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Information Classification on University Websites: A Two-Country Card Sort Study

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Abstract. Websites are increasingly used as a medium for providing information to university students. The quality of a university website depends on how well the students' information classification fits with the structure of the information on the website. This paper investigates the information classification of 14 Danish and 14 Pakistani students and compares it with the information classification of their university website. Brainstorming, card sorting, and task exploration activities were used to discover similarities and differences in the participating students' classification of website information and their ability to navigate the websites. The results of the study indicate group differences in user classification and related task-performance differences. The main implications of the study are that (a) the edit distance appears a useful measure in cross-country HCI research and practice and (b) the comparative approach of thematic and taxonomic analysis can be used to understand classification and website structure.

Keywords: website structure, information architecture, classification, categorization, card sorting

1 Introduction

It is often a challenge to retrieve information from large complex websites such as university websites. The challenge may, however, not be the same in different countries. A central issue in good website design is the classification of the information on the website (Dumais & Chen, 2000; Lakoff, 1990; Parsons & Wand, 2008). If the website information is classified in a manner that fits well with the user's perception of the topics, then information retrieval on the website is efficient, and may even be experienced as satisfying (Bernard, 2000; Cole et al., 2007). Most of the cross-cultural studies of websites have focused on the usability, language biases, and structure of Asian and Western websites. Little work appears to have been done investigating the structure of the websites in communities that have recently joined the global

Internet community (ElSaid & Hone, 2004). In this study we compare two websites – a Danish university website and a Pakistani university website – to investigate differences in their structure, and whether these differences match the way in which the local users of the websites classify information.

In existing website studies, the content holders are usually seen as the ones who determine how the information is structured (Bachiochi et al., 1997). It is, however, well-known that designers' decisions about the structure of a system may not match how users think about the system (Norman, 1986). This problem intensifies in cross-cultural settings where designers with one cultural background make websites for users with another cultural background. Two ways of improving our understanding of the interrelation between cultural background and website structure are to (a) compare across countries the structure of websites developed and used locally and (b) study how well the structure of such websites matches the way in which the target users classify the information that is accessible on the website. In this study we do both, by having Danish and Pakistani university students make card sorts of the information on their respective university websites and find information on the websites. We chose university websites as our object of study because university websites in different countries must provide support for a similar set of activities (e.g., information about available study programmes, about class schedules for current courses, and about access to resources such a libraries). We chose Danish and Pakistani university websites for this study because there are sizeable cultural differences between these two countries and because website structure and use in Pakistan has not received much research attention.

In the next section we describe literature relevant to the classification of information, particularly website information. Then, we explain the method of our empirical work, which comprises brainstorming, card sorting, and information-retrieval tasks, and we present our results. Finally, we discuss implications of the results and possible extensions of this study.

2 Relevant Literature

2.1 Information Classification

In website design, the classification determines how information is distributed across different hierarchical levels of website pages and what labelling is used to group information on a webpage. Websites use different classification and navigation structures such as linear, tree, network, and global structures (Broughton, 2001; Morville & Rosenfeld, 2006). Barber and Badre (1998) identified the localized elements of an interface (i.e., the elements specific to a given culture) and termed them cultural markers. But cultural markers emphasize only the interface elements that are preferred within a particular cultural group and do not talk about the classification of the website information. Different countries may display profound differences in the structure of website information. The research of Isa et al. (2008) explored the relationship between culture and website structure. The study found that users have their own understanding of the structure of the information on a website, and that this understanding differs across groups of users.

The placement of information at different levels of a website affects its findability. Allen (1983) investigated the effect of information depth on the response time and error rate at each hierarchical level of a website. Response times became longer for searches deeper into the

website, and the study participants made more errors when the information to be retrieved were at deeper levels (Allen, 1983). Researchers have compared the knowledge representation of students in US, mainland China, and Taiwan on four websites (Rau et al., 2004). For participants from Taiwan and mainland China, the study showed advantages of a thematic structure with respect to error rate on information-retrieval tasks. The reserach of Kralisch et al. (2006) investigated the impact of culture, language, and medical knowledge on users' information categorization. The study found that culture influences the users' preferences in information categorization, their attitudes, and their behaviour, whereas language predominantly affects the users' beliefs about ease of use and usefulness. On the basis of a large data set about national cultural differences, Hofstede (1980) has developed the concept of cultural dimensions.

