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Defining Culture-Bound User Characteristics as a Starting-Point for the Design of Adaptive Learning Systems

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Abstract: In our study we set the goal to consider culture as a crucial factor of learning system design. This culture oriented approach is put in concrete terms by comparing US-American and German learning programs on four different levels: layout, interaction and navigation, presentation of content, and the didactic approach. The results of a questioning on culturally specific approaches to computers complete this investigation.

Keywords: academic style, adaptivity, cultural dimensions, discourse structures, evaluation, HCI-usability, learning style, learning software, user modeling
Categories: K.3.1, H.5.4

1 Introduction

In developing multimedia learning systems questions concerning content and functionality of these applications are given priority. However, even the integration of HCI – design guidelines will not be sufficient as the adequacy of the didactic concept plays an important role in the context of learning.

The development of educational multimedia systems for an international audience requires the consideration of additional questions concerning culturally specific design elements. In order to meet the individual preferences of users from various cultures we take into account culture-bound differences in learning behavior, the concept of interactive learning systems (i.e. in the areas of layout, navigation or teaching method) as well as the characteristics of intellectual styles and discourse structures. These two factors influence the learning style and the design preferences of an individual user and therefore have an impact on the effectiveness of the learning process. This hypothesis sets a starting-point for our research.

The study described in this paper forms a basis for the concept and realization of a user modeling component to be integrated in a learning environment developed at the University of Hildesheim in the SELIM project (Software Ergonomics for Learning Systems In Multimedia Context). The aim of our work is to add adaptation functions that would enable the system to meet the individual needs of learners from different cultures [Kamentz&Schudnagis, 02].

2 Conceptual background

2.1 Adaptivity of hypermedia learning systems

Adaptation techniques in hypermedia learning systems are implemented by using a learner modeling component. Its function is to enable the system to adapt its performance to the characteristics of the user such as level of knowledge, interests, preferences, or goals by means of continuous monitoring of his/ her interaction behavior [Kobsa&Wahlster, 89]. Among the relevant user actions that can be recorded are the selection of a link, the navigation sequence, scrolling, page viewing time, or bookmarking.

The user modeling component can support system adaptation basically on two different levels: flexible presentation of the page content (content-level-adaptation), and adaptive navigation support (link-level-adaptation) [Brusilovsky, 98]. Research in the field of user modeling has focused primarily on implementing adaptation concepts that allow adaptation to user's knowledge and learning goals. In view of today's global and (consequently) cross-cultural communication opportunities there is a need of adapting the layout and the performance of interactive learning systems to the layout preferences, thinking patterns and learning styles of students from different cultural backgrounds.

2.2 Cultural differences in academic style and learning strategy

The area of cultural anthropology comprises a very broad field of research. In the context of educational hypermedia design not only those general cultural values are relevant, that are described in the various models of culture [Hofstede, 93; Trompenaars, 93; Hall&Hall 90]. Aspects of culture which are placed even deeper below the surface such as differences in academic styles (especially with regard to discourse structures) or the characteristics of learning situations, need to be considered as well.

Based on his analysis of culture-bound variables in the area of science Galtung [Galtung, 81] contrasts four intellectual styles as models of thought and behavior shown principally by intellectuals, which also help to explain the different discourse structures dominant in various cultures. He distinguishes between one oriental and three western cultural areas characterized by relatively homogeneous methods of conveying and presenting knowledge, for example regarding the structuring or sequencing of information. According to his definition the following countries can be classified as belonging to the four academic styles:

1. "Saxonic Style": Countries of the Commonwealth, USA
2. "Teutonic Style": German speaking countries, countries of Eastern Europe, Russia
3. "Gallic Style": France, Italy, Spain, Portugal, South America
4. "Nipponic Style": Japan (having no periphery beyond itself)[1]

[1] Due to ignorance Galtung excludes the Indic, Sinic and Arabic style out of this classification and hopes for an extension of his exploration in these cultural areas.

