	100.0

Table 21: Native Languages of Participants in the Quantitative Phase

Native Language

		Frequency	Percent
Valid	English	59	49.2
	Chinese	60	50.0
	Spanish	1	.8
	Total	120	100.0

Table 22: Group-wise Native Languages of Participants in the Quantitative Phase

Group-wise Native Language

Country			Frequency	Percent
America	Valid	English	59	98.3
		Spanish	1	1.7
		Total	60	100.0
Taiwan	Valid	Chinese	60	100.0

Web-Oriented Digital Literacy

Participants were asked to rate their understanding with six important web-oriented technology terms on a Likert type scale, ranging from one (have no understanding) to five (have a full understanding). The list covers tools that are commonly used, as well as skills favored in web-oriented activity, including: (1) MP3, (2) Preference Setting, (3) Refresh or Reload, (4) PDF, (5) Advanced Search, and (6) Download. For both groups, participants considered themselves as knowledgeable website users, the American group had a mean of 27.63 (out of 30) and a Standard Deviation of 2.60. Their Taiwanese counterpart had an overall mean of 26.05 (out of 30) and a Standard Deviation of 3.36 (see table 23). An independent-samples *t* test was conducted to evaluate if there was significant differences between the American and the

Taiwanese group in the self-reported web-oriented digital literacy survey.   The Levene's Test for

Equality of Variances was significant, which indicated unequal variances in these two groups.

Using the adjusted method, the *t* test was still significant, $t(111.12) = 2.89$, $p < .01$ (see table 24).

This implies that compared to their Taiwanese counterparts ($M = 26.05$, $SD = 3.36$), American

participants ($M=27.63$, $SD=2.60$) consider themselves as having a better understanding on the

aforementioned technological terms, they had statistically higher overall score on Web-Oriented

Digital Literacy survey.   In addition, the 95% confidence interval for the difference in means

ranged from .50 to 2.67.   Figure 3 demonstrates the scores distribution of Web-Oriented Digital

Literacy for the American and the Taiwanese group.

Table 23: WODL Scores Group Statistics

WODL Scores Group Statistics

	Country	N	Mean	Std. Deviation	Std. Error Mean
WODL Total	America	60	27.63	2.604	.336
	Taiwan	60	26.05	3.357	.433

Table 24: Independent Samples t-test for WODL Scores

Independent Samples Test for WODL Scores

		WODL_Total	
		Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F	7.186	
	Sig	.008	
t-test for Equality of Means	t	2.887	2.887
	df	118	111.121
	Sig. (2-tailed)	.005	.005
	Mean Difference	1.583	1.583
	Std. Error Difference	.548	.548
95% Confidence Interval of the Difference	Lower	.497	.497
	Upper	2.669	2.670

Figure 3: Distribution of Web-Oriented Digital Literacy Scores for the American and the Taiwanese Group.
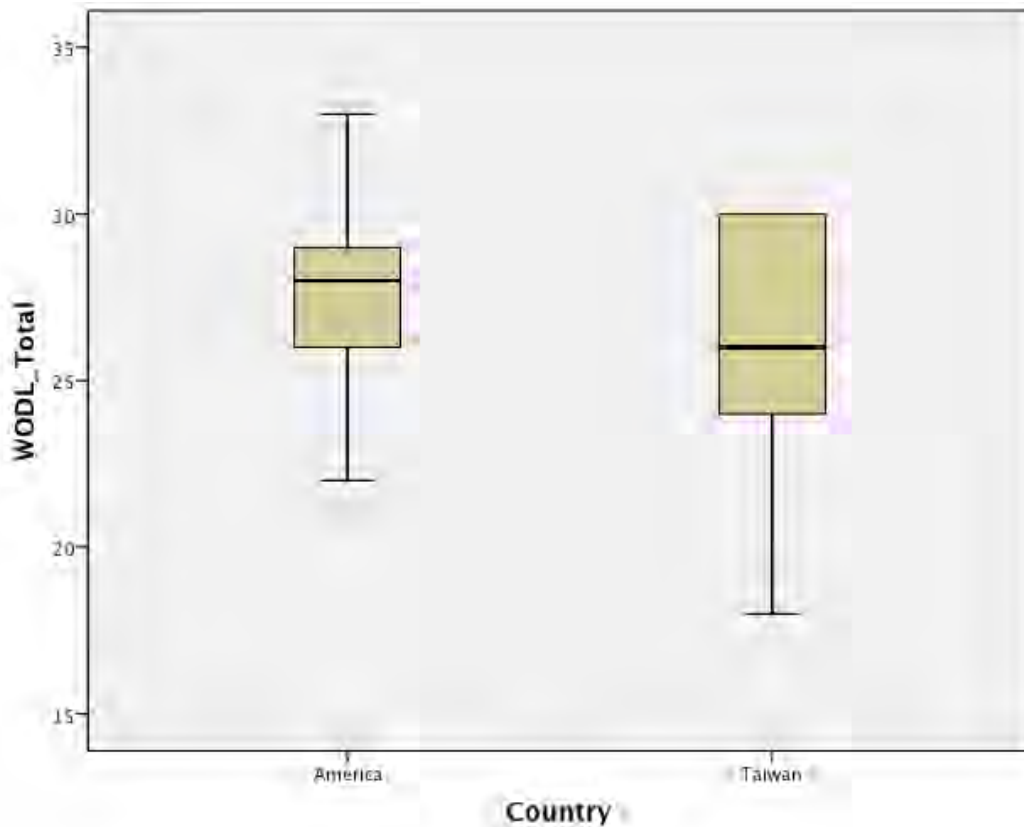
Research Findings in Hypotheses Tests

Hypotheses One

H1: Information task performance of users would be different in both performance time and
    accuracy when exposed to interfaces of different design approaches (matching or
    mismatching to their cultural preference).

The American Group

A one-way multivariate analysis of variance (MANOVA) was conducted to determine the
effect of the match condition (match versus mismatch) on the overall performance for the
American group.   Significant differences were found between the two matching conditions on

the dependent measures, Wilks's $\Lambda = .85$, $F(2, 56) = 5.15$, $p < .01$. The multivariate η^2 based on Wilks's Λ was .15, which indicates a medium effect size (see table 25). Table 26 contains the means and the standard deviations on the dependent variables for the two match conditions.

Table 25: Multivariate Tests for the American Group.

Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.981	1457.677[b]	2.000	56.000	.000	.981
	Wilks' Lambda	.019	1457.677[b]	2.000	56.000	.000	.981
	Hotelling's Trace	52.060	1457.677[b]	2.000	56.000	.000	.981
	Roy's Largest Root	52.060	1457.677[b]	2.000	56.000	.000	.981
Match	Pillai's Trace	.155	5.149[b]	2.000	56.000	.009	.155
	Wilks' Lambda	.845	5.149[b]	2.000	56.000	.009	.155
	Hotelling's Trace	.184	5.149[b]	2.000	56.000	.009	.155
	Roy's Largest Root	.184	5.149[b]	2.000	56.000	.009	.155

Table 26: Mean and SD on the Dependent Variables for the Match Conditions in the American Group

	Performance Time		Accuracy	
Match Condition	M	SD	M	SD
Match	775.18	264.68	12.31	1.65
Mismatch	1002.63	413.25	11.57	1.79

Analyses of variances (ANOVA) on the dependent variables were conducted as follow-up tests to the MANOVA to investigate the effects of matching conditions to the dependent variables, the performance time and the accuracy. Using the Bonferroni method, each ANOVA was tested at the .025 level; the ANOVA on the performance time was significant, $F(1, 57) = 6.29$, $p = .015$, $\eta^2 = .10$, while the ANOVA on the accuracy was non-significant, $F(1, 57) = 2.74$,

$p = .103$, $\eta^2 = .05$ (see table 27).

Table 27: Test of Between Subject Effects in the American Group.

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Performance Time	762840.167[a]	1	762840.167	6.289	.015	.099
	Accuracy	8.155[b]	1	8.155	2.741	.103	.046
Intercept	Performance Time	46605959.530	1	46605959.530	384.224	.000	.871
	Accuracy	8406.732	1	8406.732	2825.816	.000	.980
Match	Performance Time	762840.167	1	762840.167	6.289	.015	.099
	Accuracy	8.155	1	8.155	2.741	.103	.046
Error	Performance Time	6914039.299	57	121298.935			
	Accuracy	169.574	57	2.975			
Total	Performance Time	54498631.686	59				
	Accuracy	8578.000	59				
Corrected Total	Performance Time	7676879.466	58				
	Accuracy	177.729	58				

The Taiwanese Group

A one-way multivariate analysis of variance (MANOVA) was conducted to determine the effect of the match condition (match versus mismatch) on the overall performance for the Taiwanese group. Significant differences were found between the two matching conditions on the dependent measures, Wilks's $\Lambda = .67$, $F(2, 57) = 14.06$, $p < .01$. The multivariate η^2 based on Wilks's Λ was .33, which indicates a medium effect size (see table 28). Table 25 contains the means and the standard deviations on the dependent variables for the two match conditions.

Table 28: Multivariate Tests for the Taiwanese Group.

Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.972	972.812[b]	2.000	57.000	.000	.972
	Wilks' Lambda	.028	972.812[b]	2.000	57.000	.000	.972
	Hotelling's Trace	34.134	972.812[b]	2.000	57.000	.000	.972
	Roy's Largest Root	34.134	972.812[b]	2.000	57.000	.000	.972
Match	Pillai's Trace	.330	14.060[b]	2.000	57.000	.000	.330
	Wilks' Lambda	.670	14.060[b]	2.000	57.000	.000	.330
	Hotelling's Trace	.493	14.060[b]	2.000	57.000	.000	.330
	Roy's Largest Root	.493	14.060[b]	2.000	57.000	.000	.330

Table 29: Mean and SD on the Dependent Variables for the Match Conditions in the Taiwanese Group

	Performance Time		Accuracy	
Match Condition	M	SD	M	SD
Match	742.99	212.49	11.73	2.21
Mismatch	1353.27	625.52	10.03	2.46

Analyses of variances (ANOVA) on the dependent variables were conducted as follow-up tests to the MANOVA to investigate the effect of matching condition on the dependent variables, the performance time and the accuracy. Using the Bonferroni method, each ANOVA was tested at the .025 level; the ANOVA on the performance time was significant, $F(1, 58) = 25.60$, $p < .001$, $\eta^2 = .31$, in addition, the ANOVA on the accuracy was also significant, $F(1, 58) = 7.94$, $p = .007$, $\eta^2 = .12$ (see table 30).

Table 30: Test of Between Subject Effects in the Taiwanese Group.

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Performance Time	5586479.930[c]	1	5586479.930	25.601	.000	.306
	Accuracy	43.350[d]	1	43.350	7.936	.007	.120
Intercept	Performance Time	65915264.811	1	65915264.811	302.071	.000	.839
	Accuracy	7106.817	1	7106.817	1300.985	.000	.957
Match	Performance Time	5586479.930	1	5586479.930	25.601	.000	.306
	Accuracy	43.350	1	43.350	7.936	.007	.120
Error	Performance Time	12656236.766	58	218210.979			
	Accuracy	316.833	58	5.463			
Total	Performance Time	84157981.508	60				
	Accuracy	7467.000	60				
Corrected Total	Performance Time	18242716.697	59				
	Accuracy	360.183	59				

Hypotheses Two

H2: The website perceived usability questionnaire score of users would be different when

exposed to interfaces of different design approaches (match or mismatch to their

cultural preference).

The American Group

An independent-sample t test was conducted to evaluate the hypothesis that the score on

website perceived usability questionnaire (PSSUQ) would be higher when the American

participants were exposed to the match condition as opposed to the mismatch condition.   The

test was significant, with $t(57) = 2.11$, $p = .04$ (see table 32).   Table 31 contains the means and

the standard deviation of PSSUQ scores of the American groups.

Table 31: Group Statistics of PSSUQ Score for the American Group.

Group Statistics

|	Match	N	Mean	Std. Deviation	Std. Error Mean
PSSUQ Total	match	29	58.51724	11.743146	2.180647
	mismatch	30	52.96667	8.256589	1.507440

American participants on the match condition, who used the AE design on the average

rated the website perceived usability ($M = 58.52$, $SD = 11.74$) higher than those who were

exposed to the mismatch condition ($M = 52.97$, $SD = 8.26$) with the TE design.   The 95%

confidence interval for the difference in means was quite wide, ranging from .27 to 10.83.   The

eta square index indicated that 7 % of the variance on the scores was accounted for by whether

participants were assigned to a match or a mismatch condition, which by convention can be

interpreted as medium effect size.   Figure 4 shows the distributions for these two conditions in

the American group.

Table 32: Independent Samples t-test of PSSUQ Total Scores for Match Condition in the American Group.

Independent Samples Test

		PSSUQ Total	
		Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F	2.56	
	Sig	.115	
t-test for Equality of Means	t	2.106	2.094
	df	57	50.107
	Sig. (2-tailed)	.040	.041
	Mean Difference	5.551	5.551
	Std. Error Difference	2.636	2.651
95% Confidence Interval of the Difference	Lower	.273	.226
	Upper	10.828	10.875

Figure 4: Error Bars for the PSSUQ Total Scores of Match Condition in the American Group.
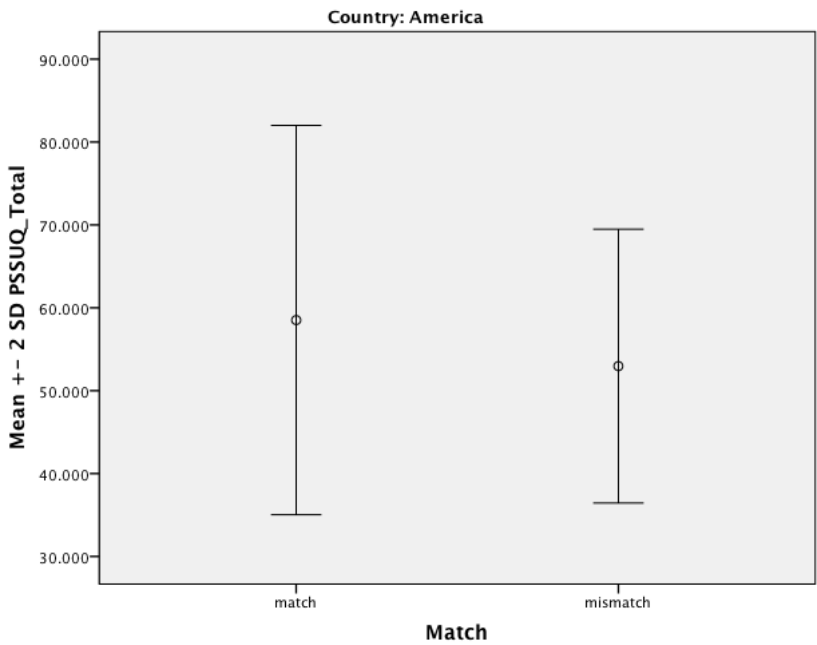
The Taiwanese Group

An independent-sample *t* test was conducted to evaluate the hypothesis that the score on the website perceived usability questionnaire (PSSUQ) would be higher when the Taiwanese participants were exposed to the match condition as opposed to the mismatch condition. The Levene's test for quality of variances is non-significant which indicated the equality-of-variance is assumed. The test however was significant, $t(58) = 3.48$, $p < .01$ (see table 34). Table 33 contains the means and the standard deviation of PSSUQ scores of the Taiwanese groups.

Taiwanese participants on the match condition, who used the TC design on the average rated the website perceived usability higher ($M = 58.67$, $SD = 11.73$) than those who were exposed to the mismatch condition ($M = 46.93$, $SD = 14.29$) of the AC design. The 95% confidence interval for the difference in means was quite wide, ranging from 4.99 to 18.48. The eta square of .17 indicated that 17 % of the variance on the scores was accounted for by whether a participant was assigned to a match or a mismatch condition, which by convention can be interpreted as large effect size. Figure 5 shows the distributions for these two conditions in the Taiwanese group.

Table 33: Group Statistics of PSSUQ Score for the Taiwanese Group.

Group Statistics					
	Match	N	Mean	Std. Deviation	Std. Error Mean
PSSUQ Total	match	30	58.66667	11.730695	2.141722
	mismatch	30	46.93333	14.293172	2.599705

Table 34: Independent Samples t-test of PSSUQ Total Scores for Match Condition in the Taiwanese Group.

Independent Samples Test

		PSSUQ Total	
		Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F	1.542	
	Sig	.219	
t-test for Equality of Means	t	3.483	3.483
	df	58	55.950
	Sig. (2-tailed)	.001	.001
	Mean Difference	11.733	11.733
	Std. Error Difference	3.368	3.368
	95% Confidence Interval of the Difference — Lower	4.990	4.985
	95% Confidence Interval of the Difference — Upper	18.476	18.481

Figure 5: Error Bars for the PSSUQ Total Scores of Match Condition in the Taiwanese Groups.
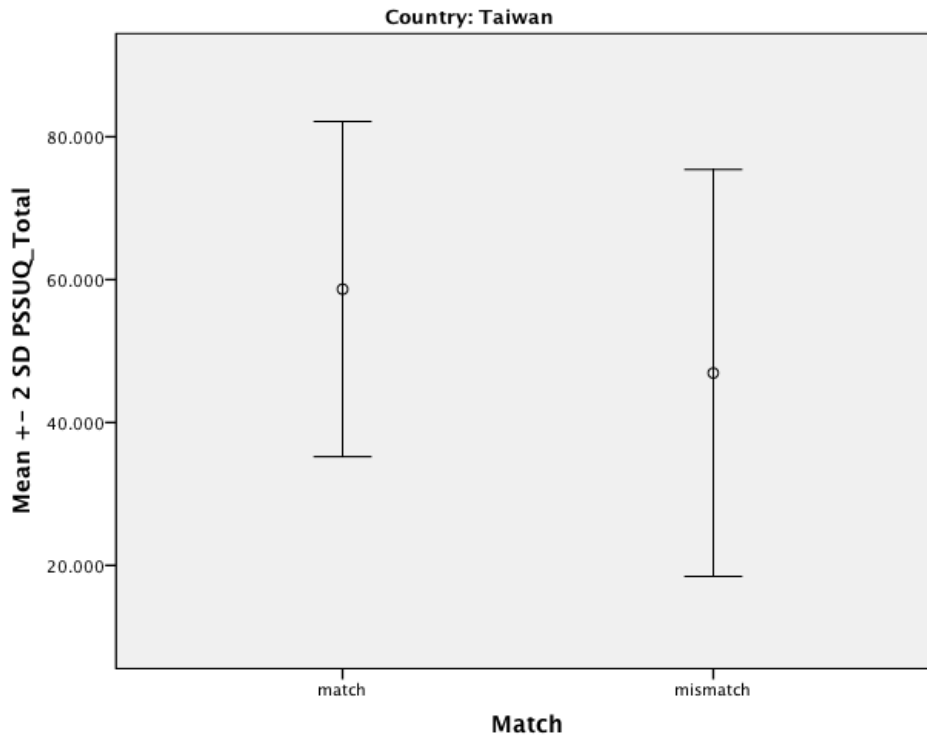
Summary of Quantitative Findings

Two groups of participants were recruited for this study, which included 60 Taiwanese college students (33 males and 27 females) and 60 American college students (30 males and 30 females).   Unequal variances were found in the self-reported perceived digital literacy survey of these two groups, overall American participants considered themselves to have higher digital literacy on web-oriented information technology than their Taiwanese counterparts.

The result of one-way multivariate analysis of variance (MANOVA) showed significant differences on overall task performance (which includes the performance time and accuracy) between the two matching conditions in the American group, Wilks's $\Lambda = .85$, $F(2, 56) = 5.15$, $p < .01$, and the multivariate η^2 based on Wilks's Λ was .15, which indicated that Americans performed better when exposed to the matching (AE) design.   The follow-up results of Analyses of Variances (ANOVA) indicated that the performance time was significantly influenced by the matching conditions $F(1, 57) = 6.29$, $p = .015$, $\eta^2 = .10$; however, the performance accuracy was not $F(1, 57) = 2.74$, $p = .103$, $\eta^2 = .05$.   In the Taiwanese group, the result of one-way multivariate analysis of variance (MANOVA) was also found statistically significant.   Different levels of performance were found in the two matching conditions (matching v.s. mismatching with cultural preferences), Wilks's $\Lambda = .67$, $F(2, 57) = 14.06$, $p < .01$, and the multivariate η^2 based on Wilks's Λ was .33, which indicated that Taiwanese performed better when exposed to the matching (TC) design.   In addition, both follow-up procedures of Analyses of variances (ANOVA) were significant, which indicated that both performance time ($F = 6.29$, $p = .015$, $\eta^2 = .10$), and accuracy ($F = 7.94$, $p = .007$, $\eta^2 = .12$) were significantly influenced by the matching conditions.

For the perceived usability issue, in the American group, The *t*-test was significant, *t*(57) = 2.11, *p* = .04, which indicated that American participants who used the matching (AE) design (*M* = 58.52, *SD* = 11.74) on average had higher perceived usability on the interface than those who used the mismatching (TE) design (*M* = 52.97, *SD* = 8.26).   In addition, 7% variance of the PSSUQ scores was accounted for by whether a participant was assigned to a match or a mismatch condition in the American group.   In the Taiwanese group, the *t*-test was also significant, *t*(58) = 3.48, *p* < .01, which means the Taiwanese participants in the match condition, who used the TC design, on average had higher website perceived usability (*M* = 58.67, *SD* = 11.73) than those who were exposed to the mismatching (AC) design (*M* = 46.93, *SD* = 14.29). In addition, 17% variance on PSSUQ scores was accounted for by the matching conditions.

Findings in the Qualitative Phase

Overview

12 participants, six Taiwanese and six Americans were invited to participate in the observation/interview process of the qualitative phase.   All of the participants were college students in a university at the time the observation/interview was conducted.   The Taiwanese participants were students in a National university in the Southern part of Taiwan.   As for the American participants; they were college students in a major university in the State of Kansas. Before the observation/interview was conducted, the main foci, as well as the scopes of the research were explained to the participants.   The participants then received initial information letters followed by the debriefing of the details of what they should be doing after providing

consent.

This study implemented a sequential explanatory mixed-methods design, the main interview protocols, as well as the direction of the qualitative phase were developed based on the findings of the quantitative phase. The qualitative phase was aimed at providing richer understandings and supplements for the data collected in the quantitative phase. Several questions have been answered in the quantitative phase, however some more questions arose and can only be answered and clarified by probing and exploring participants' experiences and perceptions. These questions can be classified into two main categories; first, what caused the differences on the responding time in those two different matching conditions in each group? Second, what are the main contributors that cause the differences on the design satisfaction and/or desirability in those two different matching conditions in each group?

The processes and procedures used to answer the aforementioned questions consisted of a think-aloud observation in which the participants were asked to verbalize their thought while performing information search tasks using two systems with content composed of the native language of theirs, and an semi-structured in-depth interview to probe their attitudes, experiences, feelings, and preferences toward the two systems provided. In addition, the themes in the following section are focused on comparing and contrasting the differences of these two groups instead of finding a common group.