2.2 Mental Models and Website Structure

A mental model is a cognitive structure of concepts and procedures that users apply when selecting the relevant goals, choosing and executing appropriate actions, and understanding what happens when they interact with a computer system (Carroll, 2003). The concepts of classification and categorization are used interchangeably in the literature on human-computer interaction (HCI), information management, and information systems. A classification is a clustering of information that shares a common property (Bowker & Star, 2000; Lakoff, 1990). It is a set of metaphorical boxes that contain information with common themes (Lakoff, 1990). In addition to information classification and navigation on websites, culture is an important aspect of website structure. In this study we explain culture as information-classification tendencies shared by a particular group of people with the same nationality, and we describe their mental model using card sorting.

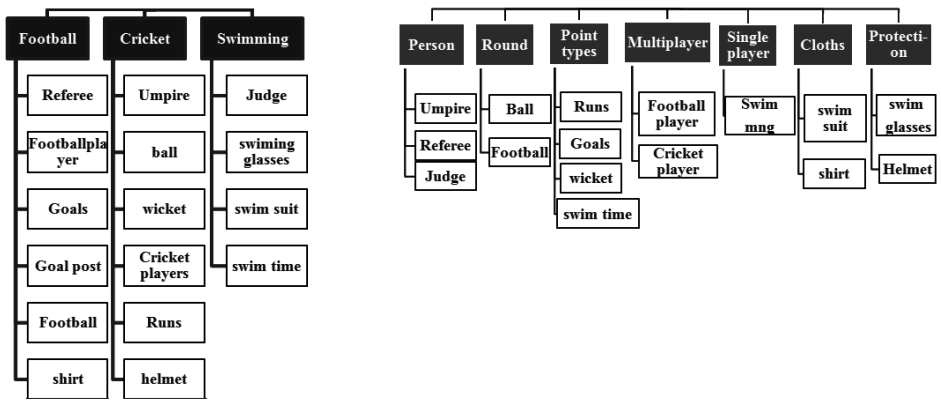
Figure 1 presents a more complex example that is closer to a website structure. Figure 1(a) is a thematic classification of items into three groups. The items in each group of the thematic classification are related to each other and can be explained without the group names *'football'*, *'cricket'*, and *'swimming'*. The classified items in the thematic classification have a coherent story of the situation for each group. Figure 1(b) is a taxonomic classification with seven groups. The items in each group of the taxonomic classification are related to each other through higher levels of abstraction. It also explains that classified items in a group inherit properties from the group name.

2.3 Thematic and Taxonomic Classification

Different users may prefer different classifications of the information on a website. Specifically, a user may classify the information items in a thematic or taxonomic way. A thematic structure classifies items into groups according to themes, each of which includes all the elements that relate to the name of the group. The items in a thematic classification are related to each other through a coherent story or situation. In a thematic classification of banana, monkey and panda, the two items banana and monkey go together. Banana and monkey provide a thematic classification based on eating habits and a coherent story of the situation that monkey eats banana.

A taxonomic structure classifies items into groups according to the function or inferences drawn from the items in the group. The study of Rau et al. (2004) used the notion of 'functional' to explain taxonomic classification. The items are related to each other through

higher level abstraction, the names of the groups. In a taxonomic classification of panda monkey and bannana, panda and monkey are grouped together because they are similar at a higher level of abstraction, whereas banana belongs in another group. The higher level of abstraction common to panda and monkey is that they are both mammals.



a) Thematic Classification b) Taxonomic Classification

Figure1: Classification structure of Thematic and Taxonomic Classification

Smiley and Brown (1979) examined people's conceptual preference and found that young and old individuals preferred thematic classification while school age and college adults preferred taxonomic classification (Smiley & Brown, 1979). Rau et al. (2004) explained classification from the example that cleaning liquids such as dishwash liquid, bathtub cleaner, toilet bowl cleaner and detergent are usually grouped together as cleaning products in supermarkets, because of their cleaning function – a taxonomic classification. These cleaning liquids are not grouped together according to a thematic relation. In a thematic classification, dishwash liquid would be grouped with other kitchen items according to their use-situation relations.