These four intellectual styles are characterized along four dimensions, which are all present to some extent in every style category:

Paradigm analysis
Descriptions
Theory formation
Commentary on the work of other intellectuals

When composing teaching materials and developing learning software for an international audience different writing conventions also need to be observed. In the context of cross-cultural research on discourse structures Clyne [Clyne, 94] compared English and German essay writing. He defined several categories in which different composing rules were particularly apparent. These include:

- Linearity vs. Digressiveness
- Form orientation vs. Content orientation
- Textual symmetry
- Data integration
- Use and presentation of definitions
- Use of advance organizers

Cultural variations in the areas of academic style in general and discourse structures at a more specific level can be deduced from cultural value systems such as those investigated by Hofstede [Hofstede, 93]. In particular three of his cultural dimensions may have influenced the development of intellectual style profiles: individualism vs. collectivism, power distance, and uncertainty avoidance. The following descriptions of these categories focus on their impact in the area of instructional practice, taking into account aspects such as teaching strategies or the relation between teacher and student [Hofstede, 86].

1. Individualism vs. Collectivism

This value orientation focuses on the intensity of ties among individuals in a society. Differences in the context of learning refer primarily to the definition of a general learning goal. Students in individualist societies expect to learn “how to learn”, whereas collectivist learners focus on learning “how to do”. Another difference can be observed in area of communication and debate. In collectivist societies students will only speak up when asked personally by the teacher and usually agree with collectively approved opinions, as formal harmony has to be maintained. On the contrary, individualist learners will not be embarrassed to speak up in class in response to a general invitation by the teacher, and to express their personal views, as controversal discussions and pluralism of opinions are fostered. According to Hofstede’s analysis English-speaking countries and the whole of Northern Europe rank high on individualism, whereas most Asian, Middle Eastern, and Latin American cultures (with the exception of Brazil) count as collectivist societies.

2. Power Distance

Power Distance measures the extent to which subordinates (employees, students) accept inequality in power and authority distribution. In the context of learning teachers in small power distance societies are in the position of an expert ("primus inter pares"), who conveys impersonal (neutral) "truth" and who expects his students to initiate communication. In large power distance cultures teachers present knowledge as their personal "wisdom". As an authority they are expected to outline learning paths to follow. Small power distance can be found in cultures such as Germany, USA, Canada or Scandinavian countries. France, Spain, Belgium, Arab countries, most Latin American cultures (except for Argentina) and East and Southeast Asia are found in the large power distance category.

3. Uncertainty Avoidance

Uncertainty Avoidance describes the extent to which individuals feel threatened by uncertain or unknown situations. Cultures with a weak uncertainty avoidance such as English-speaking and Southeast Asian countries are characterized by acceptance of risks and ambiguous or new situations as a part of everyday life. Transferred to the context of learning this attitude will make students feel comfortable in unstructured (open-end) learning situations with vague objectives and broad assignments. In societies with strong uncertainty avoidance, i.e. Latin, Islamic, German-speaking, and some Asian cultures students will prefer structured learning situations with precise objectives and detailed assignments.

At this point it becomes necessary to analyse the impact of cultural dimensions and the resulting characteristics of the respective academic style on the design of learning programs. For instance, if one compares the principles of behaviorism, cognitivism, and constructivism as the three learning theories commonly applied in the field of learning software [Schulmeister, 97], an interesting analogy to the cultural dimensions of individulism vs. collectivism and power distance can be identified. With the transition from behaviorism to constructivism the focus continuously moves from teacher (or system)-centered to student-centered learning. A similar transition takes place when proceeding from a collectivist to an individualist orientation and from large to small power distance. In collectivist societies and/ or in cultures with large power distance the teacher stands in a position of authority and dominates the whole process of learning. In individualist and/ or small power distance cultures the focus is placed on learner-centered education. The individual student is granted more personal freedom and control of the learning process. However, further investigation is required on the question, whether a learning model corresponds with a particular culture.

3 Goals of research and methodology

3.1 Goals of research

The primary goal of research in this part of the SELIM project is to investigate the effects of cultural values in the areas of academic style and learning on the design of learning programs from different cultures, in particular concerning layout, navigation, content presentation and the didactic approach.

The second goal of this study is to examine whether cultural value orientations lead to differences in learning style and approach to computers. As a next step we plan to set up culture dependent profiles of learning program design principles based on the results of the research presented in this paper. These profiles are supposed to form a starting-point for the concept of an integrated user modeling component enabling the SELIM learning system to adapt automatically to the characteristics of learners from different cultures. The evaluation of the adaptive learning environment is supposed to be performed within the evolutionary approach of a rapid prototyping process which involves cross-cultural usability testing with students from multiple cultures.

