Intercultural User Interface Design – Culture-Centered HCI Design – Cross-Cultural User Interface Design: Different Terminology or Different Approaches?

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Abstract. This paper presents the terminology containing several relevant concepts used in intercultural user interface design as well as the results of an analytic study of literature in the area of culture-centered human-computer interaction (HCI) design. Their meaning and application context is analyzed and implications are discussed. Some reviewed examples of related work helped to clarify the issues and to establish a conceptual basis to elucidate the different research approaches in the area of intercultural user interface design.

Keywords: Approach, Terminology, Research Paradigm, Culture, HCI, Cross-Cultural, Design, Intercultural, Culture-Centered, Methods, Tools, Standards, Overview, User Interface Design, User Interface, Human Computer Interaction.

1 Publications in the Field of "HCI and Culture"

"Intercultural research in Information Systems is a relatively new research area that has gained increasing importance over the last few years [..]" ([1]: 17). Publications compiled by the author within the field of research connecting culture and HCI support this and serve to determine the current state of research in this area and to categorize the main research topics in culture-centered human-computer interaction (HCI) design. Using the key words "cross-cultural HCI" when searching the ACM digital library reveals an exponential rise of publications in this area since the year 2000 (cf. [2]). There are several papers in the literature review concerning the usage of information systems in their cultural context. Two of the first important books regarding internationalization of HCI are *Designing User Interfaces for International Use* by [3] and *International User Interfaces* by [4]. Another introduction to the study of cross-cultural of HCI is [5] reviewing the research methodology, the technology transfer and the diffusion of innovation to shed light on the cross-cultural study of human-computer interaction. Another overview of culture and its effects on HCI is given by [6]. [7] reviews cultural information systems research to postulate a shift to a theory of information technology culture conflict. [8] illuminates the relationship between

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culture and computers by a review of the concept of culture and implications for intercultural collaborative online learning. [9] provides an overview of a decade of journal publications about culture and HCI. From this survey several "hypes" can be identified in this area. The first one happened in the early 1990's. The next one was around 2000 and since about 2010 research in intercultural HCI design has steadily increased. In these "hypes" the number of publications is high indicating high research interests and rising effort.

2 Analysis of Concept Usage and Research Approaches

After clarifying the relevant terminology, it will be investigated, whether the same concepts are used differently or whether different concepts are used similarly as well as which concepts are used correctly in the related work. Then the question will be analyzed whether there are different research approaches and paradigms in the area of "HCI and culture.

2.1 Terminology

In scientific context, the interaction, at which information is exchanged between a user and some system via a user interface (UI), is called "human-machine interaction" (HMI) or "human-computer interaction" (HCI) (cf. [10]). The user initiates tasks with the system and the system responds with the results to the user and vice versa.[1] Hence, HCI design need not be used synonymously with UI design. However, in the industrial design context, the meaning of HMI is often defined as "human-machine interface" equaling the concept of "user interface". Similarly, even in the scientific context, the concepts "intercultural", "cross-cultural", "culture-centered" and "culture-oriented" are used intermingled with further related concepts such as globalization, localization, glocalization, internationalization, iconization and culturalization (cf. [11]). In addition, different concepts are applied in the same contents to express the relationship of user interfaces with culture. For instance, the content of the following papers is very similar even if the concepts in the titles are different: "globalization of user-interface design" ([12]), "global and intercultural user-interface design" ([13]), "cross-cultural user-interface design" ([14]), "international and intercultural user interfaces" ([15]), "globalization, localization and cross-cultural communication in user-interface design" ([16]) and "Cross-cultural user-experience design" ([17]).[2] To put it in a nutshell, when relating HCI and culture, the relevant terminology is not used coherently at all times.

[1] The system can be a machine or a computer. The concept of HMI is used so that it subsumes HCI because computers are special machines. Even if there is a difference between HCI and HMI, it is often wrongly confused.

[2] This is also supported by the fact that the content of these papers was created by the same author.