3 Method

In order to investigate the match between the structure of university websites and their users' classification of the information accessible on the websites, we performed a card-sorting study with students from two universities. A cross-case analysis (Yin, 2003) was performed of the two university websites. The study was conducted in the usability laboratory at the University of Management and Technology (UMT) in Lahore, Pakistan, and the usability laboratory at Copenhagen Business School (CBS) in Copenhagen, Denmark.

3.1 Card sorting

Card sorting is a technique aligned with Kelly's personal construct theory (Kelly, 1991). It assumes that people make sense of the world through classification and that people can describe their own classification of the world with reasonable validity and reliability (Kelly, 1991; Rugg & McGeorge, 1997). Card sorting provides an insight into how users classify

information and, thereby, how they construe their world, illuminating the otherwise often tacit ways in which they group, sort, and label information and objects (Deibel & Anderson, 2005; Donna Spencer, 2009; Rugg & McGeorge, 1997). The general idea of card sorting is to ask participants in interviews or workshops to sort labelled paper cards into piles. The analyst then compares the different participants' sorting of the cards. Card sorting has been used in multiple studies of knowledge organization and information classification. For example, Chen and Occenã (1999) used card sorting to investigate domain experts' ways of organizing their knowledge. Martine and Rugg (2005) measured the perceived similarity of webpages using card sorting, and McLaughlin and Mandin (2002) used card sorting to assess the clinical curriculum and medical students' knowledge organization.

3.2 Participants

A total of 14 Danish university students at CBS and 14 Pakistani university students at UMT participated in the study. Nielsen (2004) reports that for practical purposes approximately 15 users are enough to reach a correlation of 0.90 in a card sort but recommends twice as many for a big project.

To recruit participants, a message was posted on a Facebook page of the university. The message contained a link to a document that explained the purpose of the study, the criteria for participation, and the activities and duration of the experiment. The message and document were posted in English and in the local language (Danish in Denmark and Urdu in Pakistan). In Denmark, we also applied snowball sampling by asking each recruited participant to point out a possible future participant among their acquaintances. We required that all participants should be 20-35 years of age, hold citizenship in the country, be residents of the country, have been born and raised in their country, have attended primary school in the country, and have lived in their country for most of their lives but they may have been abroad for part of their later education. We aimed for an equal number of male and female participants. All participants should have at least 5 years of experience using computers and the Internet. We excluded participants with experience as software or hardware developers – including analysts, designers, programmers, and testers.

N = 28	*Danish*	*Pakistani*
Years of age (M $\pm$ SD)	22.6 $\pm$ 1.3	21.3 $\pm$ 3.3
Number of study years (M $\pm$ SD)	16.1 $\pm$ 0.9	15.0 $\pm$ 1.7
University-website use in minutes/week (M + SD)	108.2 + 131.6	12.2 + 11.1
Male (%)	50	50
Female (%)	50	50

Table 1: Participants' demographics

Table 1 shows demographic information about the participants. There was no age difference between Danish and Pakistani participants, $t(26) = 1.34$, $p = 0.2$, but a significant difference in number of years of study, $t(26) = 2.07$, $p < 0.05$. There was also a significant difference in weekly use of the university website, $t(26) = 2.7$, $p < 0.05$. The Pakistani participants explained in interviews that they mainly used other sources for information about their university. We attained a balanced gender distribution in both groups.

3.3 Procedure

All the sessions were conducted individually. The participants were welcomed in the usability lab and signed an informed consent form. Then, the test leader introduced the participants to card sorting, and asked them to fill in a questionnaire with questions about their age, study years, internet use, and time spent on the university website during the last week. The experimental part of the sessions comprised three activities, to be described below: brainstorming, card sorting, and information retrieval. Each participant received a gift voucher of DKK 200.

