A Review of Empirical Intercultural Usability Studies

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Abstract. In this paper, we discuss the applicability of usability engineering methods to software engineering projects in intercultural contexts. We have conducted a review of 55 empirical studies from the field of intercultural usability engineering. Categories from ISO TR 16982 were used as a classification framework.

1 Introduction

This paper presents first results of a literature review of usability engineering methods in intercultural interaction design and usability engineering projects. Our goal is to describe which different types of methods have already been researched regarding their applicability in intercultural contexts. A sample of 55 articles is analyzed and categorized according to the methodological framework given in the international standard ISO TR 16982[1] (Ergonomics of human-system interaction – Usability methods supporting human-centered design) [1]. Besides a quantitative analysis we also discuss qualitative aspects of method usage and conclude with a brief description of future modifications in the review procedure and scope of analysis.

2 Motivation and Objectives

In intercultural software development projects people from different cultures are confronted and work together as, e. g., moderators, subjects, programmers or, more generally, as stakeholders. These people obviously differ in nationality and native language. But there are also subtle differences in patterns of non-verbal communication and values that guide their behavior. These distinctions have presumably impact on the procedure and also on the results of usability engineering methods. Therefore the applicability of methods should be investigated.

In studies which address this topic, three main reasons are given, why the application of specific usability engineering methods should be considered in research: One reason is the origin of methods: The majority of methods was developed in the western world

[1] The standard is going to be replaced by ISO 9241-230 [66]. We have used the scheme from ISO TR 16982, because in the current state of the new version the distinction of methods seems to be too fine-grained and the standard is not yet finished.

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and therefore the adequacy and applicability of these techniques outside their original cultural context is questionable ([2], [3], [4]).

The second and more relevant factor is the impact of culture on the results of usability testing methods which could be observed in some studies. [5] conducted an evaluation with both, subjective methods as well as objective evaluation methods. As objective measures task completion and errors were reported and questionnaires and interviews were used as qualitative methods. The results of both method types did not correlate. The users' performance with the system tested was poor but the results of the questionnaire and interview were positive. The different outcomes were attributed to the culture of the subjects from the far east, who probably were afraid of losing face.

Besides the effect of culture on the results of a method, specific problems with the practical application of the method itself were observed. Evers used three different techniques to evaluate a university website: Interview, thinking aloud and questionnaires. Participants with different cultural background were tested with the same procedures. Subjects were divided into four groups: UK, USA, NL, JP. Depending on the culture of the subjects specific problems could be observed with the methods: Japanese participants had difficulties to speak out loud during the thinking aloud while North American subjects seemed to answer the questionnaire in a quiz-like manner and tried to give the appropriate, "right" answer [6].

3 Review Methodology

In our ongoing literature review current research from the field of intercultural usability engineering is collected and classified into different categories of usability methodology. The goal of this analysis is twofold: First, we want to identify clusters of research, methods that have been widely investigated, but also gaps where research appears to be missing. Second, the classification serves as a framework for clustering best practices in the future.

3.1 Data Sources

Articles were taken from four different databases:

- Proceedings from the *International Workshop on Internationalization of Products and Systems* of the last two years (IWIPS 2010, 2011)
- A current handbook on intercultural design [7] (References from the chapter „methodology" were analyzed)
- *HCI Bibliography* (http://hcibib.org), an international bibliography for literature in the domain of human-computer interaction studies
- *Digital Library Mensch-Computer-Interaktion* (http://dl.mensch-und-computer.de), a digital library collecting HCI literature primarily from German language countries.

3.2 Selection of Articles

The following three criteria were defined to model the requirements for further analysis. Only articles which met all three criteria were investigated and classified:

1. Explicit focus on at least one usability engineering method
2. Empirical nature of research: usability engineering methods are applied in a empirical study
3. Intercultural context: A usability engineering method is investigated with regard to a specific culture, or several cultures in comparison.

3.3 Classification Framework

As a classification framework we have employed the classification of usability engineering methods from the Standard DIN EN ISO TR 16982 „Ergonomics of human-system interaction – Usability methods supporting human-centered design". We have selected this standard as a reference framework because it appears to be a reliable and distinct source of different categories and a good starting point for getting an overview over the field of investigated methods. The standard describes twelve classes of usability engineering methods. We conflated Expert evaluation and Document based methods (Table 1).