2.2 Concepts

At least the following concepts are used in the area of HCI / user interface design and culture:

- Cross-cultural HCI / user interface design ([14], [18]),
- Culture-oriented HCI / user interface design ([19]),
- Intercultural HCI / user interface design ([20], [21], [22]),
- Culture-centered HCI / (user) interface design ([11]).

Supported by the analysis in section 2.1 above, it can be assumed that these concepts are also similarly used to express similar meanings, i.e., taking cultural aspects into account in HCI design.

However, their connotations are different inclining the concepts to be applied differently in diverse contexts. Intercultural HCI design means the process of HCI design in the cultural context (cf. [23]: 42-43). According to [19], intercultural HCI design describes the user and culture oriented design of interactive systems and products taking the cultural context of the user into account with respect to the respective tasks and product usage ([24]: 87). [23] presented the steps of this process called "intercultural usability engineering" (cf. [23]: 60 et seq.). This approach has grown in academic literature from 1990 to 2000 and has emerged from the processes of globalization, internationalization, and localization of products. In addition, [14] required that cross-cultural HCI design should account for dimensions of cultures (cf. [14]). [11] introduced the culture-centered HCI design process based on research on cross-cultural interface design (cf. [14], [19]) and cross-cultural user experience design (cf. [25]) applying iterative analysis to take the target users and their cultural needs into account.

In addition, there are differences in meaning between the concepts "intercultural" and "cross-cultural" as explained by [26]. "Intercultural" variables represent knowledge that can be obtained only by observing at least two cultures and their differences, i.e. doing intercultural research (cf. [26]) to obtain relevant knowledge for the internationalization of software and system platforms. However, they can simply also be called "cultural" variables, because the values of those variables represent knowledge for a specific culture (relevant for system and software localization).

2.3 Approaches

[27] "developed an HCI cross-cultural design approach [called Meaning in Mediated Action (MMA)] which focuses specifically on how representations and meaning mediate action" ([27], p. 307) dealing with *cultural diversity* and differentiating between systems targeted for particular cultures and systems intended to be shared by culturally diverse users, because "existing approaches are inadequate for dealing with this issue." ([27], p. 287). This approach was referenced by several of the approaches that followed in the area of "HCI and culture". [24]: 108 developed an approach for the design of intercultural human-machine systems using the "method of culture-oriented design" (MCD). The MCD integrates factors from established concepts of

culture-oriented design into existing concepts of HMI design. Knowledge about cultural differences is thereby integrated into existing methods. [28] found out that the global software development life cycle works efficiently for multicultural societies such as Malaysia in contrast to the Western driven usability assessment techniques. [29] developed a cross-cultural interface design strategy with four phases:

1. Investigation: determination of user behavior, identification of social and cultural factors and assessment of different indigenous user attitudes,
2. Translation: generation of a consistent cultural model based on the output of the investigation phase to identify and illuminate similarities and differences of the user groups,
3. Implementation: utilization of the cultural model to create internationalized/localized prototypes to perform usability tests with indigenous user groups,
4. Evaluation: analyzing results, optimizing the prototype using iterative loops in order to reach the final product.

The authors emphasized the insights from [20], [30] and [31] as vital and based their work on them along with others such as [4], [28], [32], [33], [34] and [35] and, in fact, their approach resembles the MCD-approach of [24]. [36] provided an overview on the theory and methodology as well as the user interaction paradigms and technologies in the area under discussion (entitled "Cross-Cultural Design"). The authors wandered in this overview from cross-cultural psychology, physical ergonomics and anthropometry to graphical user interfaces, web and hyper media as well as mobile computing and presented the related methods. They elucidated all these areas in the light of culture and described the activities there. Therefore, "Cross-Cultural Design" as used by [36] is rather more a "headline" than an approach: the activities and methods used in this area were summarized and labeled by "cross-cultural design". [36] identified the following authors providing first milestones in cross-cultural HCI design: [31] and [37]. [14], [15] extrapolated user interface design guidelines from the classic works of Hofstede (cf. [38]) and Hall (cf. [39], [40], [41]). "A less explored direction of cross-cultural design research has focused on cultural differences in cognition." ([36], p. 183). [42] and [43] worked on cultural differences in user interface information structures and in cognitive styles respectively.