3.3.1 Brainstorming

Once the participants had filled in the questionnaire, they were provided with a set of 5×5 cm blank index cards in two colours. Participants were asked to indicate elements of website content on cards of one colour and names of groups of website content on cards of the other colour. And, participants were asked to sort their element cards into the groups defined by their group cards in such a way as to create a site map for a university website. The participants were told that they did not necessarily have to make a grouping similar to that of their own university website. As recommended in previous studies, participants were requested to justify the created website structure orally (Medin, et al., 1997; Ross, 2004). The intension of this brainstorming activity was to elicit the participants' understanding of what information to include on a university website and how to structure it. Participants were provided 15 minutes for this brainstorming activity.

3.3.2 Card sorting

For the card sort, the participants were provided with 50 index cards. They were also provided with six category names, each representing a page on their local university website (http://uk.cbs.dk/, https://e-campus.dk/ for Copenhagen Business School, and http://www.umt.edu.pk/ for University of Management and Technology). The Danish and Pakistani participants received separate sets of cards.

a) Brainstorming b) Card sorting

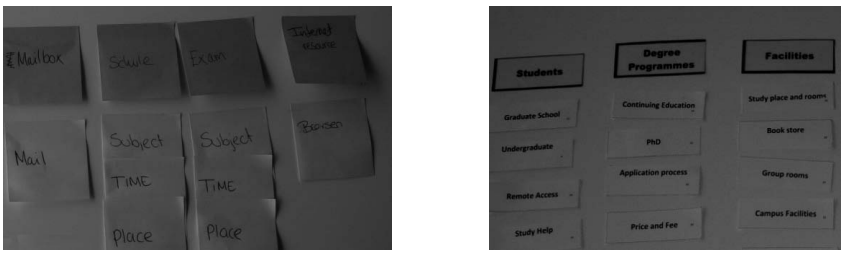


Figure2: Part of the brainstorming and card-sorting data

The selection of web pages for the cards was made by two researchers. Both sets of 50 cards were in English because both university websites were in English. We used a semi-closed card sort, in which participants begin with predefined cards and groups but are allowed to rename groups, add new groups, and remove groups (Geven et al., 2008; Lewis & Hepburn, 2010). The participants were asked to sort the cards into groups that constituted what they

would consider a natural classification of the website content. Participants were provided 15 minutes for this activity. Figure 2 shows data from the brainstorming and card sorting.

3.3.3 Information-retrieval tasks

The participants were asked to solve five information-retrieval tasks on the website of their local university. The tasks concerned information the participants might need to retrieve from the website. As an example, one of the tasks was: *Please find the contact information of the person/secretary who can provide you further information about Hostels. Please notify the instructor when you finish.* Due to the differences between the Danish and Pakistani websites, Danish and Pakistani participants received tasks that were pair-wise similar, but not identical. Participants were provided three minutes for each task.The university websites of CBS and UMT (Figure 3) were selected for use in this study because we had full access to these sites and because they were considered representative for the class of university websites in the respective regions.

3.4 Data Analysis

The *brainstorming* data were analyzed by characterizing the type of classification that was present in the categories and subcategories created by the participants. Three independent coders (i.e., the authors) analyzed the brainstorming data by coding each group as *thematic* categorization, *taxonomic* categorization, or *other*. The coders first coded about one fifth of the data as an individual training exercise and then collectively discussed their codings. As a result of the training it was decided that when participants made multi-level groups that involved *taxonomic* classification at one level and *thematic* classification at another then that group was coded as *other*. Then the coders individually coded the remaining brainstorming data. Table 2 shows the pair-wise agreement between the coders and the kappa values (a statistical measure of the interrater agreement of categorical items). The kappa values are fairly moderate, according to the interpretation given by Landis and Koch (1977). The agreement varies between 59 and 68 percent with the kappa value varying between 0.39 and 0.52.

