

Making Intelligent Tutoring Systems culturally aware: The use of Hofstede's cultural dimensions

Emmanuel Blanchard, Claude Frasson,

HERON Laboratory, Computer Science Department,
Université de Montréal, C.P. 6128, Succ. Centre-ville,
Montréal, Québec Canada H3C 3J7
{blanchae, frasson}@iro.umontreal.ca

Abstract:

e-Learning is the concept of teaching people through the Internet. By definition, an e-Learning session is not limited by any border, meaning that learners implicated in this session could differ by many criteria which include gender, social classes, religion, nationality, occupation... It has been shown that many of those elements can impact on learning and some are already assessed in e-Learning. However, currently, when an e-Learning system receives a connection call from a user, the system will not make any difference whether this user is French, Chinese, or American... According to cross-cultural studies, culture has a big impact on individuals' cognitive processes and also on how individuals understand and interact with their environment and peers. In this paper, we show that e-Learning systems which want to adapt to their learners and keep them motivated will take huge benefits by considering learners' culture. We present some results from our study which support Hofstede's Individualism/Collectivism scores [Hofstede, 1980]. Based on those results and on cross-cultural studies in management and psychology, we propose different elements of learners' culture that an e-Learning system should consider.

Keywords. e-Learning, culture, Intelligent Tutoring Systems, intelligent agents, emotion.

1. Introduction

e-Learning is the concept of teaching people through computer networks. By definition, an e-Learning session is not limited by any border, meaning that learners implicated in this session could differ by many criteria which include age, gender, social classes, religion, level of education, nationality, occupation... It has been shown that many of those elements can impact on learning.

Gender particularities are becoming to be assessed in e-Learning and Intelligent Tutoring Systems. For example, Arroyo et al [2000] found relations between gender and hint interactivity: boys seem to prefer low

interactive / low intrusive hints whereas girls have a preferential tendency for the opposite.

Gender, education and age differentiation are already a norm in research fields such as management or psychology. Those fields have also identified others elements that can deeply affect behaviours of individuals in a particular context. One of the most powerful of these elements is Culture. To the best of our knowledge, it has never been treated in the e-Learning research field.

In this paper, we present elements able to strengthen e-Learning systems (such as Intelligent Tutoring Systems) by using cultural considerations. Following results of studies in both management and cross-cultural psychology fields, we define what a culture is and quickly present ways of differentiating cultures (see Hofstede [1980]). We show that cultures have a strong impact on people's learning because they affect cognitive processes (such as emotion [Scollon et al, 2004]), perceptions and interactions an individual can have with his/her environment and peers. Then, we present results of a cross-cultural study we made. Those results seem to validate the use of Hofstede's Individualism/Collectivism dimension in future culturally aware e-Learning systems. Finally, we propose an architecture for Culturally AWAre Systems (CAWAS) for e-Learning where we introduce the notion of Culturally Intelligent Agents (CIA).

2. Cultural differentiation

Before discussing of interests of integrating cultures in e-Learning, let's focuses on what we mean exactly by culture: what is a culture? This question may seem trivial at first but, in fact, different definitions exist. As Kashima [2000] mentioned, some researchers, inspired by Vygotsky among others, see a culture as "*a process of production and reproduction of meanings in particular actors' concrete practices (or actions or activities) in particular contexts in time and space*". Another point of view also enounced by Kashima [2000] is that some people think that culture is a "*relatively stable system of shared meanings, a repository of meaningful symbols, which provides structure to experience*".

In general, when researchers are mostly interested with the ways cultures interact with psychological processes, they tend to favour the use of the first definition but when researchers are interested in cross-cultural comparisons, they favour the second one because the notion of culture as a stable system is important to be able to establish comparisons. e-Learning could take advantage of both of those views. For example:

- The first definition (culture as a process of production of meanings) could be used conjointly with cognitive assessments of emotional state in order to better understand learner's reaction in a specific emotional context,
- The second view (culture as a stable system) could be used to explain variations in learning results, practices and behaviours across cultural clusters.