[11] "addresses culturally rooted factors within user interface design. The design implications of globalization are discussed, together with the related processes of internationalization, localization, 'globalization', ionization and culturalization in order to establish a basis for a new approach to HCI design. The potential for a more diverse culture-centred, design-based system —'Culture-Centered Design' (CCD) is introduced, and a CCD process developed. A redesigned computer interface, incorporating a consistent and culturally rooted metaphor for a Chinese user target group is discussed. A culturally specific 'garden' metaphor is developed and applied as an alternative to the current global 'office' or 'desktop' metaphor. A working demonstration of the interface is piloted with a group of Chinese users to assess its success in terms of interactivity, usability and cultural significance. The overall results of the first two evaluation phases have shown very positive outcomes for the use of the CCD system and Chinese garden metaphor." ([11], p. 1).

Within this approach, [11] focuses on culture-centered interface metaphors (e.g., [44]) as well as on iterative analysis taking into account Nielsen's usability engineering lifecycle model and Apple computer HCI guidelines as well as guidelines from ISO and W3C in order to cover the value of the user's cultural context. However, the simplified CCD process is similar to the standard usability process defined in ISO 9421-210 (cf. [45]) focusing on social and cultural aspects and does not differ significantly from the other approaches called intercultural design, culture-oriented design or cross-cultural design because [11] based their approach called "Culture-Centered Design" on the work of [12], [19] and others, who refer to cross-cultural interface design as the authors themselves admit: "The authors hereby introduce a new culturally oriented system, namely, Culture-Centred Design, whose development was based on existing literature and research by Marcus, Röse and others, who refer to cross-cultural interface design (Aykin, 2005)." ([11], p. 9). Even if, the CCD approach is a holistic one, i.e. a complementary view to existing design methodologies such as a task-centered design process considering research on target user group related to cognition and usability taking into account the end user's as well as the designer's view by appropriate "filters", i.e. lenses, it is very similar to the approaches of [23] and [24], who also emphasized the minimal gap in the socio-cultural background between user and designer. Therefore, the contrasts between the previous approaches that served as basis for CCD (cf. [24] and [23]) are not so different from CCD.[3]

Hence, in sum, there are no really different approaches related to the different concepts discussed in section 2.2 above. However, surveying literature in the area under discussion revealed that there are approaches used for the same purposes in the area which, however, are named totally differently from the concepts discussed before. For instance, one such approach is semiotic engineering. Semiotic engineering was suggested by [46] for user interface languages and by [47] for HCI. Since then, the group of De Souza worked on this approach to make it useful for HCI design and suggested 2012 metaphors for guiding the design of cross-cultural interactive systems. Semiotic engineering is considered to be a valuable approach to HCI (interface) design and a relevant and promising framework in the intercultural field (cf. [48]), because it can be combined with culture and HCI to take into account cultural aspects in HCI design (cf. [49]). In semiotic engineering, HCI is seen "as a two-tiered communicative process: one is the designer-to-user communication and the other is the user-system interaction. [..] HCI can only be achieved if both levels of communication are successfully achieved." ([47]: 55). [50] developed the communicability evaluation method taking into account "that interactive systems are metacommunication artifacts, by telling designers, in a number of ways, how well their message is getting across." ([47]: 56, cf. also [23]). The semiotic engineering approach complements cognitive and social theories useful for intercultural HCI design by providing new perceptions on the process and products in HCI design.

[3] Nevertheless, the application of CCD on the analysis of the desktop metaphor for the Chinese context led to the insight that the garden metaphor is more appropriate for Chinese users, which could cause a shift to the use garden metaphors for Chinese user interfaces in the future.