To analyze the *card sort* data we calculated, for each participant, the distance between the structure of the information on the website and the participant's classification of the information as represented in the participant's card sort. The distance between two classifications is the number of disagreements between them. That is, a distance of one means that a single card is placed differently by a participant compared to how the information is structured on the university website (Deibel & Anderson, 2005; Nawaz & Clemmensen, 2007). This resulted in an average distance between the Danish university website and the Danish participants' card sorts and an average distance between the Pakistani university website and the Pakistani participants' card sorts. We also calculated the average distance between all pairs of Danish participants' card sorts and the average distance between all pairs of Pakistani participants' card sorts. To calculate the distances, we used the UW Card Sort Analyzer (http://www.cs.washington.edu/research/edtech/CardSorts/).

The data from the *information-retrieval tasks* were analyzed by determining how long participants took to answer the tasks and how many tasks participants answered correctly. Tasks not solved within the allocated three minutes were treated as incorrect.

a) University website in Denmark

b) University website in Pakistan

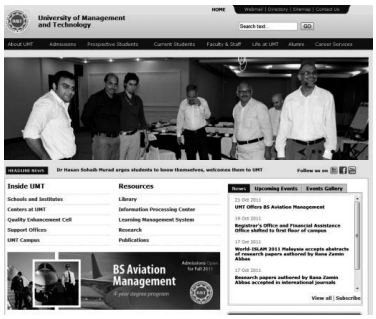


Figure 3: Screenshots of the two university websites

The answers to the information-retrieval tasks were at different depths in the website structure. That is, the answers were a different number of mouse clicks away from the position at which participants started solving each task. The depth was determined for each task and labelled low, medium, or high. We contend that higher depth corresponds to higher task complexity.

Coder	*1 vs. 2*	*1 vs. 3*	*2 vs. 3*
Number of agreements	115	132	127
Proportion of agreement	59%	68%	65%
Agreement (Kappa)	0.391	0.524	0.472

Table 2: Interrater reliability of coders

4 Results

Below we first analyze the brainstorming data, then the card-sort data, and finally the information-retrieval tasks.

4.1 Brainstorming

Table 3 shows that the Danish participants made an average of 7.1 first-level categories during the brainstorming session, whereas the Pakistani participants made an average of 6.7 first-level categories. There was no effect of participant group on the number of first-level categories, $t(26) = 0.58$, $p = 0.6$. Seven (50%) of the Danish participants made second-level categories during their brainstorming session, whereas only three (21%) of the Pakistani participants made second-level categories. There was no effect of participant group on the number of second-level categories, $t(26) = 1.59$, $p = 0.1$.

N = 28	*Danish*	*Pakistani*
Number of first-level categories (M ± SD)	7.1 ± 2.0	6.7 ± 1.0
Number of participants who made sub-categories	7	3
Percentage of Taxonomic categories (M ± SD)	32.1 ± 9.9	51.2 ± 15.0
Percentage of Thematic categories (M ± SD)	34.2 ± 12.7	33.2± 15.5
Percentage of Other categories (M ± SD)	33.7 ± 16.1	15.7± 13.6

Table 3: Brainstorming

There were significant differences between the two groups in the percentage of *taxonomic* categories, $t(26) = -4.26$, $p < 0.001$, and *other* categories, $t(26) = 3.42$, $p < 0.01$. There was no significant difference between the two groups in the percentage of *thematic* categories, $t(26) = 0.36$, $p = 0.7$. Danish participants used a mixture of taxonomic and thematic categories and therefore many of the Danish participants' categories ended up being coded as *other*, whereas Pakistani participants made more use of taxonomic classification and not many pariticipant made sub-categories. The brainstorming data showed some differences between the participants in their classification of university-website information. This suggests that the information on such websites should be structured differently to match how Danish and Pakistani students classify information.

4.2 Card sorting

To investigate the quality of the structure of the information on the two university websites, we analyzed how well this structure matched the way participants classified the same information. Table 4 shows the average distance between the structure of the website content and the participants' card sorts of the website information. The Danish participants had an average distance of 22.4 from the website, the Pakistani participants had an average distance of 26.1. There was a significant difference in distance between Danish and Pakistani participants, $t(26) = -4.7$, $p < 0.01$, indicating that the two websites match their users' classification of the website content to different extents.