Sample Population in the Taiwanese Group

Six Taiwanese students, four females and two males were recruited to take part in the qualitative phase. All participants are of Chinese/Taiwanese ethnicity and were full-time college students at the time this study was conducted, with an age range of 19 to 21. They had

the self-rated WODL scores ranged from 22 to 30 (out of 30), all of the them considered themselves as experienced Internet users, however, only two participants (one female and one male) had experiences on taking at least one fully online course.   The participants included Jin-Ye, Hsin-Yee, Mei-Lin, Fey-Jin, Chiang-Chi, and Yu-Hsuan.   The following section provides a synopsis for each of participant.

Jin-Ye was an undergraduate law student on the third year of study, who was determined to become an attorney after graduating from school at the time this study was conducted.   She never had any experience on any online courses.   In addition, she scored 24 in the WODL survey, and mentioned that she is very comfortable and has no problem in using Internet and information technology.   She uses search engines, in particularly Google all the time, not only for leisure purposes, but also as one of the tools that help her over-loaded schedule.

Hsin-Yee was a junior who majoring in law and intended to apply herself to a graduate program after finishing college at the time this study was conducted.   She thought a LLM program in the United States would be a great option for her.   She scored 28 in the WODL survey, and considers herself as an avid Internet user.   She is very comfortable with most of the online technology such as computers, smartphones, tablets, as well as a series of online gaming devices.   In addition, she uses Internet for all kinds of purposes, leisure, academic, communication, and even shopping.

Mei-Lin was a third year information science major at the time this study was conducted. She described herself as an aspiring information system designer, and she has extensive knowledge in information/computer technology.   She said that she spends a lot of time doing projects and assignments using a computer (most of time, online).   In addition to the Windows

154

system, she also is fluent in the Linux system, but she didn't have many experiences on the Mac system.   She scored 30 in the WODL survey, and considered herself more of a designer than an online system user.

Fey-Jin was a sophomore pursing a double major degree in economics and political science at the time this study was conducted.   She owns a smart phone, a laptop and a tablet, however she doesn't feel the urgent and/or necessity for using them in everyday life.   She said: "*most of time I use my computer only for school works, and my phone and tablet were gifts from my parents… I don't use them as much as I suppose to do… I know how to use Internet and also understand the benefits (of using it), but honestly, I don't think it's a big part of my life, at least for now.*"   She had 22 in the WODL survey, which is on the relative lower end on the spectrum in both the American and the Taiwanese group.

Chiang-Chi was a second year economics major at the time this study was conducted. He scored 28 in the WODL survey, and described himself as an avid Internet user, as he said: "*I cannot imagine to live without Internet, I spend probably 4 to 5 hours, either gaming or browsing online every day.*"   He owns several devices, including a smartphone, a tablet (both devices run on Android systems), and a Chromebook (laptop runs Chrome OS as an operating system), which he claimed to be integrating with each other seamlessly.

Yu-Hsuan was a junior in an applied statistics program who spent a lot of time on online gaming at the time this study was conducted.   He described himself as an "online gaming fanatic" who would not only stay up all night to paly online video games but also was working on designing his own game.   He has extensive knowledge in information technology (both software and hardware) and built several of his own computers.   He scored 30 in the WODL

survey.

Sample Population in the American Group

In the American group, six students, three female and three male answered and agreed to participate in this study, all of them were of Caucasian ethnicity and were full-time college students enrolled in a Midwest public university in the USA at the time the study was conducted. The age of participants' ranged from 19 to 21, with self-rated WODL scores range from 25-30 (out of 30).   All of the American participants considered themselves as experienced Internet users.   In addition, although different in subject matters, all of the American participants have taken at least one online or blended course in the past.   The participants include Eric, Austin, Joshua, Amanda, Courtney, and Alex.

Main Themes

The interview protocols (see Appendix III) were developed in accordance with the primary findings in the quantitative phase and aimed at understanding the underlying elements which contribute to the findings in the quantitative phase.   The data collected from the qualitative phase is able to be analyzed from many perspectives.   In this study, the perspective of evaluating the data against the framework of Activity Theory was taken.   Activity Theory as a lens for analyzing data provides means for observing the human-interface interaction embedded in the social context.   In this study, the activity could be described as a student uses an online learning system (interface) to find answers for an information seeking task which were aimed at looking for the required information for an online course in a computer lab of her/his school.   To analyze this activity in an Activity Theory point of view, the object of the activity then is to find the answers for the information seeking tasks which were critical in finishing an

online course.   There is certain division of labor, between the students and the instructor, between the system/interface designer and the users, and even between the students who take the online course (even though they probably will not meet in person).   There is a set of rules covering what is meant to be a student in a blendied or online course, some might be explicit, set by law, regulation, or rubrics, but many of them are most certainly implicit, either as a part of the social-cultural environment or as the unwritten rules of an institute.   Three themes were distilled and emerged from the data analysis and discussed below, which are: (a) people from different cultures utilized different strategies in executing the information seeking tasks, (b) people from different cultures have different perception toward online learning interfaces, and (c) culturally aware design is a functional approach to address different needs and provide meaningful interaction for people of different cultures.

Theme 1: The information seeking behavior is similar in process but distinct in execution

Both American and Taiwanese participants used similar strategies in solving the information-seeking tasks.   Since participants had a very specific goal of what they needed to achieve by using the interface/system (which is set by the researcher), thus the information-seeking activities were more of purposive than exploratory.   In this study, the information-seeking activities entailed articulating a question verbally, formulating actions, browsing the content, following the links, evaluating the relevancy, as well as extracting required information from the content.   The data demonstrated that the participants followed very similar patterns in solving the tasks.   They started with interpreting the tasks, transferring the tasks into a series of manageable actions that can be easily done without being distracted or overwhelmed.

According to the tasks or the break down actions, participants assessed the relevancy of the items and/or links by using its descriptor before deciding to go into or avoid a particular category. They assigned/attributed significance to the links and items based on their understanding and expectation and chose the one that was assumed to be the most relevant to their goal.   However, after going into that particular category, there might be inconsistencies between the descriptor and their expectation; in that case, participants need to reassess the relevancy and readjust their subsequent actions.   After the inconsistencies were solved, participants browsed through the content and strategically inspected and extracted information to retain the useful/relevant one and filtered out the irrelevant one to solve the information-seeking tasks.   Although the strategies of solving the tasks were similar, the execution of the information-seeking task, however were different in the American and the Taiwanese groups, the following section discusses how American and Taiwanese participants conceptualized system interfaces and how different they were in executing the information-seeking tasks.

1-1 The Taiwanese participants tended to build a mental image of system by exploring, while the Americans participants relied on prior experiences.

In the case of using a novel interface, it is suggested that users might first try to develop an image of the interface, and then devise a script of processes to be followed in solving a task, which composes of the pre-existing knowledge and the prediction of the system behavior(s). That is to say the more identical the mental model with the actual system design, the more effective the interaction would be.   American and Taiwanese participants have very different strategies in developing the system image of the interface.   Taiwanese participants preferred a pre-task exploration which can help them to understand how the system was structured and

prevent disorientation in the task performance.   In addition, they didn't assume that the mental model(s) they have can be transferred and applied to a novel system (such as the American interface) without further adjustment, thus hold a relative cautious manner in using it.

When encountering a novel interface/system, Taiwanese participants avoid making assumptions of what the system behaviors are.   For Taiwanese participants, they have the tendency of developing an overall image of the system by exploring/using the system before starting the tasks.   Jin-Ye for example thought: "*you can't be 100% sure where the information is, I mean every system was designed differently, right? So I thought it's a good idea that I at least have a peek of (the system interface) before I start (the information seeking tasks).*"   In a very similar vein, Hsin-Yee said "*(the American interface) looks different (from the other online learning system I have used before), I just tried to understand what's in it and figure out how to use it.*"   Yu-Hsuan thought, for him a best strategy to understand a system is to explore it (before using it), he suggested that one could never assume how a system was organized and the ways of functioning, he said "*chances are, the design is not always intuitive; sometimes you even need to read a menu to understand how to operate a cell phone.*"   The following is an excerpt from Yu-Hsuan's information seeking behavior observation:

When asked to conduct an information-seeking task by using the American interface, Yu-Hsuan started by visually examining the home page without moving the cursor. He gazed upon the slideshow block in the upper center of the main information Div for a while (to see the alteration of the slideshow) then proceeded his scanning again.   He went through each of the information blocks starting from the instructor information block (on the upper left corner in the main information Div).   He clicked on the "more" link which opened another browser window and led to another web page with the information of the instructor.   He went through the

159

information quickly, and tried to go back to the page.   First he tried to use the "go back" button on the browser, however, it's not clickable at this time, he soon realized it's a new window and he clicked on the tab to go back to the page to be tested.   He then moved to the course sessions block (the very right column of the main information Div), and quickly reviewed each of the lesson icon, moving the cursor in a zigzag pattern without actually staying in any of the icons. He then clicked on the sessions link, which led him to the main sessions page with the icons and titles for each of the lesson, he looked for the "go back" button again, and this time it worked, and led him back to the main page.   Subsequently, he went back to the very left column and reviewed the institution block, then the evaluation block, he clicked both of the links on the blocks to see further information, and used the "go back" button on the browser to reach back to the main page.   He then moved to the center column and quickly went through the information in the syllabus, clicked on the link which links to the main syllabus page, he roughly reviewed the page without clicking any hyperlinks and went back to the main page by using the "go back" button.   Afterward, he moved to the requirements blocks, briefly reviewed the description and clicked on the "more" link, which opened a pop up window to display further information, he closed the pop-up and proceeded to the course description block which had the very same behaviors as in the course requirements block.   He then clicked on the next items in the main navigation bar....

The excerpt showed that Yu-Hsuan went into each of the links in the information blocks and tried to figure out either how the information was structured or where the information was in the American interface.   However information architecture was not the only thing he learned from the exploration, he also learned the system behavior(s) by clicking on links, items and going back and forth between the pages/systems.   The exploration in most of the cases might

160

not be able to enhance the actual task performance to a great extent; however, it helped

Taiwanese participants to build a mental image of the system that is able to aid them in mapping

out their actions and avoid ambiguity and disorientation.   In facing a new system/interface,

Taiwanese participants don't overly rely on the prior experiences and knowledge; instead they try

to build a mental image of the system by exploring it.   However, it doesn't mean that Taiwanese

participants don't have expectations and assumptions of how and what a system/interface should

be, instead it means that they tend to avoid the uncertainty and disorientation by spending time in

understanding a system before using it.

For American participants, they utilized diverse means in dealing with a novel system,

however, they tended to apply the prior experiences (acquired from using other systems and

often time assumed to be transferrable) in guiding their actions and modified them accordingly

when they encountered inconsistencies between their mental model and the design throughout

the tasks.   Most of them didn't spend much time on exploring the system; two of American

participants even indicated that they could start the tasks immediately without pre-exploration.

One of the American participants, Joshua started his information-seeking task by briefly

reviewed the about page (the default page) and decided to use the top navigation bar, he said

"*…I'm gonna start (my first task) with (Activities).*" He pointed to the "Activities" in the top

navigation, clicked and it led him to the Activity page: "*Now I have to find, um… Educational

Data… Educational Data ….*" He then clicked on the link in the sub menu and went into the

Educational Data section, and reviewed the page briefly: "*what's the question again?.... I am

looking for... um…*" He then went back to the task description read the information again and

highlighted the section of how many (1) columns, (2) rows and, (3) formulas are required in the

description page.   He then went back to the system interface window, and scrolled down the

screen quickly using the side-scrolling bar to locate the answer. "*Here!*" Joshua said, and highlighted the texts that state the information of "*10 columns, 10 rows and three different formulas.*"

From the think-aloud observation of Joshua, we can see that Joshua utilized a rather instinctive approach in solving the information-seeking task. It seemed that Joshua had a clear plan in finding the answer and had a theory of where the information might be. Those assumptions might function as directors which provided Joshua not only a plan that led/guide him in his information-seeking behavior, but also the predictions of how the system was structured and functioning.

When asked how he solved the first task, another American participants Austin said "*… I started with (Activities the navigation object) (and then) Educational Data (title of the session), because, for the question, that's where, I think, the answer should be.*" Amanda also mentioned that she followed her instinct to find the answer, after reading the question she said "*…we are looking for the Evaluation for Educational Data … the reason I chose 'Evaluation' (on the navigation bar over Sessions), is because it's obvious (the place where I can find the answer.)*" She further implied that her main focus was the navigation items and she relied on the categorical attribution and classification. She said, *"It's kind of an instinct, usually I don't need to go through every detail (of a system),"* when she needs something she just went to the place where she thought she could find it. The strategy that she usually used is to "*choose (the categorical item on the navigation) that is most relevant to (the attribution of the information I need).*" This strategy usually works for her, and it is how she utilized most of the online systems. In addition, when asked how she figured out this strategy, she mentioned, "*I guess (I learned how to do this) just from my (prior) experiences (of using other websites.)*"

Overall, Taiwanese participants relied more on exploring the system in building a mental model of how the system was structured and functioning. However, it doesn't mean that they cannot or do not know how to use a novel system without first exploring it. The exploration not only serves as means in understanding the system, but also is a strategic measure to avoid the uncertainty they might encounter later on when using the system. In comparing with their Taiwanese counterparts, American participants have much stronger opinions in directing their own information-seeking behavior. In addition, American participants overall showed a tendency of applying prior experiences on using systems instead of relying on the pre-exploration of the system as Taiwanese participants did.

1-2: Taiwanese work on functional relationships while Americans work on categories.

Taiwanese participants consider the center of a learning system to be the lesson units, more concretely, Taiwanese participants in this study thought the appropriate way to organize/group the information was by using their functional relationship, i.e., the theme or the unit which they considered to be the individual sessions. When asked to verbalize their strategies of resolving information-seeking tasks, Taiwanese participants tended to interpret the question into the logistic of "Information A is belonging to (or a part) of the theme B." In one of the information-seeking task, participants were asked:

"You are working on the course activity for the Educational Data session, but you forget the exact requirements for that activity. Now you want to find the information of how this particular activity is evaluated in the course website. In order for you to have a full credit on this activity, how many (1) columns, (2) rows and, (3) formulas do you need to include

in your final spreadsheet project?"

Although executed in different ways and paces, all Taiwanese participants considered that assignment requirement/evaluation is a part of a particular lesson, thus, for them lesson is an appropriate place/category to start the information-seeking task with. Hsin-Yee, for example, explained how she planned her information-seeking task: "*(After reading the task description) I thought, since we were looking for the evaluation for the activity (which is a part of the Educational Data lesson), I assumed I should be able to find it (under the session) …. For me, assignment evaluation should be arranged under the activity, so you can easily know what you should do about the (activities) assignments, plus, you don't need to switch back and forth between two different pages."* Some of the Taiwanese participants knew they could access to the assignment evaluation by using either "Sessions" or "Evaluation," (in some cases, even Activities) however they still tended to use Sessions instead of Evaluation because they perceived a session as the fundamental unit in a course and perceived the task as "looking for the assignment evaluation that was subordinate to Educational Data session"

Yu-Husan pointed out that: "*…I think (to look for the assignment evaluation under) both 'Sessions' and 'Evaluation' made sense (for this task) to me, but I chose 'Sessions' because the task specifically asked you to look for the evaluation information for the Educational Data (activity), and for me, Education Data is the main (concept/point) of the task, so that's the reason I chose to start with (Sessions) in the first place … But, I don't know, maybe if you have 'Evaluation' (appears) before 'Sessions' (on the navigation bar) I would choose 'Evaluation' (over Sessions)."*

It's worth to mention, two of the Taiwanese participants found the answer for the task by

using the activities page under the Educational data session.   After going into the Educational

Data session, instead of choosing the evaluation/assessment page, Fay-Jin seemed lost and

reviewed the subordinated pages one by one; Jin-Ye, in another way, chose the activities page

directly, but both of them found the answer in the activities page, which has exactly the same

requirements stated in the evaluation page.   Although with different paths and strategies, both of

them considered the requirements of activity should be subordinate to a lesson.

American participants, by contrast, utilized more diverse measures in solving the task,

however, overall they have the tendency of seeing things with categorical attributes and

perceiving navigation items as the conceptual objects.   American participants, when asked to

verbalize their information-seeking processes, tend to apply the logic of "Information A is a type

of category C" in conceiving of a search plan. For American participants, when asked to conduct

the very same information-seeking task as Taiwanese participants had as aforementioned, most

of them used the navigation object "Evaluation" or "Activities" to look for the information

instead of "Sessions."   For them, to use "Evaluation" or "Activities" (the navigation item) is

more direct and instinctive than going into Sessions and then finding the evaluation rubric.   The

way they perceive the task is "to find the evaluation or activities correspond to Educational

Data" and they put more emphasis on the "Evaluation" or "Activities"—the navigation objects

because they are closer to the attribution of the information (they were asked to find) than

"Session"— the functional unit.   These two objects, for American participants, seemed to be

much more appropriate places to start their search task than "Sessions."   Amanda, for example

considered the task was to find the information about how an activity would be evaluated, so she

reviewed the navigation items, and decided to choose "Evaluation" and then the Educational

Data session to review the evaluation rubric.   Eric had very similar behavior as Amanda, he

explained: "*When I first saw (the question), I thought you were asking me to find the requirements for an activity. But later, when I started (using the website for the task), I saw (the navigation item) Evaluation, so I thought maybe that's what the question asked … What I thought was, you want me to look for, um, (the information of) how the assignment would be (evaluated), so, um… I used Evaluation, because it was the thing you asked for.*"

Eric further explained: "*…(I)n some cases I might use Sessions (instead of Evaluation), and yes, it also makes sense, for (the information of evaluation) … Um, my (first response) to the question was (to use) Evaluation because it's obvious for me, because it's the word you used in the question, but (in a different circumstance)…um, maybe (when I am already in the Session) or something, I would use (the assessment link under session level) because of the convenience instead of evaluation (on the navigation)….*"

Taiwanese and American participants have different tendencies in perceiving and organizing information.   First of all, they interpreted the same information differently, with the same task description (although in different language), Taiwanese participants tend to perceive the task as "to look for the activity evaluation information that was subordinate to Educational Data," while American participants read the task as "to find the evaluation requirement/activity information which correspond to the Educational Data." The perception differences in the information caused participants to use different strategies in solving the task.   Moreover, the cognitive reasoning skills relied in solving the task were also different between these two groups; while Taiwanese participants focus on the functional relationships (theme and/or unit); American participants prefer to work on categorical attributes.   These tendencies, although instinctive in nature; however are more of habitual than constant, meaning, they are tentative and could be changed strategically in accordance with the situational context and/or conditions.

1-3: Information seeking is an integrated process requiring constant strategic adjustments.

Information seeking is an integrated process which includes various actions of planning, reasoning, classifying, linking, reading, comparing, and extracting in the hypermedia environment. When performing an information-seeking task, users are not only applying, but also constantly adjusting their actions in order to achieve their goal. Participants may have different experiences and preferences in the system interface; however, they share several things in common. Although they relied on different cognitive skills, both groups of participants utilized a series of similar actions to solve the tasks. When working on a different interface, all of the participants showed elasticity in adjusting and modifying their strategies/actions in order to manipulate the new environment to conform to their needs and achieve the goal.

In this study, Taiwanese participants were shown the American interface (the one designed not in accordance with their cultural profile) prior to the Taiwanese interface (designed in accordance with their cultural profile). As mentioned in theme 1-1, overall, Taiwanese participants have the tendency to explore the interface/system to build a mental image of it. Through the exploration they learned not only how the information was structured, but also the system behaviors which are able to aid them in mapping out their actions, avoiding uncertainty and resolving ambiguity. However, when asked to conduct the second information-seeking task using the second interface, (because they were told they were very similar systems) most all of Taiwanese participants didn't spend much time on exploring it, instead, they tend to pick up the assumedly appropriate strategies learned from using the first shown (American) interface, and commence with their search.

In the second task, Taiwanese participants were asked:

You are working on the course activity of the e-Portfolio lesson, now you are almost done with it, but you realize you need to upload it to your online portfolio using an FTP application which you haven't installed in your computer yet. In order for you to complete this activity/assignment and meet the due date, what is the name of the FTP application (for the Mac computer) that you need to download and install in your computer? (You don't have to download it, just provide the name of the application.)

Due to the similarity in navigation design, as well as the seemingly familiarity on information organization, it seemed, Taiwanese participants didn't feel the urgent necessity to explore before using, and they were able to access to the e-Portfolio session by using the Session object in the navigation without encountering any difficulties.   Furthermore, after going in to the e-Portfolio session, they were able to switch their mental image from information block design to the menu list design, and quickly adapted and directed their attention on the sub-menu list on the left side of the main information Div.   However, by reading the task description alone, most of them couldn't be certain about where the information would be.   They pondered what would be the appropriate sub-category for the information, for most of them, the measure they took was to switch back to the "scan and explore" strategy to review the subordinate pages under the e-Portfolio session in order to find the answer.

Some participants, however, have clear idea than the others, Chiang-Chi stated *"I think it's probably under Activities or Resources, but Instruction is also a possibility you cannot rule out."*   He started his search from Activities page, and after reviewing the content, he soon decided to switch to the Resources page, and found his answer in it.   Fey-Jin, in another way,

seemed lost in the middle of the task, she had no problem in selecting Session in the navigation, but after going into the e-Portfolio session, she started switching back and forth between the task description window and the system interface window.   Fey-Jin said, "*I really have no idea where I could find this information; I know it should be somewhere around here (in the e-Portfolio session), but the question is a little bit confusing to me.*"   After being provided some subtle directions, she said, "*I think I will just read (the subordinate piages) one by one till I find it.*"   Nevertheless, she still found the correct answer for the task.

The American group followed a very similar procedure as the Taiwanese group; the only difference, however, was the sequence in which the interfaces were shown.   For American participants they were first asked to use the Taiwanese interface to solve the first information-seeking task.   After that, they were shown the second interface— the American Interface.   American participants were asked to use the American interface to solve the same information-seeking task mentioned prior.   Overall they had very similar information-seeking behaviors as they had in solving the first task—they relied on prior experiences and most importantly, categorical information to find their answer.   American participants, compared to Taiwanese participants, showed more diverse ways in finding the information.

Austin, Joshua, Courtney and Alex had very similar thought; they believed that there should be information under the Activities that indicated what application should be used in completing the activity.   However, when they found there was no "Activities" in the navigation, they switched their strategy (to accommodate to the changed situation).   Austin, Eric and Courtney turned their attention to the navigation object "Resources;" their rationale was, as Joshua put it, "*it is the next possible*" category to find the information.   Joshua said: "*First, I think I could find my answer in Activities… like (what I did) in the first (task)… because I thought you asked for an app for the*

activity, but (after finding there is no activities in the navigation in the American design) I think

maybe Resources… apps are some kind of resource, so I assumed maybe I could find it (in

Resources)…. (After going into the Resources page in American interface) First, I was looking

for the (sub-menu of the sessions), but there wasn't… (the measure I took was) I just tried to find

it the old-fashioned way (by going through the page and blocks) and I found my answer

(Cyberduck for Mac FTP in the e-Portfolio section)."

