

# Cross-Cultural Adaptation of e-Learning Contents: a Methodology

Emmanuel Blanchard, Ryad Razaki, Claude Frasson

HERON Laboratory, Computer Sciences Department  
Université de Montréal, C.P. 6128. Succ. Centre-Ville  
Montréal, Québec, Canada H3C3J7  
{blanchae, razakiry, frasson}@iro.umontreal.ca

**Abstract:** e-Learning, the way of teaching people through the Internet, is a global methodology. This definition implies that learners coming from different countries could attend the same e-Learning session. Culture has been shown as an important inductor for peoples' behaviours in different contexts, including learning. Cultural intelligence, as described by Earley and Mosakowski is a "*seemingly natural ability to interpret someone's unfamiliar and ambiguous gestures the way that person's compatriots would*". In a precedent work, given this definition, we have proposed a new kind of system called Culturally AWARE System (CAWAS) that is centred on Culturally Intelligent Agents (CIA) i.e. agents that are able to understand and adapt to cultural specificities of learners. In this paper, we extend this research and present a methodology to adapt the content that will be displayed to a learner, according to their cultural profile.

**Keywords:** cross cultural e-Learning, adaptation, multi agents system

## 1. Introduction

e-Learning, the way of teaching people through the Internet, is a growing practice in nowadays educational systems. Highspeed Internet, lower costs of computers and the increase of the computer sciences understanding in the population make this methodology accessible to more and more people over the years. This "democratisation" is undoubtedly positive news. But it also implies new objectives. While information is globally accessible and network technologies have greatly evolved, we can now think about e-Learning applications where thousands of learners coming from all five continents could coexist synchronously and learn together.

As it has been shown in many different studies (see for example, [Hofstede, 2001]), culture can have a great impact on the way people (and learners) behave in particular situations, on the way they interact with their environment and peers and on the meaning they give to a specific concept or symbol. In this respect, in cross-cultural studies, this relation between cultural membership and concept/symbols interpretation is obvious.

According to Kashima [2000], there are two schools of thinking when it comes to defining a culture. Some researchers 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*". For others, it is a "*relatively stable system of shared meanings, a repository of meaningful symbols, which provides structure to experience*". As we can see, a major distinction between those two definitions is the way culture is seen as a static or dynamic system but both definitions agree on the fact that culture and concept/symbol interpretation are closely linked.

Emotions have a growing importance in the e-Learning research field [Conati, 2002; Chaffar & Frasson, 2004]. Research has shown that culture influence among other things the frequency with which people experience positives or negative emotions (for example, people from western countries will experience positive emotions more frequently than people from eastern countries, [Scollon, 2004]), the determination itself of the concept of a positive or negative emotion (for example, in western countries, pride is seen as a positive emotion whereas in eastern countries, it is associated with negative emotions [Kim-Prieto et al, 2004]).

Culture can also influence the preference of a learner for individual or collaborative work [Blanchard & Frasson, 2005], anxiety [Cassady et al, 2004], reward allocation [Fischer and Smith, 2003]... Therefore, taking culture into account appears to be very profitable for many aspects of e-Learning. In this paper, we will mostly focus on the understanding of concepts/symbols that happens to be a critical issue in e-Learning.

If the content in a global e-Learning activity is not adapted in function of the culture, there are risks that learners of different culture background consider the same concept in different manners. The representation an author (from a particular country) makes of the domain to be learned could also disturb learners with different cultural values. How to adapt content displayed to a learner depending of his cultural specificities?

First we describe a Culturally AWAre System (CAWAS) for an e-Learning activity [Blanchard & Frasson, 2005] and its architecture. Then, we present an implementation of an authoring tool to create cultural templates of multimedia documents. Finally, we describe the process we propose in order to adapt multimedia contents to a learner's cultural specificities inside a CAWAS. This process depends on the methodology we used to represent cultural groups, cultural specificities of learners and resources.

## 2. Culturally AWAre Systems for e-Learning

There are two main ideas behind the CAWAS design for e-Learning: a notion of cultural intelligence and a dual representation of cultural rules.