Those two definitions allow us to think about many different kind of cultural clusters. Hofstede's work [1980] was concerning national culture but also used the concepts of organisational and occupational cultures. This study is the most recognized work on cultural differences. In 1980, Geert Hofstede analysed results coming from more than 100 000 persons. For his study, he used a bank of IBM employee attitude surveys undertaken between 1967 and 1973. Those employees were working in 66 different countries. In his work, he defined 4 different bipolar cultural dimensions (a fifth was added later). For 40 out of the 66 countries, he was able to give a comparative score for each of these four dimensions. Nowadays, values for 57 national clusters are available. Subsequent studies concerning commercial airline pilots, students, civil service managers, "up-market" consumers and "elites" in a large number of countries have validated Hofstede's assumptions.

Hofstede's dimensions are:

- Power Distance (PDI): it *"focuses on the degree of equality, or inequality, between people in the country's society."*
- Individualism/Collectivism (IDV): it *"focuses on the degree the society reinforces individual or collective achievement and interpersonal relationships."*
- Masculinity/Femininity (MAS): it *"focuses on the degree the society reinforces, or does not reinforce, the traditional masculine work role model of male achievement, control, and power."*
- Uncertainty Avoidance (UAI): it *"focuses on the level of tolerance for uncertainty and ambiguity within the society - i.e. unstructured situations."*
- Long Term Orientation (LTO): it *"focuses on the degree the society embraces, or does not embrace long-term devotion to traditional, forward thinking values."*

"Hofstede's five dimensions" is the most famous cross-cultural work and still the major reference in today's cross-cultural researches. However, there is not a consensus on Hofstede's results (see McSweeney [2002] for example).

In fact, although many attempts to define and measure culture exist, Smith and Bond [1998] concluded that all of them have produced convergent results, which validate the concept of cultural dimensions as enounced by Hofstede.

3. The impact of culture on learning and cognitive processes

In this section, we present some results that show the great importance of dealing with culture in order to be able to understand the learner and adapt to it. Given those different studies, we not only say that cultural awareness is useful for e-Learning but sometime necessary to avoid bad deductions concerning learners' behaviours and de facto to take good decisions for learners' future evolution.

Emotion has a growing importance in today's e-Learning and Intelligent Tutoring Systems researches. Inspired by Ortony et al [1988] and by Picard [1997], many researchers are currently working on ways of assessing learners' emotions (Conati [2002]) or inducing it [Chaffar & Frasson, 2004]. Making computer systems emotionally intelligent should allow more proximity with the user, enhancing the quality of human-computer interactions.

Concerning the link existing between emotions and cultures, Scollon et al [2004] did a really interesting work. First they showed that, depending of the culture you are living in, you experience some emotions more or less frequently. In daily life, hispanic and european Americans feel positive emotions more frequently and negative emotions less frequently than Indian, Japanese and others Asian cultures. In general, there is more cultural variability in positives emotions than in negatives emotions.

What is a positive or a negative emotion? This notion also differs between cultures. For example, Kim-Prieto et al [2004] showed in a cluster analysis of 46 countries that, in general, pride is seen as a positive emotion in western societies whereas in non-western, pride is considered as a negative affect because "it separates individuals from others". Scollon et al [2004] found similar results for Europeans and Hispanics (western) compared to Indians (non western). Scollon and her colleagues also mentioned a study of Shaver and Schwartz [1992] who found that for Chinese respondents, "love-related concepts clustered near sadness and other negative emotions related to attachment and loss". Cultural differences in test

anxiety [Cassady et al, 2004] and in reward allocation [Fischer and Smith, 2003] have also been reported.

4. Our results

Following those readings, we lead a study to find differences between groups of learners. In this section, we present some of our most significant results concerning gender and cultural differences.