Alex had the very same reaction after finding out there was no "Activities" in the navigation, although, like Austin, Joshua and Courtney, she sought for the next possibility. However the choice she made was to use "Sessions" instead of "Resources" to commence with her searching task: "*My first thought was, it should be in the Activities, since (the term activity) appeared in your question quite often… but there was no "Activites" there, so I guess I have to go with (a different category)…. I don't think Resources and Evaluation are (possible categories) for this question… I chose Sessions because, I think I could probably find (all of the information of the session) there…. Um, if I couldn't (find it) I'd probably just give up… I don't know I guess I could try every link there till I find it.*"

Eric and Amanda used the "categorical attribution" they perceived from the task description as well, however, instead of using "Activities" as Eric, Courtney and Alex conceptualized, they decided to start their search with "Resources."   They both considered the information-seeking task as "to find and download the FTP application which can help you to finish the activity," and perceived an application as a resource that could be downloaded either from the course website or an external server.

A phenomenon worth mentioning is after getting familiar with the first shown interface,

even with the conflict between preferences and design features, participants still tended to be led by the design of the first shown interface and used the mental image built from the first interface to guide their initial actions in using the second interface; however after encountering the inconsistencies, participants were able to detect the differences and picked up different strategies to solve the task and achieve the goal.   In addition, with primacy effect taken into account, the results of the PSSUQ survey showed participants overall have the tendency of preferring the interface that was developed in accordance with their cultural profile than the one that was not.

Summary

Taiwanese and American participants have different tendencies in perceiving and classifying information, and consequently, these differences caused them to rely on different cognitive tools, as well as strategies in dealing with interface navigation.   The execution of the information-seeking tasks was driven or at least influenced by information seekers' perceptions of the system and also constrained by their prior technical background—experiences with similar systems and the structure of the human information processing system (Norman, 2014).   In addition, the execution is modified during the interaction between the information seekers and the system. Since participants are different in preferred cognitive tools, experiences, perceptions and expectations on the interfaces, the ways the tasks were executed were therefore varied.   In using the two interfaces provided, participants overall showed the tendency of preferring the interface that was designed/developed in accordance with their cultural profile than the one was not.   However, both groups of participants were able to solve the tasks using both interfaces with some strategic adjustments and modifications.   This indicated that participants not only reacted to the interface, but also mentally refigured the environment to be congruent with their

preferred operating strategies and vice versa.

Theme 2: People from different cultures have different perceptions on design features.

In this study, the measure we took to simplify the representation issue was to separate the external presentation from the internal structure, meaning, what users see and manipulate in the interface is different from the way information is organized in the host server.   The respective two interfaces were constructed based on the suggestions proposed by previous studies.   These suggestions were derived from theories, filed observations and/or statistical analyses, although they all sought for improving the usability of the interface.   However, these studies pointed rather divergent directions for the respective cultural groups.   With these design differences presented, American and Taiwanese participants had different experiences and perception of these two interfaces.   These two groups of participants overall showed different preferences in the design of navigation, the structure of information organization, and the usage of presentational components.   Generally speaking, in this study, American participants favored an information structure design that was categorically based with (more) graphical presentation. Taiwanese participants, by contrast, preferred a deeper informational structure based on themes and/or function units and presented in a more textual format.

2.1: Different perceptions in information organization.

Organization system refers to how information is categorized and organized.   Although the Taiwanese system utilized a similar organizational design as the American system did, however, it implemented a different model from the American one.   For example, in the "About" section, the American design presented all the related information by using information

blocks all at once, whereas, the Taiwanese interface used a menu list to not only organize the information into corresponding sub-categories/pages but also imposed priority to each of the sub-category through the hierarch of the list.   Each participant was asked to review and compare the Taiwanese and the American system, and subsequently pick up to three adjectives for each of the system from the Microsoft Product Response Cards, which included 118 adjectives in measuring desirability in the lab setting.   From the interview data, Taiwanese and American participants had very different perceptions/experiences in these two interfaces.   The following is an excerpt from the observation transcription of how the process was conducted:

(When asked to compare the American and the Taiwanese designs), Mei-Lin first looked at the Taiwanese one.   As soon as she started her browsing, she moved the cursor to the sub-menu in the left side of the main information Div, which occupied approximately one sixth of the Div.   She clicked on each of the items on the sub-menu and saw the corresponding information shown in the right side of the main information Div.   Subsequently, she switched to the American system; in reviewing the American system, she first stared at the slide show for a while, then started her browsing.   She started her cursor from the Session block, then moved to the Instructor block, and subsequently the Evaluation, Requirement, and the Description block. She clicked on the "more information" links on most of the blocks to see the further information of each section.   Although the links responded in a different manner—some led to another tab, some opened a new page in the existing window, while some open a pop-up information box on top of the browser window—she found her way back to the system.   After she finished reviewing both designs, the Microsoft Product Response Cards were shown to her, and she was encouraged to choose up to three terms for each design in describing her feelings/perceptions toward the design.

From the Product Response Card, it is clear that Taiwanese participants felt more comfortable in using the Taiwanese design because the information had been organized in accordance with their preferences, as well as use habits.   With identical information but sorted by using a list and adding one extra level, they feel the submenu provided a structural aid for them to process the information and helped them to locate the needed information faster and more easily.   Overall, Taiwanese participants had more positive feeling (higher desirability) toward the Taiwanese design; the most frequent picked term for describing the information organization in the Taiwanese design was "easy to use."   When asked to elucidate why they chose such an adjective, Mei-Lin explained the reason she thought the Taiwanese design was "easy to use" was because "*you don't need to think too much, all you need to do is to follow the list (submenu) and go through the information.)… I think to have (a submenu) there really makes it easier for me (to use the system)… for example, I always know where I can look for (the information I need), I can just click on the (submenu item) to access the information I need.*"

Hsin-Yee had very a similar opinion to Mei-Lin's, she thought the Taiwanese design was easy to use, because the information was organized, categorized and presented "*in the right place.*"   Compared to the American design, Hsin-Yee felt the Taiwanese design was "*much easier (to use) in information seeking tasks, I have less trouble using (the Taiwanese design)… because the content is clearer and more organized.*"   She appreciated the organization of the information in the Taiwanese design and stated, "*(The Taiwanese design) works better for me, I usually have trouble finding (information) on a website (that is less organized), but I felt I was doing OK in (the Taiwanese design). And I like the way they used the (submenu) in (the content area. Having a (submenu) is like (the designer) telling you what information you need to pay attention to and how the website is organized, or at least it works like a check list, which reminds*

you what are the important things you need to know."

Chiang-Chi thought the American design was visually appealing, because of the visual components and the way information was presented; however, he would still prefer the Taiwanese than the American design in the aspect of information organization. Chiang-Chi mentioned, "*For me, (the Taiwanese design) is more practical, (in the perspective of designing courseware); personally, I want (the courseware) to be more efficient and right to the point… because I am not doing it for fun, so I don't want to spend a lot of time on it, I like (the Taiwanese design) better because it is very direct, I mean, using a list is easier for me to comprehend, it's like you have been told what to look for, and all you need to do is to follow (the list).*"

By contrast, for the American design, although some Taiwanese participants found it to be visually attractive and innovative, overall it was mostly associated with more negative adjectives (lower desirability)m such as "overwhelming" in the aspect of information organization.   In using the American design, Taiwanese participants felt distracted because without further organization, there was too much information presented and dispersed on one page. Jin-Ye, for example thought the American design was overwhelming, because of the number of the information blocks, she felt she was "*lost, and didn't know where to start.*" Mei-Lin had very similar feedback; she felt that American design (of the About page) "*includes too many components, it makes me feel anxious, I don't think you need to have that many things in just one page.*" She added that "*it seems to include a lot of information, but somehow it doesn't have a focus, don't you think?... I just felt (the information is) all over the place. I have to go through (each of the information blocks) and figure out what I can do with them.*"   Yu-Hsuan agreed with Mei-Lin, and he thought the American design needed some structural re-organization.   He said, "*I don't think you need that much information in the (about) page, a lot*

of the information (categories) is overlapping (with the navigation), and doesn't need to be presented here." He further suggested, *"It seems there were a lot of things going on, but yet, when you take a closer look, there wasn't much detailed information. You need to further click on the links to open another page for that, which for me is less effective than using (the navigation items in) the (submenu)."* He thought instead of including all the information in this page, it would be better if they *"keep only the absolutely necessary (information for the page) and get rid of the others."* And more importantly, *"including more detailed information instead of keeping referring to other (pages)."*

The American participants were also asked to review and compare these two designs as well. However, they have quite different opinions from their Taiwanese counterparts regarding these two different designs. Unlike Taiwanese participants, although American participants tend to favor the American design, they have relatively neutral feelings toward the Taiwanese design. When asked to pick three terms from the Microsoft Product Response Cards to describe their feelings/perceptions toward the Taiwanese design, the most chosen terms were "clean" and "organized," which for the American participants in this study, represented a rather similar idea. They felt the Taiwanese design was "clean" not only because it was visually "simplistic," but also they felt the use of a menu "compressed" the information into one simple list which is not a bad way for organizing information, but it consequently leaves a lot of blank space on the page, which for the American participants was not necessary a good design. American participants didn't feel the benefit of the submenu as their Taiwanese counterparts did. It didn't provide the assistance to them that it did for the Taiwanese participants in perceiving the information. For American participants it was just another way for presenting information, but not necessary an ideal or better way than the information blocks. Eric, for example didn't feel the submenu was

necessary.   He preferred the American information block design to the Taiwanese submenu design.   However, he felt that "*(the Taiwanese design) is OK, it looks nice… The menu, uh, I don't really like menu… yeah, it can be helpful (in helping finding the information) if you have (a lot of information needs to be further organized).*"   Alex had similar feelings to Eric; she felt that she "*had no problem in using either of them;*" however, she thought the Taiwanese design gave her the feeling of using courseware, she said, "*I kinda like that (the information in the Taiwanese design) is organized, but somehow, probably because the way it looks… it felt like that I was using (the courseware); I don't know, it just reminds me of (the courseware)…. (the resemblance) is not a good thing, on account that I don't really have very positive experience with (that courseware).* "   Joshua and Amanda, both had no problem in using the Taiwanese design, however they had the feeling that the use of a submenu somehow "hid" the information from the users.   They felt the way they have to "click to see" the information was not a direct and transparent way to present the information, Joshua thought the partition of information is good, but instead of organizing the information into subordinate pages like the Taiwanese design did, he preferred the transparency of the American design, which presented the information all at once.

Overall American participants felt the use of the information blocks to present all the related information at once was not only convenient for them to perceive and outline the information (of the whole system) but also made the information transparent and visually evident.   American participants preferred the less-structured organization and they didn't felt overwhelmed by the numbers of components, as well as information like most of their Taiwanese counterparts did.   Although they have various choices of terms, however, American participants overall perceived the design as "clear" and "convenient."   Joshua, for example, felt the

American design was quite clear and easy to comprehend.   He thought the way the American design presented the information made it very easy for him to conceptualize the organization of information.   He added, "*it has (all the information), and it is clear to me, I have the idea of what (is the information) I need to know (for this course), and if I need to, I can dig deeper (by clicking on the 'more' links)… that's (why I think it's) convenient.*"

Austin, also felt the American design was convenient.   First because it utilized a flatter information structure, he felt he preferred to see all the information presented simultaneously and to have all the options in sight.   He also felt that the American design was more flexible than the Taiwanese design in the way that it provided the essential information, but without mentioning too much detail; however, if he needed more detailed information, he could look for it by going into the related link(s).

2.2: Different perceptions in navigation design

A very similar navigation design was used in both the American and the Taiwanese systems.   However, an extra item, "Activities," was added in one of the designs, and was intended to provide a clear conceptual framework to users.   As mentioned in theme one, Taiwanese and American participants had different tendencies in perceiving and classifying information.   In this study, Taiwanese participants showed the tendencies of relying on a thematic structure, while American participants overall showed the tendencies of using categorical information.   These differences reflected not only how the information seeking tasks were executed, but also perceptions toward the navigation design of these two groups.

For American participants, they preferred the navigation design with one extra item better

because the extra item "Activities," was not only of service to the search tasks, but also was able to better present the conceptual/categorical framework of the system. Austin, for example, thought with one extra item, the navigation "*comes in handy,*" because in that way "*you have a clear idea of where you can go (to find the information using the navigation). For me more options is usually better than less.*" Courtney felt that she preferred a navigation that was able to represent the conceptual framework (of a system). For her, the navigation design with one extra item was better because "*it really helped me cutting down the time clicking on links.*" In addition, she further suggested, a drop-down menu might be a good idea in this context, and the navigation could be arranged in an action-oriented manner. Joshua had very similar responses to Austin's, and like Courtney, he also indicated that he preferred the way that the design was task/action oriented. He said, "*I think it's better because it showed (all the categories) you need (on the navigation) which made (information seeking tasks) easier… I don't know I think maybe because it's more straightforward?... For example, in the question, you can just use (the appropriate categorical information in accordance to the information attribution perceived from the tasks) instead of looking for alternatives.*"

Taiwanese participants, by contrast, didn't benefit from having the extra item on the navigation, because they relied their information searching more on the perceived hierarchical structure, which in most of the cases was the individual Sessions. Thus it's not surprising that some of them didn't even realize that there was an item difference in these two navigation designs. Hsin-Yee for one, didn't notice the difference until she was told. She said "*I started both my tasks from Sessions, so I didn't even notice there was one (navigation item) short (in The Taiwanese navigation).*" Jin-Ye overlooked the difference for the very same reason as Hsin-Yee, because the extra item, "Activities," was not the place where she would start the

information-seeking tasks.   When asked a hypothetical question of how she would use the Taiwanese system in a learning context, she answered, "*... I think most of time when I need to find some information, I would look for it in the particular Session... because, for example, if you want to find the evaluation standard for an assignment (in a particular session), a sensible place for me to look it up is in that particular session.*" She further explained, "*I think I am accustomed to this (thinking), (because) just like using a textbook or some other (instructional) materials you always look (for the corresponding information) in the individual unit.*"   When asked how she would use the system, Mei-Lin said, she would also "*mainly focus on the sessions.*"   She further suggested, "*...in this case there are only five Sessions, so I think you can probably use the names of sessions (as items) on the navigation. I think it's sensible, and I think somehow it would make (the structure of website) clearer to the users (in the sense of what composes the course).*" As for some of the items on the navigation, such as resources, activities and evaluation, Mei-Lin thought, "*they can go under the sessions (because it is) where they belong, as a part of a lesson.*" For the interview data, it seemed, for Taiwanese participants a sensible navigation design in this setting and context would plan the navigation in a thematic structure which emphasizes and partitions the content by sessions.   In addition, the subordinated content—the respective content pages of activities, resources, as well as the evaluation—should be organized under their theme, the sessions.

2.3 Different perceptions in presentational design

American and Taiwanese participants showed diverse tastes on the presentational design features, in addition, both groups favored the presentation designed to accommodate their cultural preferences.   There are several reasons/design features that caused participants to favor

one presentational design over another.   The following section discusses the design features that caused the different perceptions of different groups of users.

2.3.1 Blank space

To begin with, American participants have different opinions on the use of blank space on the pages compared to their Taiwanese counterparts.   The interview data indicated that American participants preferred less blank space in the layout (as well as on the screen). Overall, they felt the Taiwanese design gave them the feeling that the pages were unfinished and the space hasn't been fully utilized.   They expressed the desire of a more condensed design, with more focal points, more textual content and/or images presented.   Amanda, for one thought the blank space in the Taiwanese design compared to the American design was too much.   She preferred the American design because from the perspective of blank space usage, Amanda said, *"[The American design] looks better… I like [the way] it has more [components] on the page, and [the Taiwanese design], I don't know, [the page] looks clean and organized, but somehow, I just feel it's kinda empty, I mean, It's not bad for the most part, but for some [pages], I just think it's a little bit… um, boring… it's a little bit dull I guess, and there is a lot of [empty space in the Taiwanese design]."*   She further stated, *"[It might be helpful to have] some more images [in the Taiwanese design to help it looks better], I don't know, but I do like that it has less [information on one page], which makes reading [the content on] the page easier. I mean it doesn't look bad, but just not, not for me."*

Eric preferred more colors and/or images on the page presentation, in addition, he felt compared to the American design, the Taiwanese design was a little bit too "simplistic" for his taste due to the reasons that less components and more white space were utilized on the pages.

He said, "*It seems to me [the ratio of content information and the page space] is a little off [in the Taiwanese design], I prefer [the American design] … because, [the About page of the American design] looks far more exciting, visually… I mean it's colorful, and has more [components] going on …. [The Taiwanese design] looks way too formal, and it has too [much empty space] … um, it [makes the page] looks simple, which I think is not a bad thing, but I just felt [the information presentation] could use a little boost, and I'd prefer [to see] more colors and maybe pictures [on the page presentation].*"

Austin and Courtney both mentioned that they felt both designs had their merits.   For the aspect of blank leaving they felt that in the Taiwanese design the page look empty in some cases. From the aesthetic point of view, they preferred a page with more colors and components, however, overall they had no problems with the design incorporating more white space in the layout presentation.   As Austin mentioned, "*It's just a different (presentation design), although, I have to admit it's not my favorite, but I don't see any problem (with this design).*"   Like Amanda and Eric, Austin and Courtney also preferred the American design in the way it utilized more components, and they had a preference for visual components, in the presentation design which left less unused space on the page.

An interesting phenomenon worth mentioning is, when asked about their opinions on the blank space used in the information block, American participants overall did not think of the blank space inside of the block as unused space.   They perceived the blocks used in the American design as visual/pictorial components.   Since they considered blocks as image items, they did not consider the blank space utilized in the block as the "empty space."   Instead, as a part of the image.   Austin, Joshua, Amanda and Alex all expressed this view about the information, however, they express the desire to have the pictorial materials used in the

information block increased to a larger size.

The Taiwanese group, by contrast, did not have a unified preference on the blank leaving. Although overall they preferred the Taiwanese design over the American one, they did not feel the blank leaving, which may be a "cultural" feature, was indispensable in the design. Although, some of them felt it was nice to incorporate blank leaving in the design, and thought it made the pages look neat.   However others simply had no opinion on the use of blank space. when asked to compare the usage of blank space in both systems, they felt they could not really tell which design, in the perspective of blank space usage, was better.   Jin-Ye and Hsin-Yee felt that the blank leaving component was a good design feature because it made the pages look clean and neat.   In addition, they thought the usage of white space made reading the content a more pleasant experience, in the sense that visually the ratio of white space and content was arranged in a way that improved the ease of information digestion.

Other Taiwanese participants, however, did not have opinions about the usage of blank leaving.   When asked about their opinions on the blank space on both design, Both Yu-Hsuan and Fey-Jin implied they do not know which one they preferred more Fey-Jin even indicated, "*I don't know, I actually have no sense of the differences, they both look pretty similar for me.*" Chiang-Chi indicated that he had mixed feelings on the utilization of white space in both designs, he said, "*in some circumstances, I do like the way the white space is used (in the Taiwanese design), but others, I don't. And the same thing applies to [the American design] as well.*"   He further indicated, "*I think sometimes, [the Taiwanese design] looks too empty, I do like the way the text is easier to read, but it seems to me, sometimes [the page] looks so empty [in the of sense the blank space/content ratio].*"   Mei-Lin also felt that in some situations, some blank space needs to be downsized a little bit in the Taiwanese design because it made the page seem a little

bit void which gave her the impression that there was inefficiency in information presentation.

2.3.2 Leading, tracking, and alignment

Participants' perceptions on the blank leaving were somehow also reflected on their preferences of typography, particularly on the aspects of leading (line spacing), tracking (letter spacing) and alignment.   In Taiwanese design, due to the properties of Chinese character writing, extra spacing was needed between characters and lines to enhance the readability of the text.   By using the same Cascade Style Sheet, the same leading and tracking were also applied to the English version of the Taiwanese design (TE).   Although, the extra leading and tracking space, for most of the American participants, did not affect much of the readability of the English text.   However, two of the American participants expressed their concern about the extra space caused by tracking, mostly they felt the extra tracking space was, in some cases, distracting. Alex indicated that the extra spacing made the information presentation look loose, she suggested, "*I think (the tracking spacing in the American design) is about right, and (the tracking spacing in the Taiwanese design) is a little bit too much. (The tracking spacing in the Taiwanese design) is almost twice [as wide] as (the American design), I prefer (the text presentation in the American design), it looks [more] ... um, in place, but I don't think I have too much of a problem with (the leading spacing in the Taiwanese design), it's still readable.*" Joshua also indicated the tracking space in the Taiwanese was too much for his taste.   He preferred a more condensed presentation, he said, "*(the tracking space in the Taiwanese design) is a little bit off to me, (the spacing) makes (the information presentation) looks a little bit too loose, it look like it's been stretched out (horizontally), just my opinion.*"   Although American participants had different opinions about the tracking spacing, however, they all preferred the extra leading space in the Taiwanese design; overall there was a consensus that wider line

184

spacing made reading the content easier.

The extra leading and tracking spacing is necessary for the Chinese content.   The Taiwanese participants had a unanimous agreement on the issue of the leading and tracking spacing.   In the aspect of leading and tracking spacing they preferred the Taiwanese design which rendered the Chinese text more readable.   The main complaint by the Taiwanese participants on the American design in the aspect of typographic style was the lack of adequate leading and tracking spacing which rendered the presentation of textual materials too crowded and made it difficult and even stressful to read the Chinese content.

On the issue of text alignment, American participants preferred the English text to be left aligned rather than justified.   Unlike the features of the printing press, where one could manually adjust the tracking spacing and have a sensible way of conducting word-breaks to make the presentation functional, as well as visually pleasant, in the World Wide Web environment, when alignment is set to be justified, the browser(s) automatically adjust and present the tracking spacing in accordance with the line width where the text is presented, the tracking space thus is different from time to time and in some cases renders the textual material in a less than ideal way.   Because of the rendering issue, American participants indicated that when the English text was justified the uneven spacing between words in each line made it sometimes awkward to read the content.   Eric, for example, felt that he preferred the left aligned more because, when it was justified the different spacing made him felt that as if he need to "*adjust the [reading] speed*" in order to accustom to the different density of word presentation. Amanda had similar comments, she said, "*[in the instruction page under the information search session in the Taiwanese design], you see, in this line it has… nine [words], and [the next much longer line] also has nine [words]. There is too much space [between words] in this line. When I*

read this part, I almost felt I was slowed down by [the very long tracking spacing]."