N = 28	*Danish*	*Pakistani*
Distance from website to card sort of all cards (M ± SD)	22.4 ± 2.1	26.1 ± 2.6
Number of cards on which a majority of participants agree	34	19

Table 4: Distance between website structure and participants' card sorts

For each card we determined the number of participants who classified the card in the same way - that is, placed it in the same group. We then selected the subset of cards classified in the same way by a majority (50% or more) of the participants. This was done separately for Danish and Pakistani participants. A majority of the Danish and Pakistani participants agreed about the classification of subsets of 34 and 19 cards, respectively.

4.3 Information-retrieval tasks

Finally, we analyzed whether the task completion times and success rates of the information-retrieval tasks were affected by the depth at which answers to the tasks were located. For Danish participants the average task completion time for tasks at low, medium, and high depth was 62 seconds (*SD* = 56), 67 seconds (*SD* = 53), and 82 seconds (*SD* = 62).

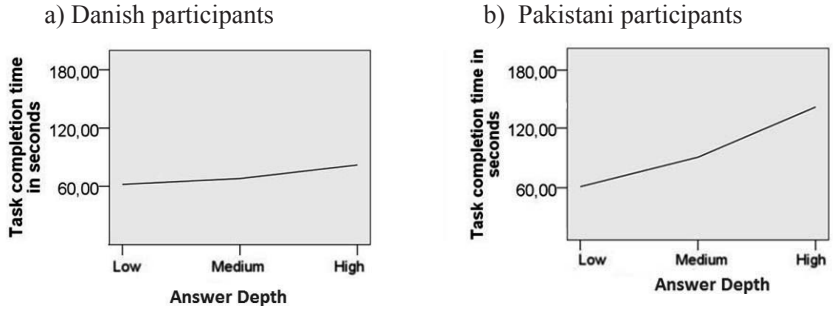


Figure 4: Relationship between task completion time and answer depth

The Danish participants' average success rate for tasks at low, medium, and high depth was 85% (*SD* = 36), 92% (*SD* = 27), and 82 % (*SD* = 62), respectively.
For Pakistani participants the average task completion time for tasks at low, medium, and high depth was 58 seconds (*SD* = 39), 88 seconds (*SD* = 59), and 134 seconds (*SD* = 51), respectively. The Pakistani participants' average success rate for tasks at low, medium, and high depth was 92% (*SD* = 26), 86% (*SD* = 36), and 50% (*SD* = 38), respectively.

Figure 4 shows the relationship between task completion time and the depth at which the answers to the tasks were located. Compared to the Pakistani participants, the task completion time for the Danish participants did not increase across depths. The Pakistani and Danish participants spent about the same time on low-depth tasks but the time for Pakistani participants increased as depth increased.

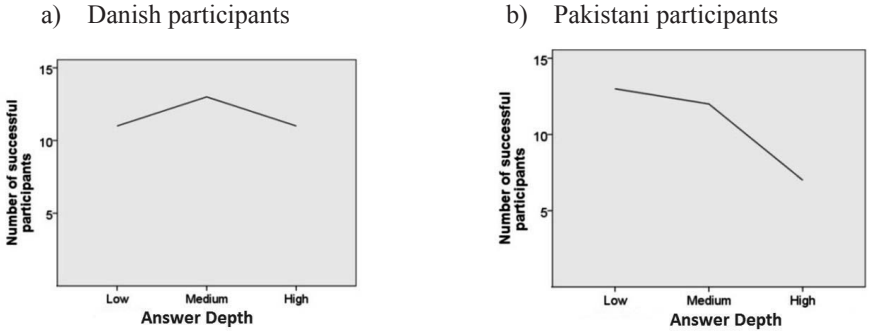


Figure 5: Relationship between success rate and answer depth

Figure 5 shows the relationship between the success rate and the depth at which the answers to the tasks were located. For Pakistani participants the success rate decreases as answer depth increased. For Danish participants we found no relationship between success rate and answer

depth. Both of these analyses suggest that the website structure affected participants' information retrieval.