### 2.1. Cultural Intelligence

The objective of this system is to adapt to learners' cultural specificities. This means that our system must be culturally intelligent, which is described by Earley and Mosakowski [2004] as a "*seemingly natural ability to interpret someone's unfamiliar and ambiguous gestures the way that person's compatriots would*". Two different aspects of the concept of cultural intelligence are needed in a CAWAS:

- *Understanding* : the ability for the system to translate a learner's behaviour/feeling/result depending on the learner's cultural specificities. This translation must allow the system to judge learners on the same basis.
- *Adaptation* : the ability for the system to display different interfaces and/or to start different learning strategies depending on the learner's cultural specificities. This translation must allow the system to give a better answer to the needs of a learner.

To resolve this constraint, we design a CAWAS with a Culturally Intelligent Agent (CIA) as a central module. A CIA is composed of two inner agents: a *Cultural Transcriptor Agent* (CTA – for the understanding aspect) and a *Cultural Action Agent* (CAA – for the adaptation aspect).

### 2.2. Dual representation of cultural rules

As mentioned earlier, there are two ways of defining a culture. We think that both those definitions can present advantages for e-Learning activities. For example:

- The first definition (culture as "*a process of production of meanings...*" i.e. a dynamic system) 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 definition (culture as a "*relatively stable system of shared meanings, a repository of meaningful symbols...*" i.e. a static system) could be used to explain variations in learning results, practices and behaviours across cultural clusters.

In a CAWAS, to fit with this dual definition, the Cultural Knowledge Base contains two kinds of cultural data:

- Static culture data (i.e. static rules obtained from readings in the cross-cultural domain. For example: *pride can be considered as a positive emotion for a learner of a western country*).
- Dynamic culture data (i.e. rules that are dynamically obtained by analysis of the use of the system. For example: *French learners in the system prefer to work collaboratively*).

### 2.3. Architecture of a Culturally Aware System for e-Learning

In this part, we describe the basic architecture of a CAWAS as seen in figure 1.

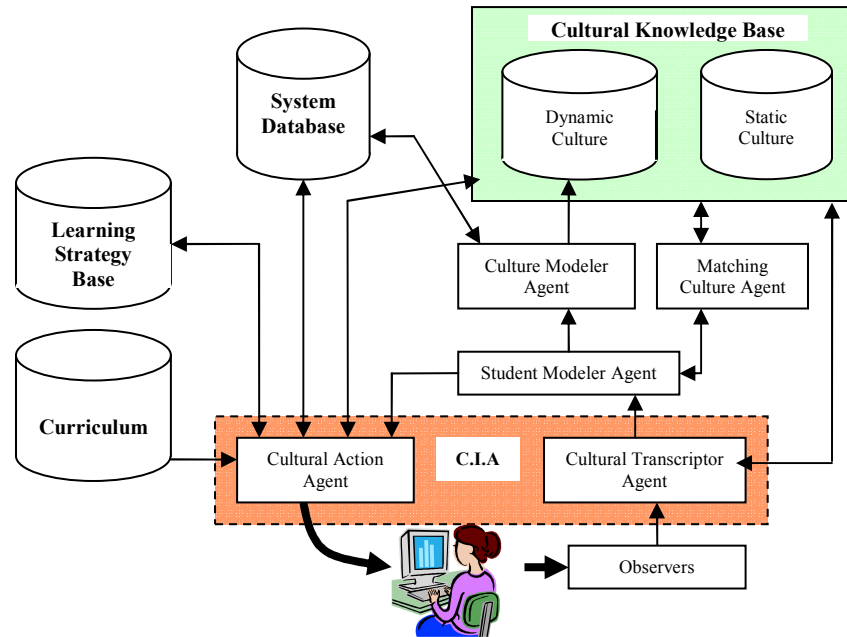


Figure 1: an architecture for a Culturally AWARE System (CAWAS)

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. 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 evolve given outcomes produced by the learner while he uses CAWAS.

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.

### 3. Implementation of an authoring tool to produce cultural templates

In this section, we present the implementation of an authoring tool for cultural templates. A cultural template has some similarities with an HTML document. The difference is that there are no multimedia tags. Instead, specific tags represent multimedia contents that will be culturally adapted according to the learner's cultural specificities.