4.1. Methodology

Our study was available on the Internet. Participants were first asked to give information such as gender, age, mother tongue, nationality, childhood countries, level of education, current occupation... Then they had to answer a set of questions concerning learning preferences, personality (using some questions from the Myers-Brigg questionnaire), relations with computers, and trust in eServices. The questionnaire was transmitted via web groups and sometimes mailing lists. A total of 256 persons answered. Most significant national groups were French (number N=105), Canadians (N=51), Brazilians (N=38) and Iranians (N=26). Our questionnaire was available in English, French, Farsi and German but most of the answers were given in English or French.

4.2. Results concerning gender differences

We first decided to consider 3 parameters: gender, age: under 26 or equal/over 26, and nationality: overall sample (N=256), French (N=105) and non-French (N=151). One of our principal questions was:

“When you have to learn a new concept or to understand a new idea, you prefer it to be explained:

A - With diagrams/drawings.

B - With oral explanations when you can interact with the speaker.

C - With oral explanations when you can just listen to the speaker.

D - With written explanations.”

Figure 1 shows the results for this question.

Answers A and B have been privileged but we found that, except one group (non-French men under 26), men preferred to be explained with graphical representations whereas women preferred human-to-human interactions.

Overall (N=256)	1	2	3	4
Male < 26 (N=61)	51%	43%	0%	7%
Male >= 26 (N=74)	49%	31%	0%	20%
Female <26 (N=78)	35%	47%	1%	17%
Female >=26 (N=43)	37%	44%	0%	19%
France (N=105)				
Male < 26 (N=33)	61%	30%	0%	9%
Male >= 26 (N=26)	42%	38%	0%	19%
Female <26 (N=35)	43%	46%	0%	11%
Female >= 26 (N=11)	36%	45%	0%	18%
Non French (N=151)				
Male < 26 (N=28)	39%	57%	0%	4%
Male >= 26 (N=48)	52%	27%	0%	21%
Female <26 (N=43)	28%	49%	2%	21%
Female >= 26 (N=32)	38%	44%	0%	19%

Figure 1: preference of style of explanation relatively to age, gender and nationality

For the two next results presented, we asked people to tell us how much they endorsed a given affirmation. They used a 7 degrees scale to answer (going from 1: “corresponds not at all” to 7: “corresponds exactly”; 4 was the mean value). Results were obtained by finding the mean score for each cluster. In general, Standard Deviation was between 1.5 and 2, which make us think that those results must be seen as a cluster tendency, not a ground truth. We used the same sub group than in the precedent question and figure 2 shows the answers to the following affirmation (taken in the Myers-Brigg questionnaire):

“I consider the scientific approach to be the best.”

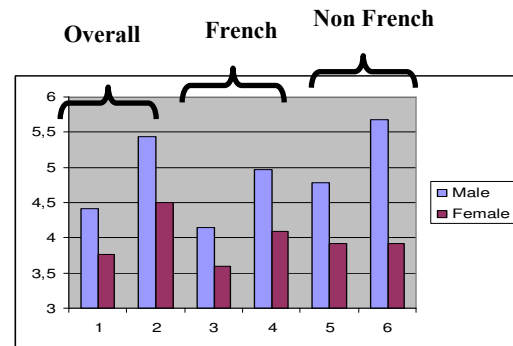


Figure 2: endorsement of the scientific approach relatively to age, gender and country.

Columns 1, 3 and 5 represent answers of people under 26 whereas columns 2, 4 and 6 concerns people over 26. It appears that while men tend to give more importance to the scientific approach, women may consider alternative approaches.

4.3. Results concerning cultural differences

Our main result concerns of course cross-cultural differences. Using the same scale than in the last question, we gave the following affirmation:

“I prefer to work alone than in a group.”

In figure 3, we present results depending on nationality, restricted to college/undergraduate students.

Canadians report greater interest for individualistic work than French. However Brazilians disagree with this affirmation. When we compare those results with Hofstede’s IDV national scores, it appears that Canada is seen as highly individualistic (Canada IDV=80), France also is supposed to be individualistic (France IDV=71) whereas Brazil is seen as relatively collectivist (Brazil IDV=38). Analysis using age or childhood countries as a discriminator provided similar results. Our results match Hofstede’s IDV scores.