5 Discussion

This cross-case study of university websites uses card-based brainstorming, card sorting, and information-retrieval tasks to investigate the participants' ways of organizing website information. There was a logic in the relationship between the three activities of the study: The brainstorming provided insight into the participants' classification of information items they considered it relevant to include on a university website, and revealed the number of participants who made sub-categories. The card sorting gave insights into the participants' classification of information items appearing on their university website, and how far the participants were from the actual university websites and from each other, in terms of the edit-distance measure. The information-retrieval tasks explored how the answer depth impacted the participants' success rate and task completion time. We find both differences and similarities between the Danish and Pakistani participants. The higher edit distance and lower success rate for Pakistani participants suggest that their mental models differ more from the structure of their university website than for the Danish participants. The difference in the percentage of taxonomic classification can be interpreted as a cultural difference in cognitive sorting style.

For the brainstorming, the analysis of taxonomic and thematic categorization shows that the Pakistani participants tend to use taxonomic classification more than the Danish participants. The Pakistani participants classify information into categories for which information items can mostly be related through higher levels of abstraction. The Pakistani participants' shallow classification may be explained by a South African study about culture, literacy, and web dimensions (Walton & Vukovic, 2003). In their study, Walton and Vukovic (2003) state that more communication practice on the web enhances users' tendency to categorize information in a way they have experienced before. Half of the Danish participants made a multilevel classification during brainstorming. These Danish participants used a mixture of taxonomic and thematic categorisation at different levels. The material and procedure of the brainstorming were the same for the Danish and Pakistani participants, and the brainstorming data can therefore be compared across the two groups of participants.

The difference in Danish and Pakistani participants' card sorts was measured using the edit distance. Previous work suggests that for websites an edit distance of 4 to 5 for comparisons of 20 website elements indicates closely related contents (Deibel & Anderson, 2005). On this basis the participants in our study were far from each other in their categorization of the 50 cards with website content. The web content may be categorized differently for numerous reasons. The information may, for example, fit in multiple categories. Content such as 'Contact us' can be placed in most of the main categories including 'Facilities', 'Library', and 'Admission'. Another reason for the high edit distances may be that the content on some cards, e.g., 'alumni', was not understood by all participants and their different interpretations of these cards would then result in placing the cards in different categories.

In the card sort, the majority of the Danish participants agreed about the placement of 76% of the cards containing website content. Conversely, the majority of the Pakistani participants agreed about the placement of only 38% of the cards with website content. Regarding the

relationship between task completion time and answer depth, Pakistani participants took more time to locate high-depth answers. Also, Pakistani participants' success rate decreases with increasing answer depth. A possible reason for this decrease may be that Pakistani participants spent less time on their university website compared to Danish participants. Methodologically, this study provides an initial investigation of an approach that can be used in cross-country comparisons of website structure. We used taxonomic and thematic categorisation to compare and contrast the participants across countries. This method can provide insight into users' classification criteria. To minimise the impact of having two different websites in the experiment, we chose the same genre for both websites.

6 Conclusion

This card-sort study offers an approach to the study of cross-country differences in the structure of university websites and user classification of website content. Pakistani students tend to use more taxonomic classification, but fewer levels of categories, as compared to Danish students. The study also finds similarities between Pakistani and Danish users, for example in the retrieval of website content that is not located deep in the website hierarchy. The edit distance appears to be a useful measure in cross-country analyses of website structure. Furthermore, comparing websites developed and used locally can be a valuable comparative approach in cross-country HCI research and practice. The current study is limited by its focus on two websites and by the moderate number of participants from each of the two countries. Another limitation of the study is that only one genre of website was researched. In this study we conducted the analysis of thematic and taxonomic classification on the basis of the card-based brainstorming data. In a forthcoming study we will apply the analysis of taxonomic and thematic classification to card sorts of actual website content.

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