The Figure 2 presents the interface of our authoring tool and two documents generated.

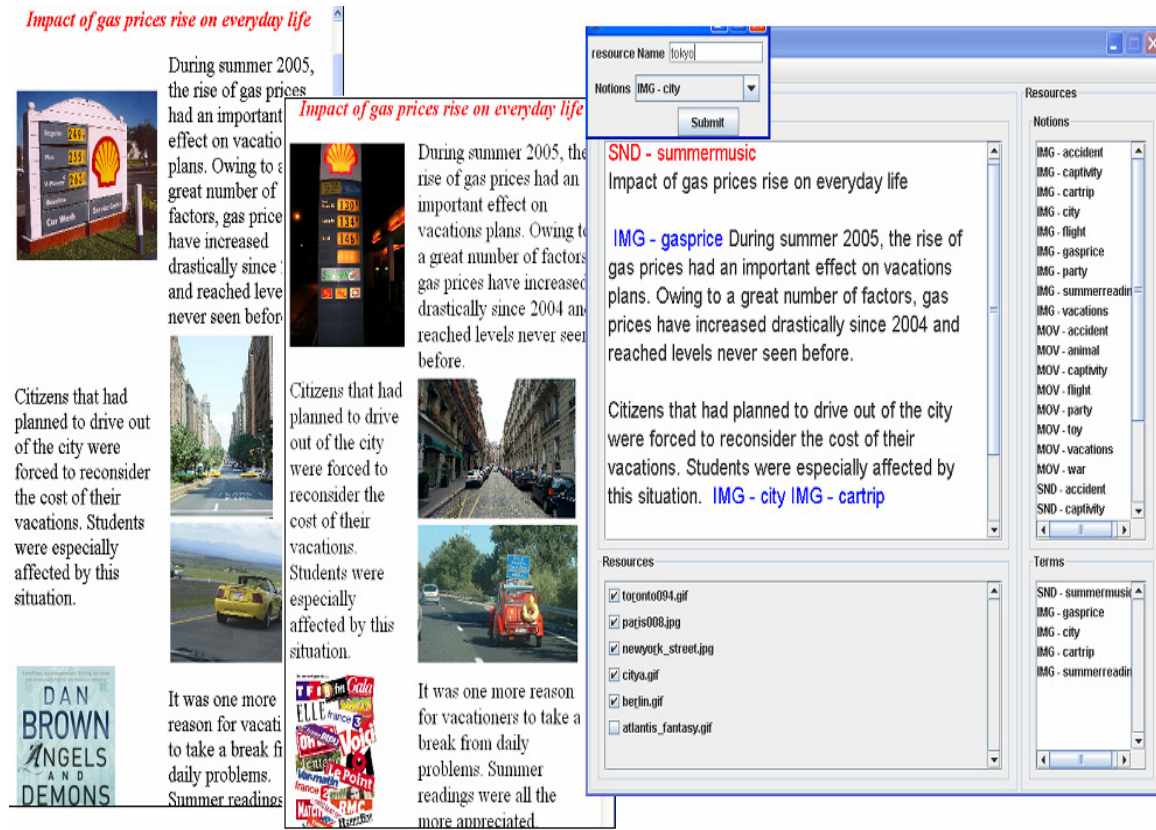


Figure 2: interface of an authoring tool for cultural templates and two possible resulting documents

In order to create a course, the author can write the text on the text area, in the center of the interface. If he wants to add multimedia contents, he can browse a list of pairs of values describing the multimedia type of content and the concept he wants to illustrate on the right of the interface. Thus he is able to select the multimedia content he needs i.e. a resource of a *type T* representing a *concept C*.

All of the resources linked with the selected pair are listed at the bottom of the interface and the author has the opportunity to unselect resources that are irrelevant (for instance, in figure 2, the text concerns a course on the importance of global economy in daily life. "Atlantis\_fantasy.gif", an image showing the mythological city of Atlantis is irrelevant for such course. So this resource is unselected). When a multimedia content is inserted, a text in color representing the pair of values appears in the main text area.