3 Discussion

It is important to consider fundamental cultural differences when dealing with members of cultures interacting with machines. Hence, the most important step is still to bridge the gap between cultural aspects and HMI design by determining relevant cultural parameters for intercultural user interface design using analytical research and empirical tests. Hence, it is necessary to perform research in this area by using existing, or introducing new, methods such as analyzing critical interaction situations between humans and computers or machines. Good opportunities for the transmission of intercultural competence are "critical incidents" (cf. [51]). Analyzing critical interaction situations between humans is a well-known method to find differences among cultures (cf. [52]). In addition, it is reasonable to apply the fundamental process, stated by "Grounded Theory" (cf. [53]) for research areas, which are still not completely analyzed in detail such as intercultural HMI design with its gaps in research until today. Furthermore, grounded theory constitutes an iterative scientific process similar to iterative software development cycles. Both, grounded theory and iterative software development can be underlying methods for all approaches in intercultural user interface design. Moreover, there are several research communities all over the world concerned with culture-centered HCI design applying different concepts and similar approaches for intercultural user interface design (IUID). These communities are centered on the people who strongly push the research towards culture-centered HCI design. Even if, there are several links between these communities by expert networks or personal meetings at conferences such as INTERACT, IWIPS, CHI or HCII or workshops such as "Re-framing HCI through Local and Indigenous Perspectives" (cf. [54]), most approaches settle on older ones without being completely new or establishing a new research paradigm.

4 Recommendations

As shown above, there is no systematic holistic approach integrating the benefits of all approaches to yield synergy effects and resulting in the universal basic approach that could be used by all researchers for intercultural user interface design. Therefore, the author suggests bundling the efforts of the research community to establish a general framework and approach to profit from it in (applied) research as well as in industrial design in the future. Furthermore, one of the most important objectives in intercultural HMI design is still to show developers of international products a way to develop their products such that they can be offered successfully in the global market. One of the most important tasks thereby is to explore the intercultural differences (e.g., different color meanings or cognitive styles) and then to consider the implications of the identified differences in designing intercultural HMI (e.g., different operation state colors, browsing style). Relevant cultural variables for intercultural HMI design have to be determined and specified by literature review and requirements analysis. The values of cultural variables show culture-dependent variations that can

be exploited for intercultural user interface design. They can be found on all levels of HMI localization (surface, functionality, interaction) (cf. [24]). Here, also cultural universals [55] and universal design [56] should be taken into account in order to yield aspects for universal design and to reduce overall research efforts: the more universal aspects independently of culture can be applied the less cultural differences must be determined empirically. Finally, the empirical qualitative and quantitative analyses of the values of the cultural variables need to integrate the results into cross-cultural HMI. In addition, the author recommends that "intercultural variables" are to be preferred in cases where the intercultural research character for obtaining the values of the variables is meant and "cultural variables", when mainly the usage of the values of the variables themselves (concerning a specific culture) is important. For instance, "Intercultural" usability engineering is a method for designing products of good usability for users from different cultures ([23]). "Intercultural" in this context refers to the special methods that are necessary to do usability engineering for different cultures (cf. [26]). The term "intercultural usability engineering" is commonly used by German usability engineers (cf. [21]) whereas outside Germany researches often use the concept of "cross-cultural usability testing" (cf. [57]) that must be conducted in order to yield good "cultural usability" (cf. [57]).

5 Conclusions

The analysis of the different concepts in the field of "HCI and culture" revealed that there is no basic concept permitting consensus among researchers in order to generate a sound terminological framework in this area. The extension of the concept of "user interface design" contains "HMI design" as well as "HCI design". The author suggests using the concept of "*Intercultural* User Interface Design (IUID)" instead of the manifold combinations of the concepts analyzed in this paper in order:

- (i) to express the relationship between user interfaces and culture,
- (ii) to avoid fruitless discussions concerning HMI and HCI as well as
- (iii) to emphasize the necessity to consider at least two cultures (that of the designer and that of the end-user) connected by the word "intercultural".[4]

In addition, the analysis of some of the most relevant approaches in the area of "HCI and culture" indicated that there are no different research paradigms but rather different concepts for the same research paradigms even though it is not easy to determine the differences within these approaches because most of them are not systematic enough. Instead the investigated approaches are (i) related to each other and (ii) use several methods and techniques which (iii) are not systemized within one general approach. Further comprehensive analysis of the state of research must show if these conclusions can be generalized.

[4] Even in the broadest sense of the meaning of the concept it would be also reasonable to say "design for cultural contexts" or "culture-centered design".

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