Table 1. Classification of usability engineering methods from DIN EN ISO TR 16982

Direct involvement of users	Indirect involvement of users
1. Observation of users 2. Performance measurement 3. Critical incidents analysis 4. Questionnaires 5. Interviews 6. Thinking aloud 7. Collaborative design and evaluation 8. Creativity methods	9. Document based methods/Expert evaluation 10. Model based approaches 11. Automated evaluation

Process was added as a category to that model in order to capture research that investigates the process of usability engineering. For some methods from the standard a short description is provided in the appendix, if the according techniques to a term were vague (see Table 2).

4 Results

So far, we have classified 55 empirical studies with respect to the framework which were published between 1996 und 2013. The following diagram shows the distribution of publication dates:

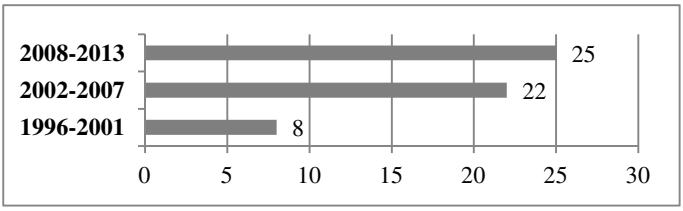

Fig. 1. Publication dates

A quantitative analysis of classes shows that the majority of studies employed *interview techniques*, 21 studies out of 55 conducted interviews. The second most frequent methods are *questionnaires* and *thinking aloud*. They were used 19 respectively twelve times. Half as much studies used *performance measurement methods* or *collaborative design and evaluation techniques*, for each category ten studies out of 55. In eight articles users were *observed*.

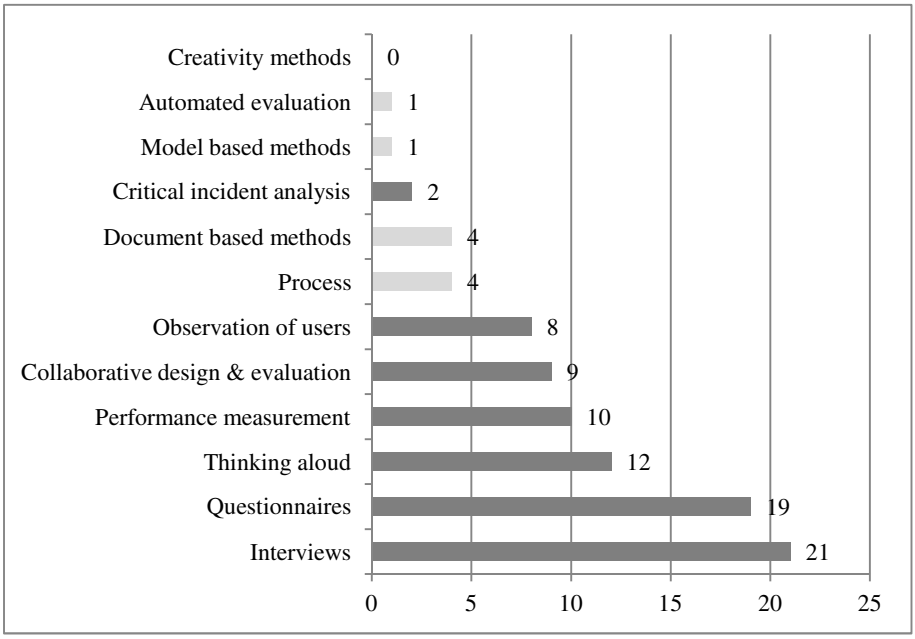

Fig. 2. Classification into categories from DIN ISO 16982

Four times the process of usability engineering in intercultural contexts was regarded and document based methods like style guides were used to evaluate or design an application.

The remaining usability engineering methods were investigated less often in our sample, with frequencies ranging from zero to four times. Details on the classification are given in the appendix (see Table 3).

5 Conclusion

Due to the small size of the sample, quantitative results must be interpreted with caution. It appears that methods with direct involvement of users are investigated more often. Methods like thinking aloud, interview and questionnaires can be identified as dominant areas (clusters) of intercultural research.