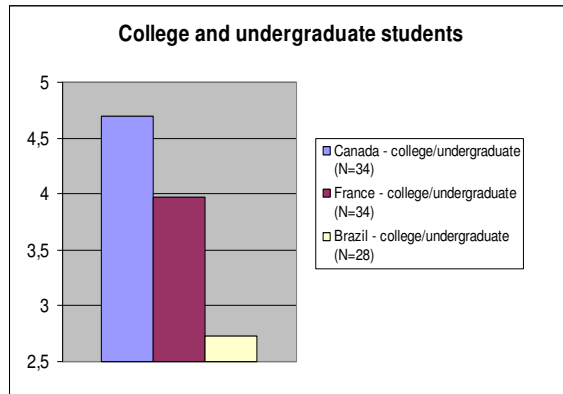


Figure 3: preference of an individualistic manner of working depending on countries for undergraduate and college students

We repeated this measure but this time, we used the overall national population in order to add the Iranian cluster as a fourth national cluster. Results are shown in figure 4.

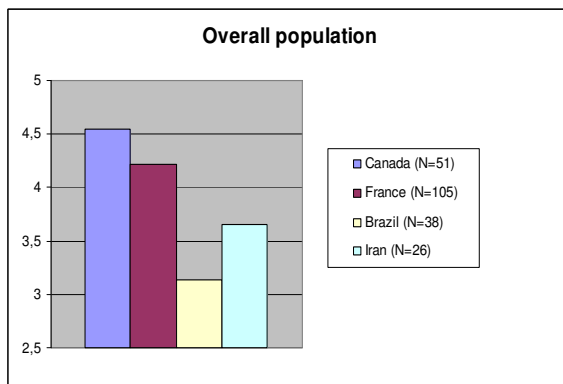


Figure 4: preference of an individualistic manner of working depending on countries for the overall population

Results stayed coherent and Iran which was also a more or less collectivist country (Iran IDV=41) reported a mean score around 3.6 (quite neutral). We have to notice that the order we found between our four national clusters

corresponded exactly to Hofstede’s order between those nations.

Those results encourage us to use Hofstede’s data in future Culturally AWAre systems for e-Learning that take into account influence of culture. Although we found some relations between learners’ preferences and the Hofstede’s IDV dimension, we suppose that others dimensions could also be useful in many e-Learning related topics (emotional assessment [Conati, 2002] and induction [Chaffar & Frasson, 2004], politeness [Johnson & Rizzo, 2004], Socially Intelligent Agents [Johnson et al, 2003]

5. Presentation of CAWAS: Culturally AWAre Systems for e-Learning

A common critic to Hofstede’s dimensions and other’s “cultural scores” is that it could reflect mostly cultural stereotypes instead of true specificities of cultures. For example, a classical argument in this sense is to remark that, whether you live in a collectivist country, you can have an individualist attitude and the opposite is also true. To our opinion, the idea when dealing with “cultural scores” is to take them as reflecting a cultural group tendency. But how to use group tendencies when we want to adapt to a learner who is, by definition, an individual? Our answer is based on the use of a “*Culturally Intelligent Agent*” (CIA) that is inspired by Earley and Mosakowski [2004]’s notion of Cultural Intelligence, i.e. “*an outsider’s seemingly natural ability to interpret someone’s unfamiliar and ambiguous gestures the way that person’s compatriots would*”. More precisely this CIA is formed by three specific agents: a “*Cultural Action Agent*”, and a “*Cultural Transcriptor Agent*” that interact with additional components into a general architecture (Figure 4) of an e-Learning system entitled CAWAS (a Culturally AWAre System).