3.2 Methodology

3.2.1 Evaluation of learning programs from different cultures

The main method applied in this preliminary research is the evaluation of learning software (i.e. learning programs on the internet and on CD-ROM) from different cultures with regard to aspects such as layout, interaction and navigation, content presentation and the didactic strategy. For this purpose we developed a catalogue of over fifty criteria which can be classified into the following categories:

- General information (e.g. culture of the author, topic, source of the program)
- Layout (e.g. the use of colors, images, icons, symbols, types of media)
- Interaction and navigation (e.g. menu concept, use of navigation tools such as list of contents, learning paths, browsing)
- Content (e.g. information structure, types of content such as explanations, examples, case studies, rules, or strategies, combination and presentation sequence)
- Didactics (e.g. learning objectives, feedback presentation, different types of exercises)

3.2.2 Questioning on learning styles and approaches to computers

The second method applied in this study is a questioning of students from different cultures on learning styles and their approaches toward computers. The aim of the questioning is to complete and deepen the results of the learning program evaluation. We believe that the cognitive styles, i.e. thinking patterns, problem solving strategies, and learning behavior develop not only on the basis of an individual's personal

predisposition but they also constitute the result of culture-bound influences. The educational system which primarily determines the development of certain problem solving and learning techniques can be regarded as a "product" of a country's particular culture. Therefore, these factors belong to the range of user characteristics that need to be considered when designing user oriented learning programs.

In the first part of our questionnaire we follow the idea of the Learning Style Inventory (LSI) as proposed in [Kolb, 84] in order to perform a cross-cultural learning style analysis. On the basis of empirical research Kolb reduced different learning behaviors to four learning styles: Converger (Pragmatist), Diverger (Reflector), Accomodator (Activist) and Assimilator (Theorist). These styles can be defined as a combination of an individual's relative emphasis on two learning dimensions:

1. Dimension: concrete vs. abstract perception of new information
2. Dimension: active vs. reflective processing of the perceived information

We view this categorization as adequate for investigating cultural differences in learning styles as the characteristics of these four learning styles correlate to several of the cultural values we described in section 2.2. The results of this part of the questioning were presented in detail in [Kamentz&Schudnagis, 02].

The second section of the questionnaire involved questions on access to computers regarding computer literacy, computer and internet usage behaviour (e.g. use of applications, handling of problem situations, topics of interest on the WWW), attitudes toward information technology, previous experiences with computing classes, and references concerning the design and functionality of learning software (e.g. types of exercises, user guidance, degree of user control). Here, we intend to explore whether different approaches to computers do exist in different cultures and to confront these findings with the results of the software evaluation.

4 Results

4.1 US-American vs. German learning systems – results of the evaluation based on our criteria catalogue

The evaluation was based on our criteria catalogue and included four US-American and four German learning systems. Our results indicate a number of differences in the areas of layout, interaction and navigation, content presentation, and didactic approach as being characteristic of US-American and German learning programs. However, they also can be the result of the subject attributes. The selected programs dealt with topics from the field of technology such as data processing, Oracle programing, hypermedia, electrical engineering and topics from the area of education and social science, i.e. problem solving skills, negotiating, and soft skills training[2].

[2] German Institute for Research in Distance Education (1998): HyperDisc: Lehren und Lernen mit Multimedia und Telematik. University of Tübingen
DigitalThink Showcase Demo: Oracle Programming. http://www.digitalthink.com/
DigitalThink Showcase Demo: Soft-Skills-Training. http://www.digitalthink.com/

Some of the program features discovered (see highlighted points) can be attributed to the influences of the Saxonic and the Teutonic academic style, and the culturally specific norms of English and German discourse presented in [Clyne, 94]. The following list gives an overview of the explored program features, but we would like to stress that these are tendencies that might change as we continue our evaluation.