Different reasons are plausible for this observation: First, direct involvement of users leads to more potential bias in usability engineering methods and therefore these methods are more questioned. Second, there are more relevant sources for adoptions from other disciplines available, like guidelines for the application or translation of surveys ([8], [9], [10], [11]).

Beyond the quantitative disproportion of research conducted among the different methods, there are some interesting qualitative findings. In the empirical intercultural usability studies four categories of qualitative information can be found:

- Differences in the implementation of a method ([12], [13])
- Differences or bias in results: negative correlation between results of quantitative and qualitative methods [6], more usability problems with certain moderator-subject combinations [14]
- Description of specific problems of one culture with a specific method ([6], [15], [16])
- Recommendations or best practices: Rules how to adopt to subjects needs to prevent problems or bias ([17], [18]).

6 Future Research

To get more detailed and representative insights the review will be continued with an expanded database and modified review procedure. In addition to the already considered databases following sources will be included:

- *Web of Knowledge* (http://www.isiknowledge.com/)
- *ACM* und *IEEE CS* digital libraries
- Research platforms of the publishers *Springer* and *Elsevier*

The review methodology will be modified regarding selection criteria and also in scope of analysis. During the collection of a sample of empirical usability studies we found that relevant information about localization of methods can be found outside the discipline boundaries of HCI research. A good example is the guideline from Schaffer and Riordan, who describe in detail how to accommodate research in a intercultural context [19]. Their work includes several adoptions and recommendations which can also be applied in usability engineering. Thus, the selection criteria will be accommodated and also non-usability studies will be collected, just as non-empirical work, which can potentially bundle best practices ([20], [21], [22]).

Beyond these selection requirements, the scope of investigation shifts from quantitative analysis to a more qualitative approach. Not only usability methods will be regarded, but also the three typical observations mentioned above: Best practices, specific problems and observed bias. All these modifications provide the basis to build a framework of prevalent problems and their solutions.

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Appendix

Table 2. Brief description of method categories in DIN EN ISO TR 16982

Observation of users	Collection of information about the user's behavior and the performance in the context of a specific task during user activity.
Performance related measures	Collection of quantifiable measurements (time to complete a task, number of errors, number of commands).
Critical incidents analysis	Systematic collection of specific events (positive or negative). Incidents are described in the form of short reports which provide information about the context.
Collaborative design and evaluation	Methods which allow different types of participants to collaborate in the evaluation and design of a system. Users play an important role in design and evaluation. (*card sorting*[1]*, prototyping, cultural probes)*
Creativity methods	Methods which involve the elicitation of new system features usually extracted from group interaction (*Creativity techniques like SCAMPER, six thinking hats.)*
Document based methods/ Expert evaluation	Usability expert uses existing checklists or documents /his own judgment to carry out design or evaluation. (evaluation based on style guides, handbooks, standards, evaluation grids)
Model based methods	a) Formal methods that are based on models to predict users performance (KLM, GOMS) b) User interface specification and design methods are applied to create models of users behavior (flow chart diagrams interaction diagrams, state diagrams or task descriptions; *use cases, stories, scenarios, personas)*
Automated evaluation	a) Algorithms are used which focuse on usability criteria and are able to diagnose the deficiencies of a product (perceptive screen complexity, presentation quality) *b) automated collection of user data* (*web-logs).*

[1] Methods formatted in italics were added by the authors to clarify the categories.

Table 3. Explicit Classification of the sample

Method	References	#
Observation of users	[23][6][24][25][26][27][28][29]	8
Performance measurement	[5][18][30][31][32][33][34][35][29][36]	10
Critical incident analysis	[37][18]	2
Questionnaires	[5][17][6][34][16][30][38][39] [40][37][27][33][15][41][42][35] [43][29][44]	19
Interviews	[14][5][45][46][24][47][48][3][16][25][38][49] [26][27][50][51][52][41][28][42][35]	21
Thinking aloud	[12][13][51][15][6][16][53][27][54][34] [41][29]	12
Collaborative design	[2][55][56][57][58][52][59] [46][28]	9
Document based methods	[36][60][61][62]	4
Automated evaluation	[16]	1
Model based approaches	[36]	1
Process	[4][63][64][65]	4