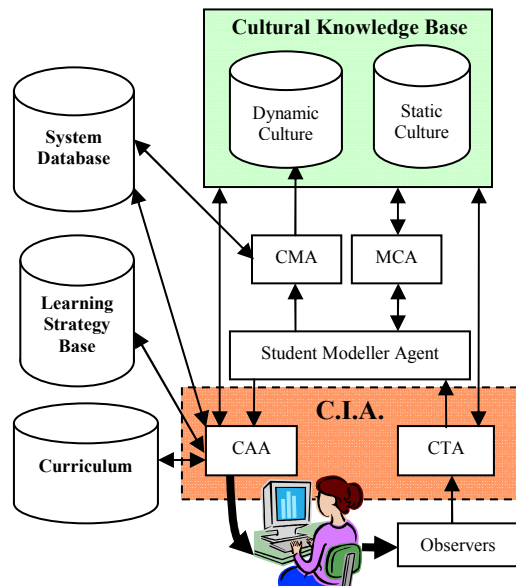


Figure 4: architecture of CAWAS (Culturally AWARE System) for e-Learning

The learner is first observed according to a variety of parameters able to distinguish specific behaviours.

These data are culturally interpreted by the Cultural Transcriptor Agent (CTA) using cultural knowledge obtained from the Culture Knowledge Base (for instance, *"pride can be considered as a positive emotion for a learner of such country"*). As we have seen before, cultural data express more a tendency than the exact attitude for every member of a cultural group.

The *"Student Modeller Agent"* (SMA) receives both data from the observer and the CTA. The SMA asks the *"Matching Culture Agent"* to know the learner's cultural types. It also transmits the learner profile to the *"Culture Modeler Agent"* (CMA). This one generates new cultural clusters which are stored in the *"Dynamic Culture"* module. Those clusters are composed of a set of empirical rules deduced from the use of the system. Dominant meanings techniques [Abdelrazek et al, 2003] could also be adapted to detect the cultural core of a group of learners.

The Static Culture module, on the other side, contains theoretical rules and assumptions on the cultural behaviours (for instance assumptions deduced from Hofstede's values and cross-cultural studies like *"if Hofstede's IDV is high, people will have a tendency to work individually"*). A factor of certainty is also allowed to each of the cultural rules. These factors will evolve given cultural outcomes produced by the learner while he uses CAWAS. We think using Active Learner Modelling techniques [McCalla et al, 2000] could also be interesting in a CAWAS architecture.

The SMA provides a complete status of the learner profile to the Cultural Action Agent (CAA). This profile includes the level of knowledge of the learner, information on his personality traits, on his cognitive state (emotion and motivation) and on his membership to specific cultural groups obtained from the Matching Culture Agent. The CAA asks the Cultural Knowledge Base to obtain the rules associated to the cultural profile of the learner. Given all the information provided by the SMA, the CAA is then in charge of planning the learning session, determining learning strategies to use and selecting information in the curriculum and in the system database in order to present the course. The CAA has a Decision-Making Engine that determines the next action to do, using non monotonic logic in order to be able to process eventual opposite rules.

6. Conclusion and future works

In this paper, we tried to stress the importance of learners' cultures for an e-Learning system. It has been shown in many cross-cultural studies that cultures affect observable behaviours and some cognitive processes (such as emotions). Underestimating the culture's role in e-Learning may lead to misunderstanding learners' reactions to different kinds of stimuli, which could lead to an error of adaptation to learners' needs.

To support the idea of making e-Learning systems aware of culture, we have presented results of a study. Although our sample of individuals was modest, we found clear relations with Hofstede's cross-cultural study [1980]. We think that using results of such large scale cross-cultural studies in e-Learning is not difficult and could be very profitable. To this extent, we have proposed an architecture for Culturally AWARE Systems (CAWAS). This architecture contains different agents which take into account learners' cultural particularities. Because we think results of cross-cultural studies are cultural tendencies, we think that it is useful to have two levels of cultural information: a theoretical one (containing the results of cross-cultural studies) and an empirical one (related to cultural behaviours inside our system).