US-American learning programs	**German learning programs**
Layout	
• About 60% of the screen is left blank, short text lines	• A single screen is nearly completely filled with content, long text lines
• Simple screen design	• Complex, but orderly structured screen design
• Short text paragraphs	• Extensive text paragraphs
• Frequent enumerations, intensive use of multimedia elements	• Plain text is the main type of media used for content presentation
• **Images and animations are used as a learning aid as well as a means of entertainment**	• **Images and animations are used mainly as a learning aid**
• Intensive use of contrasting colors, highlighting of headwords	• Moderate use of colors creating a contrast between individual areas of the screen such as navigation bar, list of contents, or the working space.
Interaction and Navigation	
• Many interaction possibilities in exercises (simulations, drag & drop-exercises, multimedia elements as "sample files" or "data sheets" for case studies)	• Partly a high degree of interaction possibilities through intensive use of simulations, in exercises a rather moderate interactivity (multiple choice, entering free text), frequent use of pop-up-windows with additional learning content
• **A rather small degree of navigational freedom (guided tour, list of contents, a small number of glossar links)**	• **Many navigation possibilities (guided tour, list of contents, browsing, search tool, display of current position within the learning space, help tool**

Table 1: Features of US-American and German learning programs

Department of Electrical and Information Engineering, TU Ilmenau: Grundlagen der Elektrotechnik. http://get-20.e-technik.tu-ilmenau.de/founer

Großmann, U. (1996): Datenverarbeitung für Betriebswirte. Interaktiver mediengestützter Einstieg. München: Hanser Verlag

InfoWorld Demo: Internet Explorer 4.0: A Beginners Guide. http://webtraining.infoworld.com/

InfoWorld Demo: Negotiating: Closing a Deal. http://webtraining.infoworld.com/

Freiburg College on Educational Studies: Einführungskurs in die Psychologie des Denkens und Problemlösens. http://art.ph-freiburg.de/www/index-d.htm

US-American learning programs	German learning programs
Presentation of Content	
• Detailed listing of learning objectives at the beginning of each learning section	• Detailed introduction to the subject with content overviews of each section or just a list of content as a preview at the beginning of the program
• **Intensive use of advance organizers**	• **Limited use of advance organizers**
• Types of content mainly comprise **facts, examples, case studies**, guidelines and principles (Do's and Don'ts, sequences of steps as a part of a strategy or procedure)	• Types of content mainly comprise **abstract concepts, ideas and facts** followed by **examples** with the first section usually dealing with the historical background of the subject
• **Content structure is linear or has the form of a flat hierarchy**	• **Content structure has the form of a deep hierarchy**
• **Small chunks of information**	• **Extensive chunks of information**
• Each learning section exists as an enclosed unit and can be worked on separately	• Each learning section is based on the previous one and therefore cannot be worked on separately
• Learning material is presented in form of a "personal communication" between the system and the learner	• Learning content is conveyed in form of an impersonal presentation
Didactics	
• **Alternation of content and exercises within a section**	• **Exercises are offered at the end of a learning section or as a separate training module**
• Types of exercises: fixed-choice assessments (multiple-choice, true/ false), **case studies**	• Types of exercises: multiple-choice, **complex free-text assignments, simulations as a part of an experimentation module**
• **Very detailed exercise instructions concerning proper task solving**	• **Limited exercise instructions concerning proper task solving**
• Feedback: "correct"/ "incorrect", **additional explanations and comments**	• Feedback: "correct"/ "incorrect", **instruction to revise content**
• Values such as learning performance and practical application of knowledge are stressed (extrinsic motivation)	• Values such as knowledge acquisition, comprehension and fun are stressed (intrinsic motivation)

Table 2: Features of US-American and German learning programs (continuation)

4.2 Cultural differences in approaching computers and learning programs - questioning results

The analysis of the questioning on approaches to computers produced interesting results concerning preferences for specific learning program features. The results presented here are based on the answers of 74 students from 14 countries (number of individuals for each culture varies between 4 and 20).

Question 1: "Do you like being guided through the learning space by a voice or by a virtual person ?"

This question was intended to provide information on preferences of learners from different cultures concerning the degree of learning process control while working with an learning program. The results can be used for the design of an adequate navigation structure within a learning space. The chart in figure 1 shows the explored differences in the perception of explicit user guidance.