The American participants overall favored a universal spacing between words; they felt that a fixed spacing made reading English text easier, and in addition enhanced the visual presentation of English text. Austin suggested that although he preferred the extra leading spacing in the Taiwanese design, however, in the aspect of tracking spacing, he preferred the American design which utilized the universal spacing. He said, "*I prefer [the tracking spacing of the American design] ... [the tracking spacing in the Taiwanese design] looks a little bit too much for me... I don't like that it has different [tracking spacing] in every line. [The tracking spacing in the American design] looks better, I prefer the equal [tracking spacing] ....*" Courtney and Alex also preferred the equal tracking spacing of the American design, they felt the different tracking in the Taiwanese design, in some cases, made the textual presentation look awkward. Alex said, "*I guess it looks OK most of time, but right here, you see this [line] ... [the tracking spacing between the words in this line] is too different in contrast to the previous and the next line. It just look weird.*"

Text alignment for Chinese writing is complicated but yet is no longer a problem in Web site design. Traditionally, Chinese writing implements a vertical and right-to-left system, which makes it's almost impossible to be rendered correctly in most of the Internet web browsers. Although W3C has been working on revisions writing mode property and provides vertical layout and text display, however, most of the modern Chinese websites adopt the Westernize system of horizontal left-to-right system in order to make the Chinese writing works on every browser. That is to say, alignment is no longer an issue for Chinese writing in World Wide Web environment anymore. In addition, because the nature of the character writing, in the web environment, every character and punctuation mark occupies equal space, which means there

would be no un-used space on the end of the line in left-aligned style, and both left-aligned and justified style would look identical on Chinese websites.   Due to the aforementioned reason, all of the Taiwanese participants could not detect the differences on the alignments, thus they did not have opinion on these two different alignment styles.

2.3.3 Page layout

Two different page layout designs were used in this study.   A "local-audit" approach was used in determining the overall appearances of the systems; during the design phase, popular websites of respective countries were audited and different design directions were set up for the respective designs.   For the American design, a relatively modern and sleek direction was set and the overall visage of the American system was borrowed from a top 3C manufacturer website which is considered to be very popular among the college student populations in the United States.   As for the Taiwanese design, a more traditional, academic/formal direction was chosen, the overall look mimicked the predominant school website design style used in most of the Taiwanese universities.   In addition, based on the suggestions/results of previous researches, for the American design, an information block layout was utilized which implemented the image-like blocks to represent the objects/items in the system.   Whereas in the Taiwanese design, a more textual oriented approach was adopted; although pictures and images were still used aplenty in the design, the functional features such as navigation and (sub) menus were mostly presented in a textual form.

Although for different reasons, overall, participants from respective countries showed preferences on the design that was concocted for the respective group preferences.   The Taiwanese design was implemented a predominant design patterns/styles in most Taiwanese

university websites, which used a top banner with navigation, two columns (left menu and right content) in content presentation and a footer section for copyright and contact information, aimed at producing a feeling of familiarity that could hopefully result in the easiness of using the interface.   Although there is no evidence of a directive/causative relation between feeling of familiarity and the fluency in performance; however, the familiarity (to the interface layout) did increased the overall perceived usefulness of the Taiwanese participants to the system.   Fey-Jin for example thought that the familiarity of the design provided the comfortability to her in using the Taiwanese interface, she explained: "*I like how this [design] look, it look very familiar to me, probably because the overall appearance the [banner] picture on the top, [sub-menu] parallel with content on the middle, look very similar to [the courseware we used in school], I somehow feel relieved…um because I think I don't need to fumble about and learn how to use it*" When asked why she thought the submenu made the system easier to use, Fey-Jin further explained, "*[the submenu] on the left gave you the overall idea [of how the information is structured] and showed what is important [in this particular section], the way it uses a menu makes [the information and the page] more organized [than the American design], and also I think it's easier for me because the way they [organize] the [page], [to parallel the submenu with the content] makes browsing for information easier, in addition, [use of the submenu] is rather instinctive to me.*"

Although they considered the American Design was visually appealing, however, overall Hsin-Ye and Chiang-Chi still favored the Taiwanese design over the American one.   Like Fey-Jin, they considered the academic/formal design style adopted in the Taiwanese design (which is the predominant pattern for school website in Taiwan) made it look friendlier in the way that the interface looks and feels similar to the courseware system they have been using for years.

Hsin-Ye considered that when using the Taiwanese design it required less process of thinking compared to the American design, She indicated, "*it's easier to deal with [the Taiwanese design] because it's similar to [other systems] that I have experienced.*"   Chiang-Chi thought the very same way, however he had an even more practical reason of favoring the Taiwanese design, and he indicated that, "*(P)ersonally, I want [the courseware] to be more efficient and right to the point, [the Taiwanese design] looks very similar to [the courseware] we have in the school, I felt like I already know how to work it and mostly, I think the design and arrangement [of the system and information] are sensible for me, so I don't' need to spend extra time learning it; because I am not doing it for fun, so I don't want to spend a lot of time on it….*"

Jin-Ye, Mei-Lin and Yu-Hsuan favored the Taiwanese design not only because the feeling of familiarity, but also the simplicity in layout presentation.   They generally thought the layout presentation in the American design was "too much" and "overwhelming;" they preferred the Taiwanese layout design because it looked simple, clean and efficient.   Mei-Lin showed her desire of a simple design, she thought the American design made her anxious because of the number of the information blocks used in the About page.   Jin-Ye had the very same comment to Mei-Lin's, she thought that the excessive number of blocks made her "*lost, and didn't know where to start.*"   Yu-Hsuan expressed the desire of keeping the layout presentation simple, he thought instead of including all the information blocks in the About page, it would be better to "*keep only the absolutely necessary thing(s) and get rid of the others.*"   He preferred the Taiwanese design, in particular the parallel presentation of submenu and the content, because "*[the design] keeps (the information presentation of) the page simple and clean. Also, the [fixed position of the] (submenu) really helps, you don't have to consistently jump around (the pages) for the information.*"

In addition to the feeling of familiarity, another reason that caused the Taiwanese participants to favor the Taiwanese design over the American one was that the Taiwanese design utilized a more consistent layout presentation throughout the system, which helped the Taiwanese participants not only on locating the information but also focusing on the information seeking tasks. The American design, compared to the Taiwanese one, utilized more diversified page templates, as well as presentation methods on the system, for Taiwanese participants, the diversified presentations was distracting and hindering the process of information seeking. Overall, Taiwanese participants considered the different layout presentation in different levels of the American system diverted their attention from the tasks, and consequently they had to pay extra energy and attention on locating the menu/sub-navigation and/or information blocks that corresponded to the information needed each time the page layout was changed.

Jin-Ye, Mei-Lin, Fey-Jin and Yu-Hsuan all thought the change of layout presentation in the American design affected their performance in the information seeking tasks. Jin-Ye, for example, thought that she needed to stop to look for the corresponding item(s) because the position/location of the menu/information blocks was changing all the time, which interrupted the overall flow of and her performance on the information seeking tasks. Hsin-Yee and Chiang-Chi although appreciated the diversity of layout presentations in the American design, however, they still benefited from the consistency of presentation in the Taiwanese layout design. Although there were different opinions on the naming scheme, as well as the priority of listing, overall, Taiwanese participants indicated that the fix-positioned submenu in the Taiwanese design helped them to focus on the task and locate the appropriate information throughout the task.

As for the American group, the participants had quite different opinions in the layout

presentation from the Taiwanese group.   Overall, American participants favored the American design over the Taiwanese one, firstly because the information block design was more pictorial than the menu list design.   As aforementioned, overall American participants expressed the favor of a website that contains more visuals and colors, and the American design more or less fulfilled their expectation on a more pictorial-oriented design.   Joshua, for example suggested that the American design, compared to the Taiwanese design was more "visual."   He appreciated the use of information blocks, which for him were an analogy to the pictorial materials, Joshua mentioned, "*I like [the American design], I like the way it uses the little images [information blocks] and icons [to represent different concepts and ideas], it's not only looks good, but also easier for me [to process the information], I think I am more of a visual guy.*"   Austin, and Courtney thought the layout presentation in Taiwanese design looked OK, however, they still preferred the American design in the way that it utilized more visual components in the presentation design and left less unused space on the page.

Amanda and Courtney, although didn't mention their preferences on information processing, however, had the similar preference as Joshua.   They both thought that the more pictorial-oriented presentation of the American design not only made the website look more appealing, but also was easier for them to operate.   Eric thought the layout presentation of the American design could probably attract younger generation than the Taiwanese design.   He indicated, "*[The layout of the Taiwanese design] look a little bit outdated for me, But it looks O.K., just I prefer more colors and images in a system, I would say it is [a] safe [design], but in my opinion, not the best design*"   As for Amanda, she didn't appreciate the formal/academic feeling of the layout presentation in the Taiwanese design, she indicated that the Taiwanese design was not very interesting in both the layout presentation and the color selection, in

addition, she said, "*something's missing*" in the design, although she couldn't identify exactly what was missing. Alex also thought that the layout presentation in Taiwanese design looked academic. She thought the Taiwanese layout which paralleled the submenu to the content was a good way to organize and present information; however, personally she cannot appreciate the academic feeling of the Taiwanese design. Although she understood the interface was intended to be used as an online learning system, visually she still thought that the American design caught her eyes and was more appealing than the Taiwanese one.

Visually, American participants appreciated the versatile layout presentations of the American design on account of more page templates/styles were utilized in different levels and sections than the Taiwanese design. Some of the American participants might appreciate the fixed/repeated layout presentation utilized in the Taiwanese design, however, it seemed they didn't think the change of layout presentations cause them critical problems in processing the content and conducting the information seeking tasks.

2.4 Different perceptions in pictorial materials

Two sets of pictorial materials were developed according to the respective suggested design direction for each cultural group, which included icons, illustration, as well as pictures. In addition, different styles that control the presentation of image size, arrangement, and placement were utilized in these two systems in order to not only differentiate the designs, but also accommodate different preferences of respective groups. It was assumed that people would favor the pictorial materials developed specifically for their preferences. This assumption was true for the Taiwanese group; however, was partially true for the American group.

Overall, the American participants preferred the set of American pictorial materials. They indicated that the Taiwanese pictorial materials, in particular the images used in the instruction section of the session, which implemented Chinese characters, as well as Asian figures, were not very relatable for them. Austin, for one, thought that the use of the Chinese writing in the pictures was confusing; because he doesn't understand Chinese, he implied "it look odd" when he reviewed the Taiwanese pictorial materials, he indicated that he would rather to have "neutral" images which used less "cultural specific" features and symbols. He said, "*I don't really like [the pictorial materials] in [the American system], but compared to [the Taiwanese ones] I do think they are more relevant, to me…. Although I don't have any problems in understanding the content without these pictures, but when you use Chinese in the pictures… um when they mix with (the English content) it feels awkward and confusing in a way.*"

Eric, Joshua and Alex also indicated that it was strange to have pictures with Chinese text in an English content website, in addition, they had the feeling that the pictures were developed for a different purpose. They indicated that since English was the default language of the system, images used in it should follow the language as well. Alex, for one thought the use of Chinese characters and Asian figures, was very strange and she couldn't help to think that it was a mistake and those images should be replaced. She said, "*I just had a feeling that [those images] were borrowed from [a Chinese version of the system], just for some reasons they have to used them here. [The American design pictures] look much more relevant to me. There's nothing wrong with [the Taiwanese set of images], some of the pictures [of the Taiwanese design] actually look fine, but probably because I don't understand Chinese, I cannot understand [some of the pictures] …well, I can probably guess if I need to, but what's the point of using [supplementary] pictures that people can't understand?… I do like the larger size [in the*

193

Taiwanese design] though."

In addition, some of the American participants implied that although in some cases, the use of text might be helpful in delivering the idea, in most cases it was gratuitous. Austin mentioned "*Even in [the case of internationalization], I would still say it's better to have images without [cultural symbols], plus, I don't think it's necessary to include text in the pictures, there are lots ways to deliver the idea [effectively] without [using] text [presented in them].*" Amanda also indicated the same way, she said, "*I don't find the text [in the images to be] helpful. I don't understand Chinese, so I couldn't speak for [the Taiwanese], but [the ones in the American design], they just repeat the information in the text, which for me, it's not that helpful. They are just embellishments, and if you ask me, they are not even that good…. I need to read the text anyway.*" She further mentioned, in some of the images the text was not readable, which made her wondered what the purpose of having the text in the image was. She said, "*if [the texts] weren't meant to be read, then why you put texts in them?*" Courtney didn't have problem of having text in the pictures, however she agreed with Amanda's comment on the use of text in the American design. She thought the text needed to be readable and in addition, text should only be used when it is an indispensable component in the picture composition.

Although overall they favored the American set of pictorial materials, Joshua, Eric and Courtney, expressed the preference toward the set of icons in the Taiwanese design. They did have opinions/comments on the representativeness of the icons chosen (for both designs), but they appreciated the icons in the Taiwanese design and thought they were able to see a theme (of design) in them. Joshua indicated that the icons used in the American design look like a mix of two or three different styles, which were fine in functionality, but lacked aesthetic. The icons used in the Taiwanese design, for Joshua, Eric and Courtney, were more appealing in the aspect

of being designed thematically.

Taiwanese participants overall preferred the Taiwanese set of pictorial materials better than the American ones.   Overall, they could not appreciate the aesthetic style of the illustrations in the instruction sections of the American Design.   Jin-Ye, Hsin-Yee, and Fey-Jin all thought the illustrations used in some of the sessions in the American design looked crude and could use some refinement.   They weren't opposed to the cartoony style of illustrations, however, they couldn't appreciate the way the illustrations was made.   Jin-Ye mentioned, "*I just thought [the characters and figures] looked grotesque, definitely not something of my taste, I couldn't appreciate something that poorly made, and I also found that it's very difficult to understand what the illustration wanted to deliver without reading the text.*"   Hsin-Yee had a very similar comment, she said, "*I don't like the style [of the illustrations] some of them looked odd. And also they looked kinda… old, and I don't know it seemed like a totally different style from the [interface design].*"   Fey-Jin said, "*I can safely say they're definitely not the Taiwanese style [of illustrations], maybe some people would like [that style], but I don't think they, in any way, would be a hit here, I am not trying to be a nitpicker, but some of them aren't very good.*"

In addition, Taiwanese participants indicated the images used in the session instruction sections looked outdated, and didn't match to the style of the interface (and other pictorial materials used).   Judging by the look and appearance of the characters and the appliance (particular the computers) used in the pictures, most of the Taiwanese participants thought that those pictorial materials were apparently made a long time ago.   Chiang-Chi, for one, thought the images and illustration in the instruction section looked like something from the previous century, Chiang-Chi, said, "*judging by the color hue and the overall vibe, I think they are definitely not new, maybe from the late 90s… they are antique but not in a good way (laugh)… to*

use them [in the Taiwanese design] created a sense of conflict, I just feel that they are

incompatible with the appearance [of the interface] and other pictures."   Yu-Hsuan also

indicated the very same thing.   He thought "*The style of [the illustrations and images in the*

instruction sections] looked very different from the overall style [of the Taiwanese design], I

don't think it's a huge problem, as long as they can serve their function well, but somehow they

gave me the feeling they are too different [in style] to be used here."

Although overall they favored the Taiwanese set of pictorial materials, however,

Taiwanese participants didn't think that the American set of images were difficult to relate to.

First of all, Taiwanese participants understood the system, as well as that the materials were

developed by an accredited public Midwestern university in the United States, so they've

prepared for having "Americanized" materials used in the system.   In addition, The American

set of images, which implemented English text and Western figures, gave Taiwanese participants

the feeling of "internationalization" which somehow have a positive effect on the acceptance of

the material.   Hsin-Yee, for example, although couldn't appreciate the aesthetic style of the

instruction images, indicated, "*I know they were not developed for the Taiwanese users, so I can*

understand why they looked so, um different [from most of the Taiwanese style illustrations], I

actually don't think it's a big problem [to have English text and Western figures] in the

illustrations and pictures, we have the dual languages [presentation/lectures] all the time in our

program, so it's actually not a problem for me."   Fey-Jin also thought to have English text and

Western figures in the images was not a problem.   She said, "*I don't have any problem having*

English (in the pictures), it's kinda good to have foreign language in the images, you can learn

the correct translation and new vocabularies from them, I personally don't think it's a big deal,

or that there's any conflict in having [English text and Western figures in the] images in a

Chinese website."

Chiang-Chi, and Yu-Hsuan although sensed the conflict of styles between the interface and the instruction illustrations; however, they understood that the conflict was caused by embedding images, which originally were developed and intended to be used in another system, in a different style of interface.   They both thought to have English text and Western figures in the images would not affect the overall acceptance of the materials; instead it might even bring about some benefits.   Chiang-Chi said, *"[the use of English text and Western figures] brought the feeling of internationalization to [the system], I know the course was developed in the United States, so I know [the content] was originally in English, I don't think it's necessary to translate the text [in the images] into Chinese, since most of us understand English."*   Yu-Hsuan agreed with Chiang-Chi, he indicated that those images although seemed conflicted with the style of the Taiwanese design, overall, they served the supposed functionality.   In addition, the dual languages presentation (English in images and Chinese in content) might even help Taiwanese users to know some of the key terms in English.   Yu-Hsuan said, "*I think [the images with English text and Western figures in them] might be helpful for people who want to also learn [the key terms in] English, but I think that they need to figure out a good way [to consistently incorporate English] in the images.*"

Mei-Lin pointed out an interesting issue.   She thought it would be nice to have a dual languages presentation or even have English content in the Taiwanese design.   She thought since the course was offered by an American university, and most of the students, who might enroll in the class, are supposedly understand English; hence it wouldn't be a problem to use English content, not to mention images with English text in them.   She didn't really have many opinions on the aesthetic style nor care about what era the images belong, she indicated, "*it's good to have*

another language." Mei-Lin personally thought by contrasting and paralleling the images with English text with the Chinese learning content she could learn three things, "*the content, the language, and a different perspective,*" at one time, which for her is an ideal way of learning.

In addition, although with different preferences and tendencies, both groups of participants had the consensus on having images in larger size, and to compliment and facilitate the topic/content of the website. They thought, first of all, the images used in the American design could be in a larger size, in addition, the using of stock images was not the best choice. In some cases, they thought some of the pictures/illustrations (in the instruction sections) were not as supplementary as they were supposed to be. In addition, they thought some of the pictures/illustrations were presented only for the sake of having pictures. They expressed the desire of seeing high quality images developed specifically for the purpose of the course which can supplement the instructional needs of the content.

Summary

Participants had their own ideas and assumptions of how and what an online learning system should feel and look like, and consequently had different perceptions and experiences on different design features. The data indicated that the American and the Taiwanese group showed diversified preferences toward design features. In detail, on the aspect of information organization, Taiwanese participants preferred a well-organized system with an imposed structure that was able to guide them in finding the information needed, by contrast, American participants preferred to direct their own searching, thus, a flat and transparent design which displays all of the information in plain sight is suitable for them.

In navigation design, Taiwanese participants preferred a thematic structure with a focus on the relationship/hierarchic of the information; by contrast, Americans participants preferred a categorical design with a focus on the attribution of the information.   In addition, Taiwanese participants preferred an object-oriented design; American participants in another way preferred a task-oriented design.

In presentational design, American participants preferred a more casual pictorial-oriented design with more condensed content/object and less unused space presented on the page.   By contrast, Taiwanese participants preferred a design with an academic feeling but with less components/objects presented on the page.   Both the American and the Taiwanese groups favored the text to be left aligned.   Taiwanese participants, due the nature of Chinese character writing, favored the design/style with extra tracking and leading spacing, extra spacing was necessary and it enhanced the readability of the Chinese content.   American participants, in another way, thought the extra tracking spacing was distracting, but was fine with the extra leading space.   As for page layout presentation, Taiwanese participants preferred a concrete display that implemented a consistent layout throughout the system.   American participants, by contrast, preferred a more pictorial design that partitioned and divided information into exclusive groups.

Lastly, for the pictorial materials, American participants preferred a website with more visuals and colors.   In addition, culturally specific pictorial materials were not appropriate for American participants on account hat they were not able to relate to the pictures with Chinese text and figures in them.   By contrast, Taiwanese participants had no problem with culturally specific pictorial material (with English text and/or Western figures presented).   In addition, the use of English text and Western figures in the pictorial materials gave the system the feeling of

"internationalization" to the Taiwanese users.

Table 35: Summary of Design Preferences for the American and the Taiwanese Group.

Design Features	American	Taiwanese
Information organization	Self-directive information seekers; preferred a more flat and transparent design which displays related information in plain sight.	Preferred a well-organized system with an imposed structure that is able to guide them in the processes of information seeking.
Navigation design	Preferred a categorical design with a focus on the attribution of the information. Task oriented	Preferred a thematic structure with a focus on the relationship/hierarchic of the information. Object oriented.
Presentation features • Blank spaces	Preferred less blank-leaving (blank space) and more condensed presentation.	Show no specific preference on the usage of blank space, however preferred fewer components presented on the page.
• Text alignment	Left aligned, and uses universal spacing. Compared to Taiwanese participants, some of the Americans preferred less tracking spacing, however, they preferred more leading spacing which makes reading content easier.	Left aligned, in addition, Taiwanese participants preferred more tracking and leading spacing. For the nature of Chinese character writing, extra spacing is necessary and it enhances the readability of the Chinese content.
• Layout	Prefer an informal/non-academic layout design, with more images presented and use more of vibrant colors.	Preferred a more formal/academic looking design with concrete display that implemented consistent page layout throughout the system.
Pictorial materials	Preferred more visuals and colors, in addition, culturally specific images (with Chinese text and figures in the pictures) are not appropriate for American participants.	No problem in visuals with English text and/or Western figures. In addition, the use of English text and Western figures in the pictorial materials gave the system the feeling of "internationalization" to

Design Features	American	Taiwanese
		the Taiwanese users.

Theme 3: Culturally aware design is a functional interface design approach.

The culturally aware design approach is based on the notions of contextual design, which consider the use, design, as well as evaluation of technology are socially co-constructed and mediated by human communication and interaction (Gay, 2004).   The underlying rationale is, by providing appropriate design features in accordance with the relevant using context (may it be cultural, environmental, physical, or the combination of them all), we can enhance not only the perceived usefulness but also the user performance of the system interface.   Through this study, the culturally aware design approach had shown that it supported the aforementioned idea; it aided users, both emotionally and physically, in conducting information seeking tasks, promoted the overall affiliation and perceived usefulness toward the system interfaces, and enhanced the task performance in both aspects of efficiency and accuracy.

Culturally aware design approach goes beyond the feature driven design model and supports the expanded definition of user-centered design.   As Dunckley and Smith (2000) suggested, culture is about how individuals behave and respond, their beliefs and values, and therefore it is necessary to reflect subjective culture in the interface design.   In this study, the "subject culture" was reflected in both the perceptual and the functional levels.   In the perceptual level, the intention was to design an interface that looks and feels like something that the users of a specific group prefer or expect.   As for the functional level, it was intended to design features that can cater and/or accommodate to the specific needs and using behaviors of

the different groups of users.

Overall, culturally aware design approach proved to be a functional approach for addressing and accommodating the different interface preferences, as well as user needs of different cultural groups.   Selected cases are presented in the following sections to show that the culturally aware design approach promoted the positive perceptions of users to interface and supported the needs of different groups of users.

3-1: Matching design features with users' expectations promotes positive perceptions.