Finally, an important part of CAWAS depends of a new class of cognitive agents: Culturally Intelligent Agents (CIAs) which are based on the notion of Cultural Intelligence [Earley & Mosakowski, 2004]. We think that CIAs could also be applied in many large-scale deployment systems, including games, e-Commerce, e-Government and e-Services in general.

Acknowledgements

We acknowledge the support for this work from Valorisation Recherche Québec (VRQ). This research is part of the DIVA project: 2200-106.

References

- Abdelrazek M, Frasson C., Kaltenbach M. (2003). **Dominant Meanings Classification Model for Web Information**. Third International Conference on Hybrid Intelligent Systems., Melbourne, Australia
- Arroyo I., Beck J. E., Woolf B. P., Beal C. R., Shultz K. (2000). **Macroadapting animalwatch to gender and cognitive difference with respect to hint Interactivity and symbolism**. International Conference on Intelligent Tutoring Systems, Montreal, Canada, pp. 574-583.
- Cassady J. C., Mohammed A., Mathieu L. (2004). **Cross-cultural differences in test perceptions: Women in Kuwait and the United States**. Journal of cross-cultural psychology, 35(6), pp. 713-718.
- Chaffar S., Frasson C. (2004). **Inducing optimal emotional state for learning in Intelligent Tutoring Systems**. International Conference on Intelligent Tutoring Systems, Maceïo, Brazil, pp. 45-54.
- Conati C. (2002). **Probabilistic assessment of user's emotions in educational games**. Journal of Applied Artificial Intelligence, pp 555-575.
- Earley C. and Mosakowski E. (2004). **Cultural Intelligence**. Harvard Business Review, October 2004, pp. 139-146.
- Fischer R., Smith P. (2003). **Reward allocation and culture: a meta-analysis**. Journal of cross-cultural psychology, 34(3), pp. 251-268.
- Hofstede G. (1980). **Culture's consequences: international differences in work-related values**, Beverly Hills, CA: Sage. (see also www.geert-hofstede.com).
- Johnson W. L., Kole S., Shaw E., Pain H. (2003). **Socially intelligent learner-agent interaction tactics**. International Conference on Artificial Intelligence in Education. Sydney, Australia.
- Johnson W. L., Rizzo P. (2004). **Politeness in tutoring dialogs: "run the factory, that's what I'd do"**. International Conference on Intelligent Tutoring Systems, Maceïo, Brazil, pp. 67-76.
- Kashima Y. (2000). **Conceptions of culture and person for psychology**. Journal of cross-cultural psychology, 31(1).
- Kim-Prieto C., Fujita F., Diener E. (2004). **Culture and structure of emotional experience**. Unpublished Manuscript, University of Illinois, Urbana-Champaign.
- McCalla G., Vassileva J., Greer J., Bull S. (2000). **Active Learner Modelling**. International Conference on Intelligent Tutoring Systems, Montreal, Canada, pp. 53-62.
- McSweeney B. (2002). **Hofstede's model of national cultural differences and their consequences: a triumph of faith – a failure of analysis**. Journal of Human Relations, 55(1), pp. 89-118.
- Ortony A., Clore G. L. & Collins A. (1988). **The cognitive structure of emotions**. Cambridge University Press, MA.
- Picard R. (1997). **Affective Computing**. The MIT Press, Cambridge, MA.
- Shaver P. R., Schwartz J. C. (1992). **Cross-cultural similarities and differences in emotion and its representation**. In C.Z. Malatesta & C. Izard (eds), Emotions in adult development. pp. 319- 338. Beverly Hills, CA: Sage.
- Scollon C. N., Diener E., Oishi S., Biswas-Diener R. (2004). **Emotions across cultures and methods**. Journal of cross-cultural psychology, 35(3), pp. 304-326.
- Smith P. B., Bond M. H. (1998). **Social psychology across cultures**. Prentice-Hall.
- Zhang Y. (2005). **Age, gender and Internet attitudes among employees in the business world**. Journal of computers in Human Behavior, 21(1), pp. 1-10.