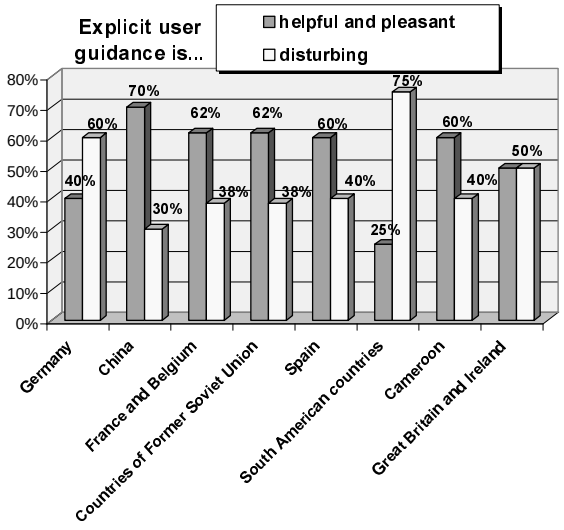

Figure 1: Perception of explicit user guidance through a learning space

We assumed, that the preference for explicit user guidance and instruction can be traced back to a collectivistic and a large power distance orientation which result in teacher-centered educational concept. As shown in figure 1, especially students from China, France/ Belgium, Countries of the Fomer Soviet Union, Spain and Cameroon expressed their appreciation of guided learning. This leads to the conclusion that explicit user guidance is to be seen primarily as the result of a large power distance, as according to Hofstede [Hofstede, 93] a correlation between the two cultural dimensions does not exist in France, Belgium, and Spain. These cultures can be positioned in the middle of the continuum between the two poles of collectivism and individualism[3].

The results for the South American countries did not confirm our assumption. Although the cultures of Peru and Bolivia do show the correlation mentioned above, the students' answers in which they expressed their preference for more freedom while navigating through a learning program resembled those from Germany, which belongs to the individualistic societies. In this case we could come to the conclusion

[3] For the Countries of the Former Soviet Union Hofstede did not collect any data.

that the development of teaching methods in these countries did not follow the general cultural values.

Question: 2: „Which metaphor should be used in a learning program in order to visualize its structure ?“

In this question we suggested the selection of two metaphors out of the following: book, room, journey, town, and building. According to our results students from different cultures do have different expectations concerning the vizualization of a learning program structure. The first association which arises when thinking of an interesting and comprehensible learning program might possibly be viewed as an indicator of the individual's learning style or even his/ her expectation of a particular navigation structure.

The majority of the subjects regarded the journey as the most sensible metaphor to be employed as an orientation aid. This choice could be interpreted as a preference for a navigation structure in the form of a sequence or a flat hierarchy whereas the book could be associated with the expectation of a deep hierarchy. Figure 2 gives an overview of the relative selection frequencies for the three metaphors with the highest overall ranking in the various cultures.

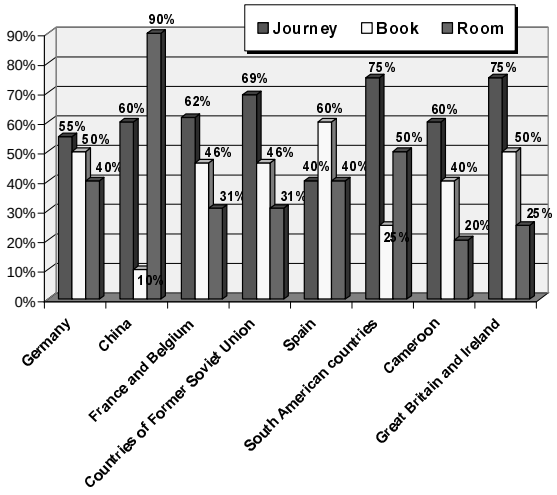

Figure 2: Prefered metaphors for visualizing learning program structure

The frequent selection of the room metaphor by Chinese students can be viewed as a particularly interesting result, which might be a consequence of the holistic thought pattern in oriental cultures. The teachings of Confucius which set out linear problem solving as a virtue also had a great impact on the Chinese culture. This culturally specific norm might possibly be used to explain the high value of the journey metaphor for the Chinese subjects.

5 Conclusion

With learning situations being highly individualized learning systems should hold an adaptive dialogue with the user and react to his/ her respective levels of knowledge and experience. Designing educational multimedia systems for an international target group requires the consideration of additional culture-bound user characteristics which influence the learning process as a whole. This leads to the necessity of extending the current range of adaptation methods and techniques in the cross-cultural context.

Our work makes a contribution to the research on cultural variations in the area of learning program design. In the first step we explored design features typical of learning programs from different cultures. Secondly, we performed a cross-cultural learning style analysis and an investigation of cultural differences in approaches to computers, which were supposed to complete the results of the system evaluation. The results of this preliminary study can be used as a starting-point for the implementation of an intelligent learning system which adapts to the individual needs of learners from various cultural backgrounds.

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