From a user's perspective the most things, if not only, that could be perceived directly without further deliberation from an interface are the fronted components, i.e., the external design features such as images, icons, color scheme, layout presentation etc.   Although the usability test involves several substantial factors, from functionality to interaction, it seems that the external design features influence greatly on the acceptance of users to an interface.   The phenomenon is somehow complicated, enigmatic even, but we could have a direct implication which when the design features meet the specific preferences or expectation of users, i.e., the interface feels and looks the way as users expected, it tends to promote the satisfaction and/or the perceived usefulness, of users toward the interface.

Drawing from the interview data, Taiwanese participants favored the Taiwanese design because it looked like (mimicked) the predominant style of Taiwanese university websites layout design, which not only catered to their preferences (on an online learning system interface), but also gave them the familiarity, as well as comfortability in using the interface.   When asked to

choose an adjective to describe the overall feeling of the Taiwanese design, Fey-Jin first chose "comfortable," because the familiar feeling of the interface to the systems that she had used before, the familiarity gave her the comfortability of knowing that she would able to operate the system. In addition, the design and consistency of system behavior also reduced her anxiety in operating the system. The feelings of familiarity (as well as comfortability) are more emotional than rational, Fey Jin explained: "*First of all, I like how (this design) looks like, I feel it's very familiar to me, [because the overall feeling/appearance, the (banner) picture on the top, (sub-menu) parallel with content on the middle], it looks very similar to (the courseware we used in school)], I somehow feel relieved…um because I think I don't need to fumble about and struggle on learning how to operate it….*"

In addition, Fey-Jin mentioned, she preferred the Taiwanese design not only because the familiarity of the appearances, but also due to the formal, academic look of the interface. She mentioned the academic style gave her the feelings of trustworthiness of the system and the content. She said, "*Compared to (the American design), I think (the Taiwanese design) looks more appropriate, because you can clearly see it's an (Instructional website), I actually like how it looks, more of an academic look… I mean it's an instructional website so it's supposed to look like an instructional website. [When it's designed] this way I know what it is for, and somehow because I know the purpose (is for instruction) and the origin (from a school), when I used it I felt at ease, because I know that the website and also the content were trustworthy and beneficial.*"

Another Taiwanese participant, Hsin-Yee thought that overall she appreciated the Taiwanese design more than the American design because the Taiwanese design was something that she expected and felt familiar with, and she enjoyed the effortlessness in understanding and

203

utilizing the interface.   Hsin-Yee stated, "*Personally, I prefer (the Taiwanese design), because it's something (that I expect) an (online learning system interface) should be. I felt that I already knew how to use it. I have to say, (the American design) looks nice, but (the Taiwanese design) would still be my first choice…. Usually I hate switching from system to system, it means extra works on learning and preparing for the new system, but (the Taiwanese design) is fine, it's well-organized and not very, um different from the one we are using right now, so I felt O.K. to switch and also confident that I don't need to spend a lot of time in understanding (how to use) it.*"

American participants had drastically different preferences from the Taiwanese participants.   They favored a more modern and informal style of online learning system interface.   On some level, although they also expected to see a more formal/academic design of online learning system interface like the Taiwanese group, when the American design was presented, they immediately leaned toward to it for the reason that it provided a fresh, novel feeling, as well as look.   Joshua for example, enjoyed the modern feeling of the design, he thought, compared to the Taiwanese design; the American design was both innovated and appealing, which for him was a good quality for the interfaces of technology tools.   Joshua said, "*One of the things I like about (the American design) is it doesn't look (like the traditional online learning system), I think it's great [that you don't have the old-fashioned look in the American design] …. I like (the American Design), for one, it is more of my taste, I like the more modern look (of the American design), I know it's an (online learning system interface), but (the online learning system) doesn't have to fall into the stereotype (of being formal and boring). Um, I also like the image (it presented)…. A more young and vibrant image… I mean, (a website) is the image of the school (online), and the perception (of the school) depends on (how the website is designed).*"

Amanda had very similar comments to Joshua's. She also enjoyed the modern, informal design of the American system, and she suggested online learning system interface did not have to look formal. Although it is situated/embedded in an academic setting, but a lot of time, as Amanda suggested, the online learning system is used in a non-academic setting, so for her, the online learning system interface should and could be designed to look fun and interesting. She enjoyed the diverse layout presentations and the information blocks that have been used throughout the American design and detested the formal/academic look because that kind of design reminded her of being in a school setting. Amanda linked the interface of the online learning management system to homework, assignments, and the feeling of tediousness. Amanda said, "*When I use (the online learning system) at home, either reading or doing the homework I don't need (the design of the interface) to remind me of school work; I mean the work (of reading and doing homework) itself is boring enough, so at least the (appearance, environment, and the experiences of the interface) can be more, um interesting and pleasant.*" She further mentioned, "*Well maybe it's just me, but when I look at (the online management system interface) it reminds me that I have more (school work) to do, which is not a good thing for me (laugh). (The online management system) ,sure, is convenient, but it's definitely not the most interesting thing (to use) in the world, especially when the only thing I do (on the learning management system) is reading and doing homework; I know it's intended to, but somehow, I just feel tedious and bored when I use it.*"

It is suggested culturally specific design approach could strengthen users' beliefs about system usefulness, influence their perception about system ease of use, and promote their overall attitude of satisfaction in using (Day, 1996). That is to say, the matching of design features to user preferences produced the emotional affiliation of users to the interface/system. In this

study, the data supported the aforementioned statement.   In addition, the American and the

Taiwanese groups had drastically different preferences on the interface design.   For the

Taiwanese group, a formal/academic design was favored on the account that it not only fulfilled

the expectation of the Taiwanese participants, but also their preferred feel/look of an online

learning system interface in Taiwan.   In contrast, American participants, although expected to

see a formal/academic design, however, they preferred a more innovative and fresh feel/look on

an online learning system interface.

3.2: Matching Design features with users' needs enhances interface usability

3.2.1: Deep organized information structure helped Taiwanese participants in the processes of information seeking tasks.

In localizing the Taiwanese system, the information structure went through a series of

reorganization in order to accommodate the different perceptions and cognitive preferences of

Taiwanese users.   The theory/rationale that led the reorganization of the information structure

was, for Taiwan, a collectivist country where people have very clear perceptions on the power

structure (high power distance) and seek for clear guidance in dealing with different situations

(high uncertainty avoidance), a high/deep hierarchical organizational model with an imposed

navigation structure was considered to be an appropriate design for information structure.   The

high hierarchical information structure of the Taiwanese system provided a framework that

accommodated the needs of the first time Taiwanese users in navigating the system.   In

addition, the positive attitude toward the Taiwanese system might be caused by not only the

information structure design, but also the positive experiences (getting the answers for the tasks

easier/faster) in using the system.   The following section discusses how different information

organization designs caused different perceptions and performance of the Taiwanese.

The American system with a flat hierarchical design, in a way, gave Taiwanese participants the feeling of having too many things going on in one page and even confusing on the account that it presented too much information and too many number of items/options at one time. Some of the Taiwanese participants in this study pointed out that they need to spend more time in figuring out where the link and/or information was in the American system because the American design, compared to the Taiwanese design, was less organized and had the information all over the place. Conversely, the sub-menu (as the extra layer) in the Taiwanese system, although required an extra click or two to reach the information, however was beneficial not only because it organized information in a way that helped Taiwanese participants to know what to look for and how to proceed with the information seeking tasks, but also functioned as cognitive aids that helped and directed Taiwanese participants in conducting the information seeking tasks.

Mei-Lin explained the reasons that she preferred the Taiwanese design was, "*the [submenu] is always in the same place so I know I can look for it when I need it… I don't have to go all over the place [to look for the information I need] ... I think having a [submenu] really makes it easier to use the system… for example, I always know where I can look for [the information I need], I can just click on [the submenu item] to access to the needed information, for me it's much easier, because [the information] has been [further] organized. In addition, [the information] was always shown next to [the submenu] so I don't need to go back and forth in different windows.*" When asked to elucidate the reasons that she thought the submenu made the information seeking easier, Mei-Lin stated, "*first of all I think [the way it organized the information in a menu] is more efficient. Um for me, it's much easier [to perceive information] by going through a short list than a page. Also, I felt it is somehow in alignment with the way I*

207

think or the way I would do [in compartmenting the content] for a website, I mean, it makes sense to me to organize [information] in this way [in an educational website], so I feel natural and effortless when using [the Taiwanese design]."

In a similar vein, Fey-Jin said, "*I particular like the [submenu in the Taiwanese design], it really accelerated the [the information seeking] process… [The submenu] listed the [topics/subtopics in each category/unit], which really helped me going through the information seeking [process]. I like the way it is [organized] in a list instead of scattering over the page, this way I could [process] the information much easier. Another thing is, it didn't open a new [windows, tabs, pop-ups] which is a huge plus for me, I usually don't like it, especially when I use a [online courseware], when they open a new window for something [when I clicked a link], and leave the [main page], I felt frustrated.*"

Compared to the American design, Hsin-Yee felt the Taiwanese design was "*much easier [to use] in information seeking tasks.*" She said, "*I have less troubles in using [the Taiwanese design] … because the content is clearer and more organized.*" She mentioned that she appreciated the information organization of the Taiwanese design because, "*[The Taiwanese design] works better for me, I usually have trouble in finding [information] on a website [of less organized], but I felt I was doing OK in [the Taiwanese design]. And I like the way they used the [submenu] in [the content area], having a [submenu] is like [the designer] tells you the main points of the content, and what is the information you need to pay attention to, or at least it could work as a checklist, that tells you what are the important things you need to know.*"

Compared to the American design, Taiwanese participants overall spend less time and made fewer clicks during the process of solving the information seeking tasks by using the

Taiwanese design.   In addition, Taiwanese participants also showed a general tendency of favoring the Taiwanese design than the American design in both the PSSUQ and follow up interview.   A deeper hierarchical design of Taiwanese system, which employed one extra level than the American design, seemed to provide a crotch for first time Taiwanese users in locating information required to answer the information-seeking tasks.   Although generally speaking, information architecture favors breadth over depth, meaning more levels of depth usually are considered to result in more problems during searching, the one extra level in the Taiwanese system, which organized and presented the content in a prescribed way, on the contrary, helped in shortening the information seeking time for the Taiwanese participants.

3.2.2: A task-oriented navigation design might enhance the performance of American participants.

Taiwanese and American participants had different tendencies in perceiving and classifying information.   As mentioned prior, in this study, Taiwanese participants showed the tendencies of relying on a thematic structure, while American participants overall showed the tendencies of using categorical information.   Since these differences reflected on not only how information seeking tasks were executed, but also individual perceptions toward the navigation design; one of the sensible solutions for optimizing the task performance might be providing different navigation designs for the respective groups.

For American participants, the task-oriented design which categorized/compartmented information by its task-attribution could be an ideal way to present the conceptual/categorical framework of the system.   It accommodates the perceptions, as well as the preferred information seeking strategy of the American participants.   In this study, in both the American and the

Taiwanese design, the navigations utilized a mix design (of task-oriented and object-oriented design, although with item differences) in attempting to combine the merits of both designs. Functionally speaking, both navigations served their functions aptly, however when asked to compare the two navigation design, American participants showed the preferences toward the more task-oriented navigation design which employed more task items in the design.

As aforementioned, American participants tended to extract the presumed properties of the task and applied the logic of "Information A is a type of category B" in categorizing/sorting the information perceived which is considered to be the action-attribution of the task.   For example, when asked to solve the following scenario based task:

> *"You are working on the course activity of the e-Portfolio lesson, now you are almost done with it, but you realize you need to upload it to your online portfolio using an FTP application which you haven't installed in your computer yet. In order for you to complete this activity/assignment and meet the due date, you need to find out what's the name of the FTP application (for the Mac computer) that you need to download and install in your computer. (You don't have to download it, just provide the name of the application.)"*

Most of the American participants thought the appropriate start point of the task would be "Activity" or "Resources"—the navigation item—because they were not only the assumed attributions which the American participants perceived from the task description, but also the categories where they assigned/categorized the task information.   In another scenario based task, American participants were asked:

> *"You are working on the course activity for the Educational Data lesson, but you forget*

the exact requirements for that course activity, as an eager student you intend to find the

information of how this particular activity is evaluated in our course website. In order for

you to have a full credit on this activity, how many (1) columns, (2) rows and, (3)

formulas do you need to include in your final spreadsheet?"

for most of American participants, they thought either "Activity" or "Evaluation" could be the

appropriate places to start their search task because, again, these two items were where the

American participants assigned/categorized the task information into.   Since the American

participants had the tendency of perceiving and utilizing the task-oriented attribution in solving

the tasks, a sensible design for the navigation could be a task-oriented arrangement which

develop the navigation items based on the possible actions that user might perceive and/or

conduct using the system.

Drawing form the interview data, American participants thought that a task-oriented

arrangement was convenient because it presented the structure of information in a way that not

only was in accordance with their perceived attribution(s) of the information seeking tasks, but

also accommodated their information seeking behavior(s).   When asked to compare the different

navigation designs, Austin felt the more action-oriented design "*comes in handy,*" because the

arrangement "*synchronizes with [my thought]*."   He liked the way the navigation

provided/presented a clear organization of the information; for him, the way it was arranged was

more instinctive, which in his opinion, might be able to "*speed up [the information seeking*

tasks]."

Courtney also thought the action-oriented design could enhance her performance in the

information seeking tasks.   She thought when a navigation was arranged in the way how users

think and act, it could really enhance the performance of the users.   Courtney indicated, she liked the way the navigation items were arranged, and "*[the action-oriented design] really helps to cut down the time on searching and clicking.*"   She further explained, "*I would choose [the Taiwanese design] over the [American design] simply because [the extra] "Activity" [navigation item] ... I can still find the answer without it, but it would cost much more time [than having the extra navigation item of Activity] ... I think the difference is clear… um when you have 'Activity' here makes [the navigation] complete, um comprehensive…. I mean, when you start [the search] using the navigation, you kinda hope to find [a corresponding item] that relate to [the information you want to find], and you hope [you can find the item], because if you can't [find it] then you would be lost and frustrated, and forced to figure out other ways [of finding the information you need] or give up.*"

Joshua also indicated that he preferred the way the design was action-oriented.   He said, "*I think it's better because it showed [all the categories] you might need [on the navigation] which makes [information seeking tasks] easier… mostly, because it's clear and straightforward, you can just get whatever [the appropriate categorical information in accordance to the information attribution perceived from the tasks] you need [on the navigation].*"   Joshua further elaborated, "*for the second [task] I thought that I could also use 'Activity' [the navigation item], although later I found out I couldn't, but it would be better if it was there [in the American design]. [In the American design] I couldn't [access the activity information using the navigation. It's, um not very convenient. You need to go [to the sessions] to find it… I mean, although it's not the right [category], but it's convenient that I could use it when I need it, and it surely could save me some time.*"

The American participants had the tendency of perceiving and categorizing information

by its presumed properties, and the habitual strategies of relying on the action-attribution in solving the information seeking tasks. An ideal way of designing navigation for the American participants might be arranging the navigation items in accordance to the tendencies, as well as the habits; meaning, to design the navigation in an action-oriented fashion that corresponds to the mental model of the Americans. To design the navigation in this way might be able to enhance, or at least reduce the time of performance of American participants in solving the information seeking tasks.

3.2.3: An object-oriented navigation design might enhance the performance of Taiwanese participants.

In contrast with the American participants, Taiwanese participants had the tendency of perceiving and categorizing the task information by its thematic attributes. For both tasks, Taiwanese participants showed the tendency of starting the information seeking tasks by using Session, the navigation item.

Hsin-Yee, for example, stated the reason she started the searching tasks by using the "Session" is because "*that's the appropriate way of organizing information.*" She further explained, *"for me, a lesson is the most basic unit of a course, I think it's organic to see information organized this way [under a session]… so that's probably the reason that I felt natural to think that if I need some [information], the appropriate place to find it is of course under a (session). "* When asked a hypothetical question of how she would use the Taiwanese system in a learning context, she answered: "*… I think, except the overall information [for the course] most of time I would look for [the information] in the particular [session]… for example, if you want to find the evaluation standard for an assignment [in a particular session], a sensible*

strategy is to look it up in that particular session."

Mei-Lin thought the same way, she said, she would also "*focus on the sessions*" when conducting information seeking tasks.   She explained, "*I think we all are used to this way [of organization], to have the [learning] content arranged by lessons [as the basic unit]. As a student, I think that's easy and convenient. It's a no brainer, when you need something from a lesson you look it up in a lesson, I mean you just follow it and it has everything in it.*"   When asked about the way that she would design the interface, Mei-Lin suggested: "*As a designer, I think in the case that there were only five lessons, you can probably use the title of sessions [as items] on the navigation. I think it's sensible and doable, and somehow, in my opinion, it would make [the structure of the website] clearer to the users [in the sense of what composes the course], and also save some time [because it would reduce one level on the IA].*"

Mei-Lin's suggestion on the design of navigation, although was her personal idea, however somehow resonated with other participants' thoughts.   Chiang-Chi, and Yu-Hsuan, although for different reasons, both felt it was not intuitive to use action-attributions, i.e., Activities, Resources, and Evaluation as navigation items/objects.   For Chiang-Chi, he thought it is "*odd*" to organize the activity information of different sessions under the same category of Activity.   He stated, "*… maybe they all [have the same attribution as an activity for a lesson], but for me, they are not related to each other, well, not that related… it's like saying um, my older brother and your older brother are belonging to the same league because they are both somebody's older brother… I couldn't put my finger on this logic, I cannot say it is wrong, but it's odd for me… I would [categorize] them by the family (lessons they belong to) instead of their roles [in the particular family/lesson].*"   Yu-Hsuan, in another way, considered that these action-oriented items (Activities, Resources, and Evaluations) should be used to direct the general

information for the course instead of specific information of the individual lessons.   Although he appreciated the idea of having multiple accessing points for the same information,   he thought each of the navigation items should present exclusive information for its particular category. Yu-Hsuan, stated, "*I think it's a little bit excessive that you have a resources page that includes all the resources for each of the lessons when you've had individual resources pages under each of lessons…. I wasn't expecting to see [the individual resources information] there, I thought it's for the overall resources [for the class, or courses] or the online support.*"   Yu-Hsuan suggested, a sensible way of compartmentalizing the information was by the lesson unit, and like Mei-Lin, he thought, lesson titles made ideal navigation items.   They were not only partitioning the information in an exclusive way, but also representing the framework of the course better (due to their thematic attribute).   In addition, Yu-Hsuan thought by doing this "*I can really save sometime by using [the session navigation item] in solving the information tasks you gave me.*"

For the interview data, it seemed Taiwanese participants had the tendency of relying on the presumed thematic attributes of the task information.   For Taiwanese participants, a sensible navigation design in this setting and context would be an object-oriented thematic design which emphasizes on and partitions the content by sessions.   In addition, organizes its subordinate components—the respective content pages of activities, resources, as well as the evaluation under the individual sessions.

3.2.4: Appropriate typography design enhance the readability of the Chinese content.

Due to the different properties of the English and Chinese writing, different typography styles were implemented in the respective designs.   Both systems implemented the Arial, sans-serif font family.   The differences were mainly reflected on the setting of leading, tracking, as

well as the alignment styles.   For the Chinese content, extra tracking and leading space was employed to make the Chinese content more readable.   All of the Taiwanese participants were aware of the differences between these two designs, in particular on the pages where greater amount of information was presented.   The major criticism of Taiwanese participants to the American design was in the aspect of typographic style that, in their opinions, lacked adequate leading and tracking spacing and rendered the presentation of textual materials too crammed and made it difficult and even stressful to read the Chinese content.

After using the American design to solve the information seeking tasks, Jin-Ye stated, "*...when I tried to find the answer [by reading through the passages], I felt it's not very easy to read the text because the characters are too close [to each other]… you see, here in (the first) section, when you have more than one line in this passage, it looks chunky… for me, I would really like [to have] some [extra] space [between the lines, as well as characters]…. When the text is [presented horizontally], I need to have some more space between the lines… I had a hard time in reading [less spacing content]. When there were long passages I sometime mixed up the lines… sometimes I jumped [missed] a line or two, and sometimes I ended up with starting to read the line I just finished, when the lines were too close to each other.*"   Jin-Ye further indicated that she needs to pay more attention in reading content in the previous mentioned condition, she stated: "*I need to read the content extra carefully [in the American style], chances are I might miss something and end up with spending more time in amending what I have messed up.*"

Hsin-Yee felt compared to the Taiwanese typographic style, the American one made the Chinese content harder to read.   She didn't think that it was too difficult to read textual content in the American style before being introduced to the Taiwanese design.   After being presented

the Taiwanese design, she had the comment that it's much easier to read the content presented in the Taiwanese style.   Hsin-Yee said, *"[The Taiwanese style] is better, I find reading content [in the Taiwanese style] is smoother and easier [than the American design] .... Mostly, I think it's because the density [of the text]. I felt [in the American design] some of the lines were too congested which rendered the text not as easy to read [as the Taiwanese style] ... in particular [in the Instruction section], also it might relate to the size of the font as well, but mostly, I think it's the character and line spacing…. To some extent, I do think the spacing thing effects my reading [of the content]. It's tiresome to read through a page like [the Instruction page in the American design] ... For one, it's a really long page that has lots of content in it, in addition, it's a little bit difficult to follow the text when there's a huge block of text crammed like [this paragraph]."* Hsin-Yee, after carefully comparing the same paragraph presented in both the Taiwanese and the American styles, stated, "*I think the (font) size might be one of the reasons [that caused the difference in the respective designs], another [reason] might be the length of the lines… when the line is longer [like in the American design], it's not as easy as reading a shorter line [as in the Taiwanese design]. Combining with the line spacing, the text [in the American design] is harder to read… I'd prefer to read [the text in the Taiwanese style], if I had to choose one, [aesthetically speaking], I like how [the Taiwanese design] looks… the proportion of illustrations and the text is more pleasant, and also [functionally speaking], it's easier to read text this way… the transition between the lines and sections is smoother.*"

Mei-Lin, from more of a designer's point of view, pointed out that the nature of the Chinese writing makes it necessary to utilize extra leading and tracking in presenting the Chinese text.   In using the American design (with Chinese content), Mei-Lin identified the typographic design issues.   She said "*It seems to me you can really use some extra spacing in the text, both*

vertically and horizontally. I would particularly use more line space. It's difficult to read text when the lines are so close to each other…. I know it's caused by the nature of the Chinese writing [in computer system], since the character occupies the whole space [square], you need to add space to make up more space… I don't think it's unreadable, but it definitely can use some more space.   The English part is fine, it was rendered [appropriately] …. I guess if you have both Chinese and English, you need to design [base on the characteristics of] Chinese, maybe even apply different styles [on Chinese and English text]."   In addition, Mei-Lin thought the typographic design/arrangement in the Taiwanese design not only made it easier to read the Chinese text, but also decreased the time in reading the text which consequently might increase the productivity of using the interface. She stated, "*I think [the different typographic styles in these two systems] does make a difference in presentation… I would say, when the text is easier to read, it enhances the usability of a system… because you can process the text faster, also you don't need to focus [on reading] all the time, so you have more [cognitive capacity] in solving [tasks] or learning the content along with other processes.*"

Extra leading and tracking spacing are necessary for the Chinese content.   The Taiwanese participants have a unanimous agreement on the issue of the leading and tracking spacing.   They felt the typographic style of the American design which utilized less spacing rendered the presentation of textual materials too crowded and made it harder to read the Chinese content.   They felt the Taiwanese style which implemented more leading and tracking space not only made the content presentation more pleasant, but also made reading the Chinese content easier and more efficient.

Conclusion—Interface design need to consider the using context

Data from the qualitative phase suggested that matching design features to the group preferences and needs enhanced not only participants' satisfaction toward the interface, but also the perceived usefulness of the interface, which indicated the culturally aware approach of interface design is not only functional but also indispensable in addressing and supporting the group needs on online learning system interface usage.   In addition, the interface determines how learnable, usable and satisfying a system functions.   Therefore, the design of an interface influences the way users interact with the system and consequently their performance on the information seeking tasks.   Hence, the "look" and "feel" of an interface should be depend on the assumptions made about the information seekers' needs and abilities

CHAPTER V : DISCUSSION AND FUTURE RESEARCH

Overview of the Study

This mix-methods study was aimed at investigating the interaction between cultural profile of individuals and website interface design features.   In particular, the focus was placed on the extent to which the cultural-sensitive design approach enhances the usability of a system interface.   In order to investigate the usability of interfaces from the perspectives of two distinct cultures, American and Taiwanese respectively, without the interference of the language barrier the content was provided in both English and Chinese.   Four systems were generated for this study, American interface with English content (AE), American interface with Chinese content (AC), Taiwanese interface with English content, (TE) and Taiwanese interface with Chinese content (TC).   The participants were only exposed to the system(s) composed with the language of their native, i.e., American participants would use only AE and/or TE systems, and the Chinese participants would only access to the AC and/or TC systems.

In the quantitative phase, American participants were randomly divided into two groups, one group was asked to utilize AE system, and the other was asked to use the TE system.   Their Taiwanese counterpart went through the same process; the only difference was one group was asked to utilize the AC system, and the other the TC system.   The sample for the quantitative phase consisted of 120 participants; 60 of them were Native-English Speakers, and 60 were Native-Chinese Speakers.   All participants in this phase were asked to respond to five information search tasks (task performance survey) by utilizing the system assigned to them,

following by the Post-Study System Usability Questionnaire, Survey Measures of Web-Oriented Digital Literacy, and a series of demographic questions.

An online survey tool, Qualtrics, was used in the quantitative phase. The survey page was preloaded/opened for the participants, while the participants were seated, they were advised to wait for further instruction. The survey administrator then explained how the survey would be done, and demonstrated how to finish a sample task (differ from tasks included in the task performance survey). When the participants were instructed to start the survey, they were first prompted to look at an information statement page to which the purpose of the study, university policies, contact information, as well as consent information were introduced to the participants. When the participants clicked on the agree/proceed button they were considered to agree with the information stated and consent to participate in this study, and were then prompted to the first task in the task performance survey.

The task performance survey consisted of five major tasks. Participants' responses on each task were timed and recorded individually. The PSSUQ and the Survey Measures of Web-Oriented Digital Literacy were administered right after participants finished the task performance survey. Five demographic information questions about participants' (1) age; (2) gender; (3) year of study; (4) ethnicity, as well as (5) native language were also collected for the purpose of this study. In addition, although different language versions (English and Chinese) were provided, participants in both conditions were exposed to the same list of tasks/questions.The task performance survey consists of five major tasks. Participants' responses on each task were timed and recorded individually. The PSSUQ and the Survey Measures of Web-Oriented Digital Literacy were administered right after participants finish the task performance survey. Five demographic information questions about participants' (1) age; (2) gender; (3) year of

study; (4) ethnicity, as well as (5) native language were also collected for the purpose of this study. Single-administered survey was used to collect data in the quantitative phase. Although different language versions (English and Chinese) were provided, participants in the each condition were exposed to the same list of tasks/questions (composed of different languages).

The main independent variable of this study was the matching condition (of user cultural profile and the design); the main dependent variables of this study are (1) task performance time, (2) task performance accuracy and (3) website perceived usability (desirability). To answer the first hypothesis, a Multivariate Analysis of Variance (MANOVA) was conducted to investigate the interaction between the factor (match condition) and two independent variables (performance time and accuracy). For the second hypothesis, an Independent-Samples *to* Test was used to evaluate the relationship of the independent variable (match conditions) and the dependent variable (perceived usability). The findings suggested there were interactions between the independent variable (match condition) and the dependent variables (task performance time, accuracy and the perceived usefulness).

After the data of the quantitative phase were collected and analyzed, interview protocols were formed in accordance with the initial findings of the quantitative phase. Twelve participants, six NES and six NCS, were recruited for the observation and the in-depth interview. Each participant was asked to utilize both two systems with content composed of the native language of the participant's. The qualitative phase was aimed at investigating the culturally different perceptions and experiences of participants toward interface design features; the process consists of a think-aloud observation in which the participants were asked to verbalize their thought while performing information search tasks, followed by an in-depth interview to probe

their attitudes, feelings, and preferences toward the two systems provided.   All observations and interviews were conducted in a computer lab setting and were audio and video recorded.   Data were collected and interviews were transcribed and analyzed for the guiding questions.   The main themes described how (a) participants perceived design components and overall design differently, and how that resulted in (b) the different levels of performance in interface usage, and led to the conclusion of that (c) culturally aware design approach could be a functional solution in improving the usability of interfaces.   The findings suggested that the use of cultural profile in interface design might increase not only the preference and desirability of users toward an interface but also the overall usability of an interface.

Discussion of Findings

Findings in Quantitative Phase

Research Question one

Does the match of website design features and users preferences influence users'
task performance on information search related tasks in using the online learning
system interface?

One of the major goals of this study was to investigate if the culturally aware design approach enhances the overall usability of the online learning system interfaces.   The results of the five performance tasks revealed that in both groups the task performance of participants was influenced by the different design approaches of the interfaces, i.e., when users were exposed to the interface designed to cater to their preferences, as well as needs (match condition); it yielded better performance in the information seeking tasks, compared to an alien interface (mismatch

condition).   This finding was in line with previous studies that have indicated that different design features are needed in supporting the different needs of different culture groups (Barber & Badre, 1998; Callahan, 2005; Chau, Cole, Massey, Montoya-Weiss, & O'Keefe, 2002; A.-Y. Chen et al., 1999; Erişti, 2009; Faiola, 2005; Faiola & Matei, 2002; Gould, Zalcaria, & Yusof, 2000; Graff, Davies, & McNorton, 2003; Magid Igbaria & Moshe Zviran, 1996; Jagne & Smith-Atakan, 2006; Luna, Peracchio, & de Juan, 2002; Marcus, 2003; Marcus & Gould, 2000; C McLoughlin & Oliver, 1999; Nam, Kim, Smith-Jackson, & Scales, 2005; Singh, Zhao, & Hu, 2005).

Aforementioned studies were based on the assumption that matching/adapting design and styles could optimize the result of using and/or learning.   Ford and Chen (2000), based on the assumption, conducted an experimental research in exploring interaction and relationship between match and mismatch of instruction presentation style and student's cognitive styles. They found significant differences in performances on conceptual knowledge for students under two different conditions.   Bajraktarevic, Hall and Fullick (2003) explored the very same issue by utilizing the global-sequential dimension (of cognitive style).   They hypothesized in the hypermedia environment, sequential students would work better with liner and hierarchical linking structure, while global students would work better with more navigational freedom; and they have found significant differences on task performance (score) under these two different conditions.

In his experimental research, Faiola (2005) focused on the interaction between designers' cognitive style, as reflected on the website design features, and the responses of cross-cultural users.   The main underpinnings of Faiola's study was to see a website, as a result of a designer's (or designers') cultural cognitive style.   He claimed that users would prefer and have higher

performance on the system designed by the designer(s) from the same cultural background on account of the design would resonate with the user preferences and ability since assumably the designer-user dyad would possess the same cognitive style. Although he approached the adaptive design issue from a different perspective, Faiola's research showed that overall users perform better and have higher level of emotion affiliation with the system when the design features meet their cognitive preferences, as well as expectation.

Although the results of the first hypothesis were consistent with the findings of the aforementioned literatures and researches, which suggested the matching of cultural profile with design features would promote the overall usability of an online learning system. However, for the results of the follow-up tests, in the American group only the performance time was found significantly influenced by the matching conditions. In the Taiwanese group, both follow-up tests were found significant which indicated that both performance time and accuracy were significantly influenced by the matching conditions. A possible explanation for the differences on the performance accuracy on these two groups might be caused by the different cognitive styles associated with respective groups. Previous researches (Nisbett & Norenzayan, 2002; Norenzayan et al., 2002) revealed that Analytic is the predominant cognitive style in America (as well as most of the Western countries), whereas Wholist is the dominant cognitive style in most of the East Asian countries, including Taiwan. Both theory and literature strongly support that analytics compared to wholists tend to have better performance with less structure information organization and longer web pages. In addition, it is suggested that analytics are better self-guided information seekers compared to wholists. That is to say when American participants (with an Analytic cognitive style) exposed to a novel system, compared to Taiwanese participants (with a Wholist cognitive style), they tend to perform better, because they are able to self-guide

and direct their attention throughout the tasks.   Although the system interface was not designed in line with their preferences and ability, however, compared to their Taiwanese counterparts, Americans might encounter less obstacles in conducting information seeking tasks under the mismatching condition.   Conversely, Taiwanese participants, when facing a less structured design (such as the American design), were more possible to succumb to the effect of disorientation and not able to perform, as well as they did in a more structured design (such as the Taiwanese design).

Research Question Two

Does the match of website design features and user preferences produce different levels of perceived usability of interface design in the online learning system?

The results on *t*-tests on PSSUQ scores in both the American and the Taiwanese groups were significant, which indicated that both American and Taiwanese participants on average rated the match design higher than the mismatch design.   These results could be explained by using Norman's theory on *Emotion and Design*.   Norman (2004) suggested that there are three levels, visceral, Behavioral, and reflective, which users respond to a design.   These three levels, although can be discussed separately, however, in reality cannot be compartmentalized and have profound influences on one another (Faiola, 2005).   Norman (2004) stated, the requirements for each level differ widely.   The visceral level is pre-consciousness, pre-thought, and the level where the appearance matters and first impressions are formed.   Behavioral level is about use, experience with a product, it is about the functionality, performance, and usability of the design, and is very sensitive to experiences, training, and education.   It is at the reflective level that

226

consciousness and the highest levels of feeling, emotions, and cognition reside.   Norman (2004) suggested, only in the reflective level that the full impact of both thought and emotions are experienced.   It is the highest level where the factors of culture, experience, education, and individual differences embody and impact, hence it can also override the visceral and behavioral levels, and these three levels correspond to the following characteristics:

Visceral design   >   Appearance and impression

Behavioral design   >   The pleasure and effectiveness of use

Reflective design   >   Self-image, personal satisfaction, memories

In addition, as Norman (2004) suggested, the visceral and behavioral levels are about the immediate feelings that coming from the experiences of seeing or using a product directly. Whereas the reflective level is about the introspective feeling or satisfaction produced by owning, displaying and using a product.   He suggested a person's self-identity locates within the reflective level, and it is where the product and a person's identity interact.   To apply Norman's emotion theory in this study, the PSSUQ scores can be considered as users' responses to the interface in the reflective level, since it asked for the users' perception toward the system after they finished using it.   The emotion responses to design features such as information structures, navigation, as well as presentational design, could drastically alter users' perception on the overall website usability.   Since a person's self-identity is involved in this level, it is suggested, the culturally specific design features might cause the different levels of emotion affiliation of a user, due to a person's cultural identity to the interface design.   In the case of making preferences, people reflect upon their personal experiences, as well as background and attaching a range of values (Faiola, 2005) that ultimately influences and caused the significant difference on the PSSUQ scores under two different conditions.

The aforementioned theory of Emotion and Design can be used to explain the group differences in the PSSUQ scores. In the American group 7% of the variance on the PSSUQ scores was accounted for by the matching condition assigned, whereas in the Taiwanese group 17% of the variance on the PSSUQ scores was accounted for by the matching conditions. In both groups, the mean score of PSSUQ on the match condition were almost identical (the American group 58.52, and the Taiwanese group 58.67). However the mean score differences on the mismatch condition of the American and the Taiwanese groups were almost significant, t (46.52) = 2, p = .051, which showed that Taiwanese participants who were exposed to the mismatch design (EC) assigned noticeably lower PSSUQ score to the mismatch design than their American counterparts (who were exposed to the CE design). This indicated that Taiwanese

Table 36: Group Statistics on Mismatch condition in PSSUQ scores

Group Statistics on Mismatch condition					
	Country	N	Mean	Std. Deviation	Std. Error Mean
PSSUQ Total	American	30	52.967	8.256589	1.507440
	Taiwanese	30	46.933	14.23917	2.599705

participants who were exposed to the mismatch design had much lower emotional affiliation to the system compared to their American counterparts. This finding was contradicting with the thought that Easterners, who possess a dialectical thinking, tend to compromise or hold an accepting attitude when encountering contradictions (Ji et al., 2000). This contradiction might be caused by the factor that in using the mismatch (American) design, overall, Taiwanese participants encountered more obstacles in solving the information seeking tasks compared to their American counterparts. The significantly longer execution time, M=1353.27 (seconds), t(58) = -2.562, p = .013, as well as the lower accuracy on task performance M=10.03, t(58) = 2.761, p = .008 , compared to their American counterparts, might contribute to the significantly

Table 37: Independent Samples t-test of PSSUQ Total Scores for Mismatch Condition in both Groups.

Independent Samples Test

		PSSUQ Total	
		Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		7.025
	Sig		.010
t-test for Equality of Means	t	2.008	2.008
	df	58	46.520
	Sig. (2-tailed)	.049	0.51
	Mean Difference	6.033	6.033
	Std. Error Difference	3.005	3.005
	95% Confidence Interval of the Difference	Lower	.0179	-.0139
		Upper	12.049	12.081

lower emotional affiliation to the mismatch design. As Norman stated, "the behavioral level is about use, about experience with a product, and experience itself has many facets: function, performance, and usability" (p. 37). When users encountered more obstacles, as well as difficulties in using a product, the unsatisfied experiences are encoded and stored in their long-term memory which consequently produce reflective responses that lead them to the conclusion that the particular product is less useful and less productive based on the experiences they had in interacting with the product.

Table 38: Group Statistics on Mismatch Condition in Performance Time

Group Statistics on Mismatch condition

	Country	N	Mean	Std. Deviation	Std. Error Mean
Performance	American	30	1002.633	413.252	75.449
	Taiwanese	30	1353.271	625.516	114.203

Table 39: Independent Samples t-test of performance time for Mismatch Condition in Both Groups

Independent Samples Test

		PSSUQ Total	
		Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F	2.434	
	Sig	.124	
t-test for Equality of Means	t	-2.562	-2.562
	df	58	50.264
	Sig. (2-tailed)	.013	.013
	Mean Difference	-350.638	-350.638
	Std. Error Difference	136.876	136.876
	95% Confidence Interval of the Difference — Lower	-624.625	-625.525
	Upper	-76.652	-75.752

Table 40: Group Statistics on Mismatch Condition in Performance Accuracy.

Group Statistics on Mismatch condition

	Country	N	Mean	Std. Deviation	Std. Error Mean
Accuracy	American	30	11.567	1.794	.328
	Taiwanese	30	10.033	2.456	.448

Table 41: Independent Samples t-test of Performance Accuracy for Mismatch Condition in Both Groups.

Independent Samples Test

		PSSUQ Total	
		Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F	1.013	
	Sig	.318	
t-test for Equality of Means	t	2.761	2.761
	df	58	53.090
	Sig. (2-tailed)	.008	.008
	Mean Difference	1.533	1.533
	Std. Error Difference	.555	.555
	95% Confidence Interval of the Difference — Lower	.422	.419
	95% Confidence Interval of the Difference — Upper	2.645	2.467

Table 42: Independent Samples t-test of performance accuracy for Mismatch Condition in both Groups.

Findings in the Qualitative Phase

Pivotal to the theoretical underpinning of this study was the work of Lev Vygotsky in the Cultural and Historical Activity Theory, which provided a paradigm for the description and understanding of the ways human beings interact with computers within the context of their environment. Twelve participants were invited in participating in the qualitative phase (six Americans and six Taiwanese) to explore and examine the experiences, as well as perceptions of people of different cultures in the process of conceptualizing and utilizing online instructional system interfaces. Findings described how participants perceived and responded to the interfaces designed using different approaches. The dissimilar experiences and perceptions of different groups of participants in different contextual environments provided insights of how design features interact with different cultural preferences and how to design and localize

interfaces based on the cultural profile of the target population. The three major findings and the corresponding discussions are presented below.

Theme 1: The information seeking behavior is similar in process but distinct in execution.

Taiwanese and American participants had different tendencies in perceiving and classifying information, and consequently, these differences caused them to rely on different cognitive strategies in dealing with interface. The execution of the information-seeking tasks is driven or at least influenced by information seeker's perceptions of the system and also constrained by their prior technical background, experiences with similar systems and the structure of the human information processing system (Norman, 2014).

In addition, the execution is modified during the interaction between the information seekers and the system. Since participants were different in preferred cognitive tools, experiences, perceptions and expectations on the interfaces, the ways the tasks were executed therefore were varied. In using the two interfaces provided, participants overall showed the tendency of preferring the interface that was designed/developed in accordance with their cultural profile than the one that was not. However, both groups of participants were able to solve the tasks using both interfaces with some strategic adjustments and modifications. This indicates that participants not only reacted to the interface, but also mentally refigured the interface environment to be congruent with their preferred operating strategies and vice versa.

Theme 2: People from different cultures have different perceptions of design

features.

Participants have their own ideas and assumptions of how and what an online learning system should feel and look like, and consequently have different feelings and perceptions on different design features.   The data indicated that the American and the Taiwanese group showed diversified preferences toward design features.   In detail, on the aspect of information organization, Taiwanese participants preferred a well-organized system with an imposed structure that is able to guide them in finding the information needed, by contrast, American participants preferred to direct their own searching, a more flat and transparent design which displays all of the information in plain sight should be a suitable design for them.

In navigation design, Taiwanese participants worked better on a thematic structure with a focus on the relationship/hierarchic of the information; by contrast, Americans participants preferred a categorical design with a focus on the attribution of the information.   In addition, Taiwanese participants preferred an object-oriented design, and American participants in another way preferred a task-oriented design.

In presentational design, American participants preferred a more casual pictorial-oriented design with more condensed content/object and less unused space presented on the page.   By contrast, Taiwanese participants preferred a design with a more academic feeling but with less components/objects presented on the page.   Both the American and the Taiwanese groups favored the text to be left aligned style.   Taiwanese participants, due the nature of Chinese character writing, favored the design/style with extra tracking and leading spacing, extra spacing is necessary and enhancing the readability of the Chinese content.   American participants, in another way, thought the extra tracking spacing was distracting, but were fine with the extra leading space.   As for page layout presentation, Taiwanese participants preferred a concrete

display that implemented a consistent layout throughout the system.   American participants, by contrast, preferred a more pictorial design that partitioned and divided information into exclusive groups.

Lastly, for the pictorial materials, American participants preferred a website with more visuals and colors, in addition, for American participants, on account of that they were not able to relate to the pictures with Chinese writing and figures, the design of pictorial materials needs to address their specific cultural preferences.   By contrast, Taiwanese participants had no problem with pictorial material with English text and/or Western figures presented, in addition, the use of English text and Western figures in the pictorial materials even gave the system a positive feeling of "internationalization" to the Taiwanese users.

Theme 3: Culturally aware design is a functional interface design approach.

From a user's perspective, the most thing, if not only, a user can perceive directly without further interaction with an interface are the fronted components, such as the outer external design features, icons, color scheme, layout presentation.   Although the usability test involves several substantial factors, form functionality to interaction, it seems the external design features influences greatly on the acceptance of users to interface.   The phenomenon is somehow enigmatic, but we can have a direct implication which is when the design features meet the cultural specific preferences of users, i.e., the interface feels and looks the way as users expected, it tends to promote the satisfaction, or at least, the comfortability of users toward the interface.

Data from the qualitative phase suggested that matching design features to the specific preferences and needs enhance not only participants' satisfaction toward the interface, but also

the perceived usefulness of the interface, which indicated that the culturally aware approach of interface design is not only functional but also indispensable in addressing and supporting the online learning system interface usability.   In addition, the interface determines how learnable, usable and satisfying a system is; therefore the design of an interface influences the way users interact with the system and consequently their performance on the information seeking tasks. This implies that the "look" and "feel" of an interface should depend on the assumptions made up of the information seekers' needs, preferences and abilities.

Integrated Discussion of Findings

Cognitive Styles in Interface Design

Briley et al. (2000), Choi and Nisbett (1998), Davis et al. (2000), Norenzayan et al. (2000), and Peng and Nisbett (1999) have found when dealing with the same stimulus East Asians and Westerners tend to be evoked and rely on different cognitive processes.   The difference in cognitive styles among Eastern and Western cultures is accepted within academia. In the field of CMC, as well as HCI, the interaction between cognitive styles and interface design has been explored to a certain extent.   Previous studies (Carter, 2002; Chen & Macredie, 2004; Leader & Klein; 1996) suggested that cognitive styles might be the most common cause of variations in human–computer interaction, users with different cognitive characteristics tend to develop and rely on different strategies in utilizing computer interface (S. Y. Chen, G. D. Magoulas, & D. Dimakopoulos, 2005).   It is in line with the finding of Ford et al. (2002), they have found the stylistic differences on a range of factors relating to information behaviors which include problem solving activities, perceptions, and attitudes.

Navigation Design

The finding of the qualitative phase was consistent with previous studies on the different perception tendencies of East Asians and Westerns on website information.   Kuhnen, Hannover, and Schubert (2001) suggested, the different perceptions, as well as tendencies on processing web information were mostly caused by the extent to which a person relies on the field, context, as well as situation. They argued East Asians who are more context dependent are easier to be affected by the context to which the stimuli appear; whereas Westerns who are more context independent are tend to processes stimuli as unaffected by the context.   To reflect these two drastically different tendencies in website information perception, Westerners who are field independent tend to assign causality to the objects based on rules about its categorical attribution thus prefer the subject categories to be arranged by the functional attributions, whereas Eastern Asians who are more field-dependent have the tendency of seeing the interaction and interrelationship between context and the objects, prefer the subject categories to be presented on the basis of relevancy (S. Chen, G. Magoulas, & D. Dimakopoulos, 2005).

Information Structure/Presentation

Participants from different country origins also showed different preferences in the ways information was presented in the system.   The findings showed that American participants worked well on the less structured system, whereas the Taiwanese participants preferred to work on a more structured system.   To see this phenomenon in the light of cognitive styles, participants of different countries who possess with different cognitive styles not only favored but also performed differently on different modes of information presentation.

The Eastern world view considers the world as a collection of overlapping and

interpenetrating substance (Nisbett, 1999).   In order to understand how the universe is constituted and functioning, it's vital to first understand the relations, principles, as well as organization of the world.   For Taiwanese participants who relied heavily on the context and the field, it is suggested listing subcategories could help them to understand and get an overview of the subject content of the system, since they tended to apply a holistic strategy on information seeking, meaning they had the tendency to see and understand the relationships between the categories, subcategories and the objects, and relied heavily on the hierarchical structure of the information.   On the other hand, Westerners had the tendency of applying their logic and using their own internal structure to organize information (Reiff, 1996), thus, they worked well, compared to their Eastern counterparts, in a less structured environment.

The findings in this research implied that Taiwanese users (wholists) need more structured information presentation.   When exposed to a less structured system, wholists tend to be overwhelmed and lost in the sea of information, hence their performance on the information seeking tasks was heavily influenced by the structure of information.   However, the information structure seem to not interfere with the Americans (analytics).   Analytics are good at restructuring and/or imposing individual structure on unstructured information, hence, they work well in an unstructured environment.   Chen et al. (2005) suggested web designers need to consider the needs of users with different cognitive styles and provide appropriate visual cues, so the system could provide authoritative guidance for users to restructure the information.

Wholists encounter more troubles in dealing with unstructured information, and prefer external/imposed structure presented by the system.   Thus, a deeper hierarchical design which utilized submenu seem to provide a crutch for Taiwanese users in locating information required to answer the information-seeking task.   Although, generally speaking, in information

architecture breadth is favored over depth, meaning more levels of depth resulted in more problems during searching.   However, the one extra level in the Taiwanese system, which helped to organize and show the content in a conceptual/topical way, seemed to contribute to shorten the information-seeking time of most Taiwanese participants.   The American system, with a flatter hierarchical design, in another way, gave Taiwanese participants the perception of "overwhelming" and even "confusing" in the way it showed too much information and too many numbers of items/options at one time.   On the other hand, the number of categories and objects presented on the pages did not hinder American participants in using the system since analytics are good at self-directing, restructuring and imposing personal structure in information.

Cultural Dimensions and Design

Cultural dimensions are considered to be useful guiding tools in designing user interfaces.   Although some of the definitions and components are not universally accepted (Marcus, 2005), other dimensions are considered to be stable across different contexts and have been proved to be representable in reflecting the culture influences/differences on user interface design.   In this study, several cultural dimensions (Hall, 1960, 1969; Hofstede, 1983, 1987, 1997; Harry Charalambos Triandis, 1995) have been utilized in guiding the design of interfaces; specifically, the dimension of Power Distance, Collectivism vs Individualism, Uncertainty Avoidance, as well as High and Low Context (communication).   These dimensions were chosen for two main reasons: first, they are directly related to the interface design in the specific context of this study; and second, they have been well-researched and are able to be translated and incorporated directly into design guidelines, particularly in the aspects of designing website navigation, information structure, and layout presentation.

Power Distance:

Power Distance refers to the degree to which the less powerful members of a society accept and expect that power is distributed unequally (Hofstede, 1997). It is suggested that people in a high power distance culture value and respect the hierarchical relationship and comply with the rules of the society. Whereas in a low power distance culture, people strive to equalize the distribution of power and demand justification for inequalities of power.

Based on the different tendencies of people in high and low power distance cultures, a more restricted design with imposed structured was utilized in the Taiwanese system; whereas a more open design with multiple access options/paths design was utilized in the American system. The results of both quantitative and qualitative phases indicated that there were significant perception and performance differences in different designs from Taiwanese and American participants. The findings of this research suggested that participants from Taiwan, a high power distance country (58 in Hofstede's report) compared to the United States (41 in Hofstede's report) had the tendency of relying on the external structure (of the website) in solving the information tasks. In addition, they also had the tendency of relying on the relationship and organizational cues in exploring the website. In contrast, American participants preferred a more informal information organizational system, they enjoyed the multiple access options and free exploration; in addition, they tended to focus more on the attribution/characteristic of individual object/information.

The different tendencies of people in the high and low power distance cultures also reflect on their preferences of website layout design. Taiwanese participants showed the preferences on a more formal and academic layout design, which was utilized/emphasized on the

title, image, as well as logo of the institute.   It is suggested that people from a high power distance culture respect the value and the image of the authorities, institutions, as well as organizations, hence they usually prefer the "official" information and trust the information because of the credibility and trustworthiness of the organization (Gould, Zakaria & Yusof, 2000, p.168).   As Fey-Jin mentioned, the academic looks and feels of the design gave her the feeling of trustworthiness of the system, as well as the content.   Whereas, for American participants, they enjoyed a more informal layout design, and thought that the formal feeling of Taiwanese layout design made the interface look not interesting and less appealing.

To reflect the cultural tendencies and preferences in the navigation design, for people in high power distance cultures, an appropriate navigation design approach would be focusing on the hierarchical relationship of the information and arranging the navigation items by their relevancy.   In addition, a submenu which imposes prescribed navigational routes can be implemented in the design.   For information presentation design, as mentioned prior, highly organized and highly categorized structure might be an appropriate approach in designing the information presentation.   Information should be further compartmentalized, and assigned priority to in order for people from high power distance cultures to process and follow more easily.   Finally, for the layout design, a formal layout that is able to present the authority and/or trustfulness of the organization can be used for high power distance culture to increase the credibility and trustworthiness of the website.   In addition, a banner with logo and pictures of the institute should be incorporated to represent the image of the organization.

As for people in the low power distance cultures, a shallower hierarchical navigation design which focuses more on the attribution of individual object/information could be an ideal design.   With a more open structure which provides more explorative options, people from a

low power distance culture might feel more comfortable and be willing to engage in using the system. For information presentation, a simple organized structure with less imposed/prescribed routes can be implemented in presenting the information and provides users with the freedom in exploring the system by themselves. As for the layout design, an informal and more pictorial design might be ideal for them.

<div align="center">Individualism vs. Collectivism:</div>

Individualism, as Hofstede (1997) suggested, can be defined as the extent to which individuals are expected to take care of only themselves and their immediate families. People on the high side of this dimension (individualism) are assumed to be more independent, initiative, and self-responsive; whereas people on the low side of this dimension (collectivism) are assumed to be more subordinated, obedient and self-sacrificed. It is suggested, individualists desire to be unique and prefer to do things in their own ways; in contrast, collectivists tend to submit to the hierarchy defined by the "group" and with no problem in following the rules (H. Triandis, 2001). Based on the different characteristics of individualists and collectivists, in this research two different styles were designed in order to accommodate the different preferences of individualists and collectivists.

Data from the interview showed that Taiwanese, who are characterized as collectivists (score 17 in Hofstede's report), preferred a more role-oriented design in navigation which placed the focus on the hierarchical relationship of an object or a piece of information to the whole system. Whereas, Americans, who are characterized as one of the most individualist cultures in this world (score 91 in Hofstede's report), favored a task/action-oriented navigation design, which emphasized the categorical attribution of the information and the functions/actions of

individual objects.

The different tendencies of individualists and collectivists also reflected on participants' preferences on the layout presentation.   The results in the qualitative phase showed that Taiwanese participants (collectivists) preferred the Taiwanese layout design which provided more relationship cues compared to the American design.   Taiwanese participants felt the information block design although visually appealing, could not help them in perceiving the relationship among the information/blocks.   It is possible that they considered a block as an individual object instead of a part of the superior category.   When the tendency of collectivists on information seeking is relying on the hierarchal relationship (visual) cues provided by the materials, dividing/compartmentalizing the concepts/objects using the blocks might weaken their ability on perceiving the relationship cues, since it might suggest the parallel instead of hierarchal relationship among information/objects.   In addition, it is also suggested that the consistent using of submenu on the left side of the main content Div provided Taiwanese participants the consistent cues on the associative relationship (both subordinate and superior) of the (items in) submenus to the main categories, as well as the corresponding information.

American participants, however, showed quite different preferences on the layout presentation.   It is suggested that individualists tend to have a task/action-oriented mental model (Marcus, 2005).   The data showed that American participants enjoyed the information block design which compartmentalized information by functionality instead of hierarchy relationship. Another factor that might contribute to the preference of individualists to the American system might be the flatter and free access information presentation design.   Without the imposed structure and path, Americans might feel more comfortable in exploring the American system by their own unique ways.

Uncertainty Avoidance:

The uncertainty avoidance dimension expresses the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity (Hofstede, 1997). The literal translation of this dimension to design guidelines is to provide different levels of information clarity and system cues in accordance with the difference preferences of a particular group of people. That is to say, for people from a high uncertainty avoidance culture, i.e., Taiwan, a clear structure, as well as easy-to-perceive visual cues need to be provided in order to decrease the level of anxiety caused by the uncertain and ambiguous situations and encourage participants to engage in interacting with the system. Whereas, for the low uncertainty avoidance people, they do not get disturbed and discouraged by the uncertainty and ambiguity, and are good at guiding and directing their own behavior, thus, it is assumed an open and less-structured design might be a perfect fit for them.

The findings in the qualitative phase were consistent with the previous assumption. The different preferences and perceptions of information organization and layout design might be partially caused by the different levels of uncertainty avoidance of respective countries. Taiwan scores 69 on this dimension and thus has a high preference for avoiding uncertainty (Hofstede). This tendency reflected on their behavior and preferences towards the information system. They favored the Taiwanese system because there was a clear structure and organization of information that they could follow to solve the information seeking tasks. The consistency in the layout design throughout the system which provided clear visual cues of the relationship among the different pieces of information made it easier for them to navigate without getting lost. In addition, the predominate formal, and academic design which looked and felt familiar to the Taiwanese participants gave them the feeling of comfortable and safe, which might also

contribute to their favor of the Taiwanese design. America scores 46 in this dimension, a below average score compared to other countries, which suggests there is a fair degree of acceptance for new ideas, innovations and a willingness to try new things in Americans. This tendency might cause them to be more open to the American design which utilized more diverse page layouts and modern appearance.

The different level of performance in using the different systems might also be partially caused by the different levels of uncertainty avoidance tendencies of respective countries. In a way, the dimension of uncertainty avoidance can also be explained as the degree to which the members of a society accept and rely their behaviors on laws, rules, as well as regulations. It is suggested that the members of a high uncertainty avoidance culture usually do better with explicit rules and guidelines, whereas members of a low uncertainty avoidance culture work better when more leeway is provided. The imposed structure and prescribed navigational paths of the Taiwanese system might be beneficial for the Taiwanese participants since it provided a set of rules for Taiwanese participants to follow, whereas the more open and free-accessed design of the American design might cause Taiwanese participants confusion and even anxiety in self-guiding navigation throughout the information seeking tasks. By contrast, for American participants, the more open design of the American system worked better for them, since, compared to the Taiwanese design, there was more space and freedom provided in the American design.

<div align="center">High Context vs. Low Context:</div>

Hall observed that ''meaning and context are inextricably bound up with each other,'' (Hall, 1989) and suggested that to understand communication, one should look at meaning and

context together with the code.   In addition, he categorized HC cultures as relational, collectivist, intuitive, and contemplative; and communication tends to be more indirect and formal, and draws on the shared knowledge of the communicating parties.   By contrast, low-context cultures are logical, linear, individualistic, and action-oriented and the way of communication is characterized as direct, precise, dramatic, open, and based on feelings or true intentions (Würtz, 2005).   These different tendencies and preferences in communication are assumed to be also reflected on the online communication.

The different perceptions and preferences of Americans (LC) and Taiwanese (HC) might be partially caused by the different levels of reliance on the communication context.   First of all, in the navigation design, American participants showed preferences on a task-oriented navigation design which listed all the possible categories (of tasks/actions) as the navigation items.   In addition, American participants prefer the American layout design which tiled information side by side on one page without further organization.   They thought the Taiwanese design somehow hid the information by imposing sub-categories in the system.   This might be caused by the different preferences on information "transparency."   Information transparency refers to the extent to which the users are required to make an extra effort in order to find the information they are looking for (Würtz, 2005).   LC cultures prefer to work on transparent system which provides a detailed overview and/or the possible options at a glance.

Taiwanese participants almost only relied on the category "Session" which they considered to be the start/highest-rank point of the hierarchy.   Taiwanese not only had no problem in using the sub-menu, but considered the use of sub-category as an appropriate way to organize and structure information.   The preference might be partially caused by the relationship orientation of the HC culture, in addition, the implementation of the "local" or said "consensual"

way of designing and organizing the information presentation provided Taiwanese participants appropriate cues in operating the interface/system. A misconception, however, is to assume that in HC cultures it is solely the responsibility of the information receivers to work on figuring out how to use the system and retrieving the information. The designers/message senders in HC need to provide contextual cues, either by using the design convention of a local way or implementing the shared experiences and/or knowledge of group members, for users to comprehend and follow the information so the online communication can be successfully established.

Visual Design

Visual components are assumed to be one of the features that have the ability to directly alter users' perceptions toward an interface at first glance. It is suggested that attention and aesthetic preferences are highly influenced by cultural resources (Masuda et al., 2008). A great number of studies have shown evidence that by using culturally appropriate visual components, it improves the overall acceptance, as well as usability of online system interfaces (Amant, 2005; Cyr, 2008; Erişti, 2009; Galdo & Nielsen, 1996; Hofstede, 1997; Smith et al., 2004; Sun, 2001). Generally speaking, these researchers considered that cultural elements such as colors, visuals (pictures, icons, illustrations...), and symbols (writing, logo, signs…), influenced the overall acceptance of a particular system. It is suggested that the different levels of acceptance of an interface are usually psychologically and sociologically caused by the different perceptions, expectations and explanations of the visual components of different groups of people.

Although in this study the visual perception issues haven't been fully explored, some of the visual components were proven to have certain effects on the perceptions of the systems. Overall, American and Taiwanese participants have quite different perceptions on the design of

icons, images and typography.   When designing the icons, the Taiwanese design utilized a more

realistic style with neutral colors that was in harmony with and blended into the overall color

scheme, whereas the American design implemented a more abstract style used more vibrant

colors that accentuated and "popped" the individual icons.   It was assumed that participants

would favor the set of icons designed in accordance with their presumed group preferences,

however, this assumption was only proven to be true for the Taiwanese participants.   The

American participants, however, had mixed feelings toward these two set of icons.   Some of the

American participants (Joshua, Eric and Courtney) preferred the Taiwanese set of icons because

the thematic design, that each icon was designed in harmony with the others.   This might be

caused by the perceived quality of the icon design.   As Cyr (2008) suggested, the quality of

visual components related to the satisfaction issue of the users.   The satisfaction of users has

nothing to do with the actual functionality of the icons, for example, when users are exposed to a

fancier or more elaborated design, higher level of satisfaction is usually evoked.

As for image design/selection, it is assumed that using culturally aware symbols,

writings, as well as figures might evoke higher levels of preferences of the members of a

particular group.   This assumption is true for the American group, but is only partially true for

the Taiwanese group.   Overall, both groups preferred the images that design specifically for

them, although for different reasons.   American participants favored the American design

because the use of culturally specific symbols, writings, as well as figures, and less favored the

Taiwanese design with the very same reason; whereas Taiwanese participants favored the

Taiwanese design over the American design due to the culturally specific aesthetic preferences.

However, when asked about their feelings about using English writing and Western figures in the

images, most of the Taiwanese participants felt that they have no problem with that.   It might be

caused by the globalization that English has become the international language in the current economy, and also the long-lasting close relationship between Taiwan and the USA that caused Hollywood productions to be permeating in the mass media of Taiwan.   Taiwanese students are not only familiar with cultural symbols of America, but also welcome them in their everyday lives.   Taiwanese participants thought the use of English text and Western figures gave the system a feeling of "internationalization," which at some level enhanced their willingness in using the materials, even though the set of images were not designed/developed in accordance with their aesthetic preference.

An interesting phenomenon has been observed; Taiwanese participants compared to their American counterparts are pickier on the quality of the images.   They tended to have more opinions on how the illustrations were depicted, and cared more about how banners, icons and logos were used in the design.   It might be caused by the factor that collectivists might have the tendency to focus on and care about the visual clues that provide the information of the relationship and affiliation of a website to an accredited organization/institute.   In addition, as Cyr (2008) explained, for collectivist cultures, a higher quality of visual components usually resulted in higher level of trustworthiness of users to the system.

Conclusion and Implication— Suggestions for Interface Design in a Cross-Cultural Setting

Matching Design features with Group Preferences and Needs

One of the main goals of this study was to investigate means to improve the quality of interface design for different cultural groups.   The results substantiated that matching design features to user preferences and needs enhance not only the perceived usefulness but also the

248

overall performance of the users.   The findings of this study mirror the results of Fullerton's (2000), Ford and Chen's (2000) and Faiola's (2005) which showed that users perform better when the system design matches their preferences and needs; their performance, however, deteriorates when the design mismatches their preferences.   It would appear that the preferences, as well as characteristics of individuals have important impacts on the way they conceptualize and perceive the design of an interface.   In addition, usually a particular group of participants had similar expectations about the design features of an online learning interface and possibly develop very similar pattern/mental model or schema to fulfill their needs in manipulating the system.   Hence, the development of user-centered interfaces and learning environments based on the group needs and preferences would further help the particular group of users not only to become better information seekers but also to become better learners in an online environment.

As Hermeking (2005) suggested, ''a culturally well designed website may be defined as communicating the right information at the right place with the right layout in the right manner and in the right time according to the culture of each of its users.''   When developing an interface under the cross-cultural setting, one must think about what kind of design promote not only the meaningful interaction, but also a positive attitude of cross-cultural users toward the interface.   It is suggested that a culturally-specific design approach could strengthen users' beliefs about system usefulness, influence their perception about system ease of use, and promote their overall attitude of satisfaction in using (Day, 1996).   That is to say, participants have their own ideas and assumptions of what an online learning system should look and feel like, and they have different feelings/perceptions on different design features; hence matching the design features to the culturally-specific preferences could produce the emotional affiliation

of users to the interface/system.

Both groups of participants agreed that a well-designed system could provide support for learning and increase productivity. However, participants showed different preferences on the design features meaning they have different ideas of what good design features are (Connolly, 1996; Horton, 1993, 1994). In addition, simply applying certain design principles doesn't guarantee the success of an interface (and the system) in an international setting. The different perceptions users hold toward the Taiwanese and American system might be caused by the conflicts and inconsistencies among the agencies in the activity system. Human perceptions are social constructs influenced by not only the overall historical/societal context but also the community of practice. The Taiwanese and American ways of thinking, communication, as well as interaction are different in many aspects; these differences, in turn, influence the information seeking behavior of individual from these two different countries.

The data indicated that the American and the Taiwanese groups had different level of preferences toward the same design, which implied that as an artifact, the interface was perceived differently under different cultural environments and conditions. Users bring their prior experiences and notions of what an online learning system interface should be, even though in some cases they might never have any personal experience on using an online learning interface. Since the consensus on how an online learning system interfaces should feel and look like was lacked in different groups, in designing an online learning interface, a cultural lens/perspective is needed to develop a system that is sensitive to the specific preferences and needs of a particular group.

Design Guidelines

Matching design features with group needs and preferences is proven to enhance the overall usability of an interface.   The following section, based on the results and findings of this study, offers some possible design strategies and guidelines in designing culturally aware interfaces for Taiwanese and American users.   In addition, cultural profiles of Taiwan and USA are also presented.

1   Table 43: Cultural Profiles and Design Considerations (Organized by Dimensions):

Dimensions / Countries	Taiwan	America
Cognitive	**WHOLISTIC** **Navigation Design:** - Emphasize the hierarchical relationship. - Show the overall context of the system. - Present Subject categories/navigational items on the basis of relevancy. - Provide supportive navigational tools. **Information Structure/Presentation:** - Show context by listing sub-categories. - Emphasize the harmonious relations among components. - Use deeper hierarchical structure and imposed sequences. - Imposed structure. **Layout** - Contextual design focus on the harmonious relationship among objects and background.	**ANALYTIC** **Navigation Design:** - Emphasize the task/action attributions. - List all possible items in navigation. - Arrange navigation items by the functional attributions or alphabetically. **Information Structure/Presentation:** - Emphasize on the individual functionality of objects. - Provide multiple paths for information. - Use shallow hierarchical structure and present possible options at one time/in one page. **Layout** - Emphasize on the objects and accentuate the functionality.
Behavior	**HIGH Power Distance** **Navigation:** - Emphasize on hierarchical relationship. - Using sub-menu.	**LOW Power Distance** **Navigation:** - Emphasize on the attribution of individual object. - Arrange navigation items alphabetically. - Allow free exploring.

Dimensions \ Countries	Taiwan	America
	Information Structure/Presentation: - Deep hierarchical. - Information should be highly structured. - Use external/imposed structure. - Compartmentalize information and assigned priority. **Layout:** - Formal/academic layout. - Authority and organization oriented. - Use logos and pictures of the institute.	**Information Structure/Presentation:** - Open and simple information structure. - Provide more exploration options. **Layout:** - Informal layout.
	<u>**HIGH Collectivist**</u> **Navigation:** - Emphasize on hierarchical relationship. - Contextual Relationship navigational design. **Information Structure/Presentation:** - Using hierarchical/relational organizational scheme. - Provide relationship cues. - Prescribe path. **Layout:** - Parallel submenu with content.	<u>**HIGH Individualism**</u> **Navigation:** - Emphasize on the functionality of individual object. - Task/action oriented design. - Allow free exploring. **Information Structure/Presentation:** - Use objective organizational scheme. - Emphasize on functionality. **Layout:** - Use information block.
	<u>**HIGH Uncertainty Avoidance**</u> **Navigation:** - Local and contextual navigational system.	<u>**MODERATE Uncertainty Avoidance**</u> **Navigation:** - Open access design, allow free exploring.

Dimensions / Countries	Taiwan	America
	- Navigation schemes to prevent lost. **Information Structure/Presentation:** - Highly structured and organized. - Provide relationship cues. - Impose structure and prescribed paths **Layout:** - Local/predominate design - Consistent layout throughout the system.	**Information Structure/Presentation:** - Less structured - Provide leeway for exploration. **Layout:** - Creative and novel design. - Provide diverse page layouts.
	HIGH Context Communication **Navigation:** - Local and role-oriented navigation design. - Use sidebars and menus. **Information Structure/Presentation:** - Provide contextual and relationship cues. - Use sidebar and/or sub-menu. - Use a "local/consensual" way in information structure. **Layout:** - Using predominate layout design and allow more space. - Use contextual menu.	**LOW Context Communication** **Navigation:** - Task-oriented navigation design. - Show possible actions in navigation. **Information Structure/Presentation:** - Clear and shallow information structure. - High transparency, provide available options at one time/in one page. - Use a "logical way" in organizing information. **Layout:** - Use information blocks, provide both visual and textual information.
Visual	**Images:** - No problem with English text and Western figures in the images. - Soft line with more detail depiction, use less saturated/neutral colors and more background in illustrations.	**Images:** - Use culturally appropriate components. - Use less text in images. - Prefer pictures in which context is subordinate to salient, discrete objects

Dimensions / Countries	Taiwan	America
	- Emphasize on the quality and execution of illustrations. - Prefer images incorporate a great deal of context (Masuda et al., 2008). **Icons:** - Prefer more detail depictions on icon design using harmonious colors. - Thematic design, balance among icons and background. **Typography:** - More tracking and leading space for readability. - Left alignment	(Masuda et al., 2008). **Icons:** - Prefer more vibrant colors and focus on the salient objects on the icons. - Thematic design, make icons stand out. **Typography:** - More tracking space. - Left alignment with equal word-space.

2

Table 44: Overall Design Guidelines Based on Cultural Profiles:

Taiwan	America
Navigation	
- Emphasize the hierarchical relationship. - Textual based and centralized. - Relationship oriented, items presented on the basis of relevancy. - Provide supportive navigational tools, i.e., breadcrumbs, sub-menu and sidebar.	- Emphasize the task attributions. - Visual based and distributed. - Task/Action oriented design, items arranged by functional attributions or alphabetically. - Provide multiple navigational options. - Allow free exploring.
Information Structure	
- Show context using sub-categories. - Use a "local/consensual" way in information structure. - Emphasize the harmonious relations among components/objects. - Use deeper hierarchical structure and imposed sequences. - Information should be highly structured. - Compartmentalize information and assigned/imposed priority.	- Use information blocks and emphasizing on the individual functionality of objects. - Use a "logical way" in organizing information. - High transparency, provide available options at one time/in one page. - Simple/shallow information structure. - Emphasize on functionality and using objective organizational scheme.
Layout/Presentation	
- Parallel sub-navigation/menu with content - Contextual design focuses on the harmonious relationship among objects and background. - Allow more blank space. - Formal/academic design. - Apply predominate local design. - Consistent page layout throughout the system. - Use banner and incorporate pictures and logos of institute.	- Information blocks that provide both visual and textual information. - Emphasize on the object and accentuate the functionality. - Informal design. - Innovative/novel design. - Provide diverse page layouts.

Taiwan	America
Visuals	
Images	
- No problem of seeing English text and Western figures in the images. - Soft line with more detail depiction and using not-so saturated colors in illustrations. - Emphasize on the quality and execution of illustrations. - Contextual oriented.	- Use culturally appropriate components. - Use less text and symbols in the images. - Objective oriented.
Icons	
- Prefer more delicate icon design, using harmonious colors. - Balance among icons and background.	- Prefer more vibrant colors and focus on the saliency of the icons. - Make icons stand out.
Typography	
- More tracking and leading space for readability. - Left alignment	- Appropriate tracking space. - Left alignment with equal word-spacing.

Limitations

This study is subjected to several limitations.   First of all, by using the framework of

Activity Theory, human activities are considered to be mediated by culture, which in many

activity theorists' point of view is an aggregation of beliefs, attitudes, values, social norms, and

standards.   The human-interface interaction, in this sense, is considered to be heavily influenced

by the specific context of a particular society, and can only be understood and analyzed by

looking into the multifaceted interaction among cultures, interfaces, and the individual's consciousness. Since culture is considered to be an aggregation, thus it's impossible for this author to conclude and explain of how and to what extent an individual's perceptions and using behaviors on an interface is caused by and/or resulted from a particular facet/dimension of a culture.

Secondly, the holistic-analytic dimension was used in guiding the cognitive aspect of this study. Therefore, the results of this study might be limited by the fact that the holistic-analytic dimension only embodies one of the several aspects of human cognitive preferences. In addition, in this study, participants were NOT tested for the cognitive style. The assumption of American as an analytic country and Taiwan a holistic is based on the research results of Nisbett and colleagues (Ji et al., 2000; R. Nisbett & Y. Miyamoto, 2005; Nisbett & Norenzayan, 2002; Nisbett et al., 2001; Norenzayan et al., 2002; Peng & Nisbett, 1999). Their results are considered to be reliable and trustworthy in reflecting and explaining the cognitive tendencies of these two countries. However there is a high possibility that people of alternative cognitive style might exist and appear in the respective groups of this study. The existence of these alternatives might compromise the overall representativeness of the sample groups of their respective national cognitive tendency.

In addition, this study used only four cultural dimensions; Power Distance, Collectivism vs Individualism, Uncertainty Avoidance, and High and Low Context (communication), in guiding the cultural aspect of the design. The rationale of using only these four dimensions is they are directly related to the purpose of this study, and they all have been well-researched and considered to be reliable in guiding the system design. However, the results of this study might also be limited by omitting other factors that might also influence the interface perceptions and

using behaviors of individuals in different cultures.   That is to say, if other cultural models or dimensions were employed, it might result in different findings.

Another limitation is the generalizability of the results from this study.   The generalizability of the results is compromised by the small sample size (120 in the quantitative phase and 12 in the qualitative phase).   In addition, the representativeness of the sample of their national cultures might also be a concern in the issue of generalizability.   In this study, the American participants were dominantly white and mainly from a Midwest state where the university was located, hence the results might not be able to holistically represent the national cultural tendency of the United States.   As for the Taiwanese participants, they were from a national university in the southern part of Taiwan.   Although Taiwan has a quite homogenous population, however the regional differences still exist, hence they might not be able to represent the national culture of college students in Taiwan fully.

As far as interface usability is concerned, it tests the extent to which "how well and how easily a user, without formal training, can interact with an information system of a website" (Benbunan-Fich, 2001).   The scope of this study investigate the first time experience of users in the systems, their first impression, and task performed, and the reasons they prefer one system to the other.   The long term effects of the systems on behavior change and/or learning result are not in the concern of this study.

Lastly, in the qualitative phase of this study, the role of this researcher, although is more etic than emic—more of an objective viewer than an inside participant.   However, personal connections still were developed during the process.   This might influence the proceeding of the interview, the following data clarification, and eventually the treatment of the data.   It is likely that a different researcher would have a different experience and different findings from the same

process.

Future Research

Many of the limitations identified during the process of this study have led to the emerging of potential further research areas that may assist in further understanding the interaction between cultural factors and the online learning system design.

First of all, different cognitive and cultural models need to be applied to examine the influences of different aspect of cognitive and cultural dimensions on the interface usability. The strength of individual dimensions, to which the degree of performance affected by the display of high level of a particular dimension, needs to be investigated.   Strategies need to be devised to see the individual effect of each dimension on the interface usage.   In addition, it would be beneficial to understand the interactions among two or more different facets of a culture.   And more specifically to understand the degree to which dimensions interact with each other, and to see if one dimension overrides, counterbalances, amplifies another dimension (or dimensions).

Based on the conceptual model, several guidelines that derived from the cognitive, cultural and visual identity dimensions were proposed.   These guidelines need to be applied in different settings to see not only the practicability but also to verify the validity.   And, it's necessary to expand the study by comparing subjects from a range of diverse cultures around the world and develop "cultural profiles" for different cultures/countries.   Based on those cultural profiles of different cultures/countries, new interfaces could be designed, and future research could be conducted by comparing and contrasting the different interfaces designed to test the

feasibility and availability of cultural profile in addressing different preferences and needs to guide the process of interface design.

In addition, this study only explores and investigates the influence of cultural factors on the perception and usability of navigation, information presentation/structure and visual design components.   Content/learning material development and learner control, which are critical issues in the educational setting, are not investigated in this study.   The different communication tendencies and social/cultural standards and preferences in material editing need to be explored to investigate the issue of learning engagement and comprehension. Furthermore, the different tendency on leaner control also needs to be explored to see the possibility in increasing the flexible learning.   In addition, this study is focused on the design effectiveness of the interface, future research could be conducted to understand the impact of interface design on the academic performance of users as a consequence of using a culturally aware design approach.

Lastly, this study investigates the interface usability issue from the perspective that an interface as an entirety of the combination of the factors of information organization, presentational (layout), navigational, and visuals design.   The usability, thus is an integral of all components of the aforementioned.   Further studies might consider and investigate the relative impacts of the individual factor that influenced cultural preferences by isolating and testing each component to investigate what is the most crucial design element in addressing the cultural preferences and needs.

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271

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Appendices

Appendix I: Information Statement for Quantitative Survey

Information Statement

The Department of Educational Leadership & Policies at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You should be aware that even if you agree to participate, you are free to withdraw at any time without penalty.

The primary objective of this study is to investigate the cultural and psychological considerations in designing/localizing a culturally appropriate learning interface. The content of the study should cause no more discomfort than you would experience in your everyday life. Your participation is solicited, although strictly voluntary, and your name will not be associated with the research findings. Your identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission. Participation in this study may benefit your understanding in some of the ideas in educational technology integration. You will likely complete the survey in less than 50 minutes.

If you would like additional information concerning this study before or after it is completed, please feel free to contact us by phone or mail. Completion of the study indicates your willingness to participate in this study and that you are at least 18 years old. If you have any additional questions about your rights as a research participant, you may call (785) 864-7429 or write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7563, email irb@ku.edu.

Sincerely,

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Appendix II: Information Tasks

1.　　　You just enrolled in an online class, and you want to contact the instructor for some detail information regarding the class.　Now you access to the course website, in order to contact your instructor, please try to find out the information about

　　　a.　Instructor's name,

　　　b.　contact number, as well as

　　　c.　email address.

2.　　　For some personal reasons, you might not be able to participate in the online meeting on Jan. 29th.　However, you want to be procrastinating and preparing in advance for the topic as well as the activity you might miss on that day.　So you access to the course website and try to find out

　　　a.　the name/title of the lesson on Jan 29th,

　　　b.　the activity which will be held on that day, as well as

　　　c.　the due date of the assignment.

3.　　　You are working on the course activity of the e-Portfolio lesson, now you are almost done with it, but you realize you need to upload it to your online portfolio using an FTP application which you haven't installed in your computer yet.　In order for you to complete this activity/assignment and meet the due date;

　　　a.　what is the name of the FTP application (for the Mac computer) that you need to download and install in your computer? (You don't have to download it, just provide the name of the application.)

4.　　　You are writing a statement (as an assignment for) lesson three, as a requirement, you need to elaborate your application of the three different learning theories we mentioned

during the online class last week.   You want to make sure that you cite and use the correct theories in your assignment, now please access to the course website and try to locate the three theories:

    a. Theory 1

    b. Theory 2

    c. Theory 3

5.   You are working on the course activity for the Educational Data session, but you forget the exact requirements for that activity. Now you want to find the information of how this particular activity is evaluated in the course website. In order for you to have a full credit on this activity, how many

    a. columns,

    b. rows and,

    c. formulas, do you need to include in your final spreadsheet project?

Appendix III: The Post-Study System Usability Questionnaire (PSSUQ)

The Post-Study System Usability Questionnaire (PSSUQ)

1. Overall, I am satisfied with how easy it is to use this system.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
  AGREE   DISAGREE

COMMENTS:

2. It was simple to use this system.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
  AGREE   DISAGREE

COMMENTS:

3. I could effectively complete the tasks and scenarios using this system.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
  AGREE   DISAGREE

COMMENTS:

4. I was able to complete the tasks and scenarios quickly using this system.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
  AGREE   DISAGREE

COMMENTS:

5. I was able to efficiently complete the tasks and scenarios using this system.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
  AGREE   DISAGREE

COMMENTS:

6. I felt comfortable using this system.

STRONGLY	1	2	3	4	5	6	7	STRONGLY
AGREE								DISAGREE

COMMENTS:

7. It was easy to learn to use this system.

STRONGLY	1	2	3	4	5	6	7	STRONGLY
AGREE								DISAGREE

COMMENTS:

8. I believe I could become productive quickly using this system.

STRONGLY	1	2	3	4	5	6	7	STRONGLY
AGREE								DISAGREE

COMMENTS:

9. The system gave error messages that clearly told me how to fix problems.

STRONGLY	1	2	3	4	5	6	7	STRONGLY
AGREE								DISAGREE

COMMENTS:

10. Whenever I made a mistake using the system, I could recover easily and quickly.

STRONGLY	1	2	3	4	5	6	7	STRONGLY

COMMENTS:

11. The information (such as on-line help, on-screen messages and other documentation) provided with this system was clear.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
   AGREE   DISAGREE

COMMENTS:

12. It was easy to find the information I needed.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
   AGREE   DISAGREE

COMMENTS:

13. The information provided for the system was easy to understand.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
   AGREE   DISAGREE

COMMENTS:

14. The information was effective in helping me complete the tasks and scenarios.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
   AGREE   DISAGREE

COMMENTS:

15. The organization of information on the system screens was clear.

STRONGLY   1   2   3   4   5   6   7   STRONGLY

AGREE   DISAGREE

COMMENTS:

16. The interface of this system was pleasant.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
  AGREE   DISAGREE

COMMENTS:

17. I liked using the interface of this system.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
  AGREE   DISAGREE

COMMENTS:

18. This system has all the functions and capabilities I expect it to have.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
  AGREE   DISAGREE

COMMENTS:

19. Overall, I am satisfied with this system.

STRONGLY   1   2   3   4   5   6   7   STRONGLY
  AGREE   DISAGREE

COMMENTS:

Appendix IV: Survey Measures of Web-Oriented Digital Literacy

Survey Measures of Web-Oriented Digital Literacy

1. MP3

HAVE NO UNDERSTANDING	1	2	3	4	5	6	7	HAVE A FULL UNDERSTANDING

2. Preference Setting

HAVE NO UNDERSTANDING	1	2	3	4	5	6	7	HAVE A FULL UNDERSTANDING

3. Refresh or Reload

HAVE NO UNDERSTANDING	1	2	3	4	5	6	7	HAVE A FULL UNDERSTANDING

4. Newsgroup

HAVE NO UNDERSTANDING	1	2	3	4	5	6	7	HAVE A FULL UNDERSTANDING

5. PDF

HAVE NO UNDERSTANDING	1	2	3	4	5	6	7	HAVE A FULL UNDERSTANDING

6. Advanced Search

HAVE NO UNDERSTANDING	1	2	3	4	5	6	7	HAVE A FULL UNDERSTANDING

7. Download

HAVE NO UNDERSTANDING	1	2	3	4	5	6	7	HAVE A FULL UNDERSTANDING

Appendix V: Interview Protocol

INTRODUCTION:

Good morning. My name is Hsin-Han. Thank you for participating in this study. This study is aimed at evaluate the usability of two different online learning system that I have been working on with the Department of Educational Leadership and Policy Studies at the University of Kansas. Both systems are comprised of the same lessons for different educational technology topics that are used in a blending learning environment. Our goal is to investigate the effectiveness, efficiency and the desirability of these two different designs.

The first part of today's session involves a task performance survey that will ask you to perform two information seeking tasks (one task for each design). To help me understand your thinking process as you using the different systems, I would like you to "think aloud" which means to verbalize and describe your thinking in detail, which include what you are looking at, thinking, doing, and feeling throughout the process of performing the tasks. I want to gain an understanding of your experiences, and your participation will provide me the insights of how to design and modify the interfaces. After the task performance survey, an after-activity interview will follow. During the interview, you will be asked to compare your experiences on using two different systems provided.

MEDIA RECORDING INSTRUCTIONS:

With your consent, during the session, I will record your using behavior and our conversation will be audio recorded. This will help me to not only capture the essence of our conversation, but also further analyze it.

Part I – Information Seeking Tasks

The first part of this session is the task performance survey, in this section you will be asked to perform two different information seeking tasks, one on each system. The tasks are different in the way of execution but similar in complexity.

The task performance survey window has already been opened in the computer. Please first read the consent information and make sure you understand all the information in this page, and if you decide to participate, please click agree to start the survey. After you click agree, you will be prompted to you first tasks, please read the task description first, then you need to click the link provided to access to the first system. The survey will time and record the number of clicking during your task performance. After you finish the first task, please provide your answer on the text box and click "submit" to submit your answer and proceed to the second task. In the second task, you just need to follow the same procedures as you did in the first task: read the description, click the link provided and provide your response.

Part II – After Task Interview

Please take as much time as you need to recall your experiences on using these two systems. Both systems are opened on the desktop, you can reference, and are encouraged to compare them as much as you need to.

1. Do you consider yourself as a tech savvy person? And from your using experiences of these two system, which one do you prefer more?
2. Do you think your prior internet and/or online system using experiences help you in using these two systems? Can you think of any difference or similarity (like navigation design, data organization, using principle… etc.) that actually make the use of these two systems more difficult or easier?
3. I found that you started your first task by using (the navigation item), can you explain the reason you think it's the appropriate place to start it? (Show interviewee the system and task again), and overall, can you talk about your logics, reasons, and/or strategies in solving the task? (Reference to the observation notes took during the task performance and ask how and why you came to the decision.)
4. (Go to the lesson level for both systems) As you can see here, even though we have identical content in both system, but we use different ways to organize the content, which system, do you think is more convenient to you in conducting the task (number)?
5. As you can see these two systems are quite different in appearances. Which one do you think looks better? Why? (Possible probes: the color scheme, page layout, visuals….)
6. Please compare the two system on the ways they present the content which one do you prefer? (Show the about page and instruction page respectively, and ask interviewee to choose, possible probes: partition ratio, use of local navigation, layout design)
7. Please compare these two sets of image collections, they were from the slide show pictures that have been use in the lessons, which set do you think is more appealing to you aesthetically? And why? (Lead interviewee to the actual page where the pictures are used) When they are used here, blending with the content and the page, which combination do you think is more appealing to you? Why?
8. Please compare these two sets of icon collections, which set do you think is more appealing to you aesthetically? And why? When they are used here, blending with the content and the page, which combination do you think is more appealing to you? Why?
9. Overall, from your experiences, can you choose three to five adjectives (show the Production Reaction Cards) for each system from the list to describe your feelings and experiences in using them?
10. As a user is there any comment or advice you would like to give to the designers who are keen to know the effectiveness, virtues, as well as drawbacks of these two systems? In your opinion, what sorts of things should they be doing to improve the systems?

Product Reaction Cards

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joeyb@microsoft.com and trishmi@microsoft.com
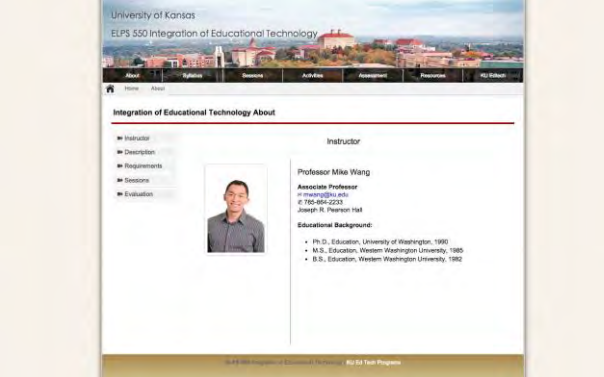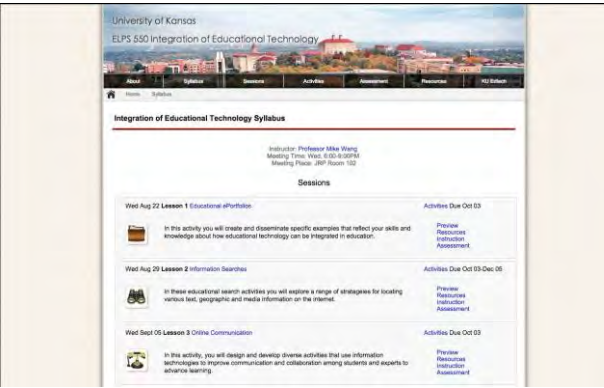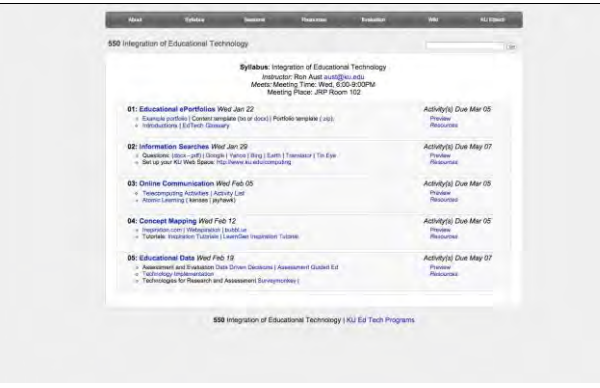
The following table contains all of the words used on the product reaction cards described in the paper *Measuring Desirability: New methods for measuring desirability in the usability lab setting*.

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If you choose to use these cards for your own research, we are very interested in your experience, so we can continue to refine the method.   Please contact us and let us know how it works for you.

The complete set of 118 Product Reaction Cards				
Accessible	Creative	Fast	Meaningful	Slow
Advanced	Customizable	Flexible	Motivating	Sophisticated
Annoying	Cutting edge	Fragile	Not Secure	Stable
Appealing	Dated	Fresh	Not Valuable	Sterile
Approachable	Desirable	Friendly	Novel	Stimulating
Attractive	Difficult	Frustrating	Old	Straight Forward
Boring	Disconnected	Fun	Optimistic	Stressful
Business-like	Disruptive	Gets in the way	Ordinary	Time-consuming
Busy	Distracting	Hard to Use	Organized	Time-Saving
Calm	Dull	Helpful	Overbearing	Too Technical
Clean	Easy to use	High quality	Overwhelming	Trustworthy
Clear	Effective	Impersonal	Patronizing	Unapproachable
Collaborative	Efficient	Impressive	Personal	Unattractive
Comfortable	Effortless	Incomprehensible	Poor quality	Uncontrollable
Compatible	Empowering	Inconsistent	Powerful	Unconventional
Compelling	Energetic	Ineffective	Predictable	Understandable
Complex	Engaging	Innovative	Professional	Undesirable
Comprehensive	Entertaining	Inspiring	Relevant	Unpredictable
Confident	Enthusiastic	Integrated	Reliable	Unrefined
Confusing	Essential	Intimidating	Responsive	Usable
Connected	Exceptional	Intuitive	Rigid	Useful
Consistent	Exciting	Inviting	Satisfying	Valuable
Controllable	Expected	Irrelevant	Secure	
Convenient	Familiar	Low Maintenance	Simplistic	

Appendix VII: Comparison of the American and the Taiwanese Designs

The Taiwanese Design	The American Design
Course level	
Navigation	
About page	
Syllabus page	

Sessions page
Activities page
Resources page
Evaluation page

Lesson level
Navigation
Preview page
Instruction page
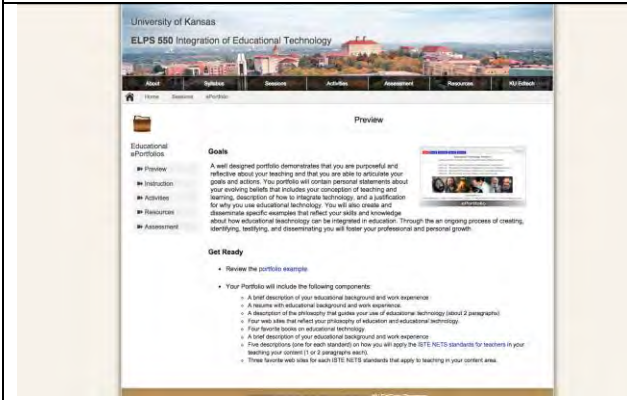
Activities page

Resources page

Evaluation page