The author has the opportunity to add new resources to the resource base by selecting a pair in the list of available pairs and clicking on a "add resource" button. A menu (on the top left corner of the figure 2) will then be displayed. Figure 3 presents the cultural template obtained for the example shown in our interface.

```
[SND - SUMMERMUSIC: djRyad_socaParty.mp3; sambaDoBrasil.mp3; macarena.mp3;
mcManu_onTheBeach.mp3]Impact of gas prices rise on everyday life

[IMG - GASPRICE: europompe.jpg; gas.jpg; gasPrice.jpg] During summer 2005,
the rise of gas prices had an important effect on vacations plans.
Owing to a great number of factors, gas prices have increased
drastically since 2004 and reached levels never seen before.

Citizens that had planned to drive out of the city were forced to
reconsider the cost of their vacations. Students were especially
affected by this situation. [IMG - CITY: toronto094.gif; paris008.jpg;
newyork_street.jpg; cityA.gif; berlin.gif][IMG -CARTRIP: deuche.gif;
ontheroad.jpg; car04.gif; maTutureAMoi.jpg]

[IMG - SUMMERREADING: revuepresse.gif; danbrown.gif; vsd.jpg; peltzer.gif] It
was one more reason for vacationers to take a break from daily
problems. Summer readings were all the more appreciated.
```

*Figure 3: an example of a cultural template*

In the next part, we present the process of cultural adaptation of multimedia contents.

## 4. A process for the cultural adaptation of multimedia contents

The objective is to obtain a multimedia document adapted to learner's cultural specificities. First, an author has to generate a cultural template. When the author finishes his work, the cultural template file is created.

Later, a learner connects to the CAWAS and the system detects that he needs to learn some specific knowledge. The system will load a cultural template corresponding to the knowledge to be learned. Before displaying the course to the learner, the system will launch a process that will choose which multimedia resources to show to this specific learner.

Many resources can represent the same concept. For the concept "party", we can have pictures of people dancing, eating, discussing, clubbing, laughing... The difficulty is to choose the appropriate resource to represent the concept depending on learner's cultural characteristics. For example, if we display a picture showing people discussing and drinking alcohol to represent the concept "party", it could have a negative impact on Muslim learners.

Figure 4 (on the next page) presents this process of choosing a resource to illustrate a concept.

In the next subsections, we will explain how we represent cultural groups, cultural specificities of learners and Cultural Interest Scores of a resource. Then we will describe the process of selecting the correct resource.

### 4.1. Cultural representations

#### 4.1.1. Representing cultural groups

Figure 4 shows two different cultural groups A and B. As mentioned earlier, a CAWAS contains a Cultural Knowledge Base that holds cultural rules (static or dynamic). A Rules Weights Vector (RWV) is linked to each cultural group. A RWV is a set of weights that are associated with each rule existing in the Cultural Knowledge Base. In figure 4, the fact that 8 cultural rules are currently defined in the Cultural Knowledge Base means that each RWV in this CAWAS is currently composed of 8 weights.

Each weight has a value between 0 and 1. If, in a RWV, the weight of a rule is close to 0, then the people belonging to this cultural group don't refer so much to this rule. The closer the weight to 1, the stronger the relationship between the rule and people belonging to this cultural group.

#### 4.1.2. Representing learners' cultural specificities

The legend of the figure 4 shows the elements that are presents in a learner's model to represent his cultural specificities.

As for cultural groups, learners have a personal RWV to represent the extent to which they endorse each of the cultural rules. They also have a membership score for each existing cultural group (MS.A and MS.B in figure 4). The membership score for a group X (MS.X) is obtained with the following formula:

$$MS.X = \sum_{i=1}^n \frac{1 - |L.RWV_i - X.RWV_i|}{n}$$

In this formula,  $n$  is the number of existing cultural rules,  $L.RWV_i$  is the weight associated to the rule number  $i$  for the learner  $L$  and  $X.RWV_i$  is the weight associated to the rule number  $i$  for the cultural group  $X$ . One should notice that, given this formula, an MS.X has a float value between 0 and 1. If an MS.X of a learner is high (around 1), the learner belongs to the group X. If an MS.X is around 0, the learner doesn't belong so much to the group X.

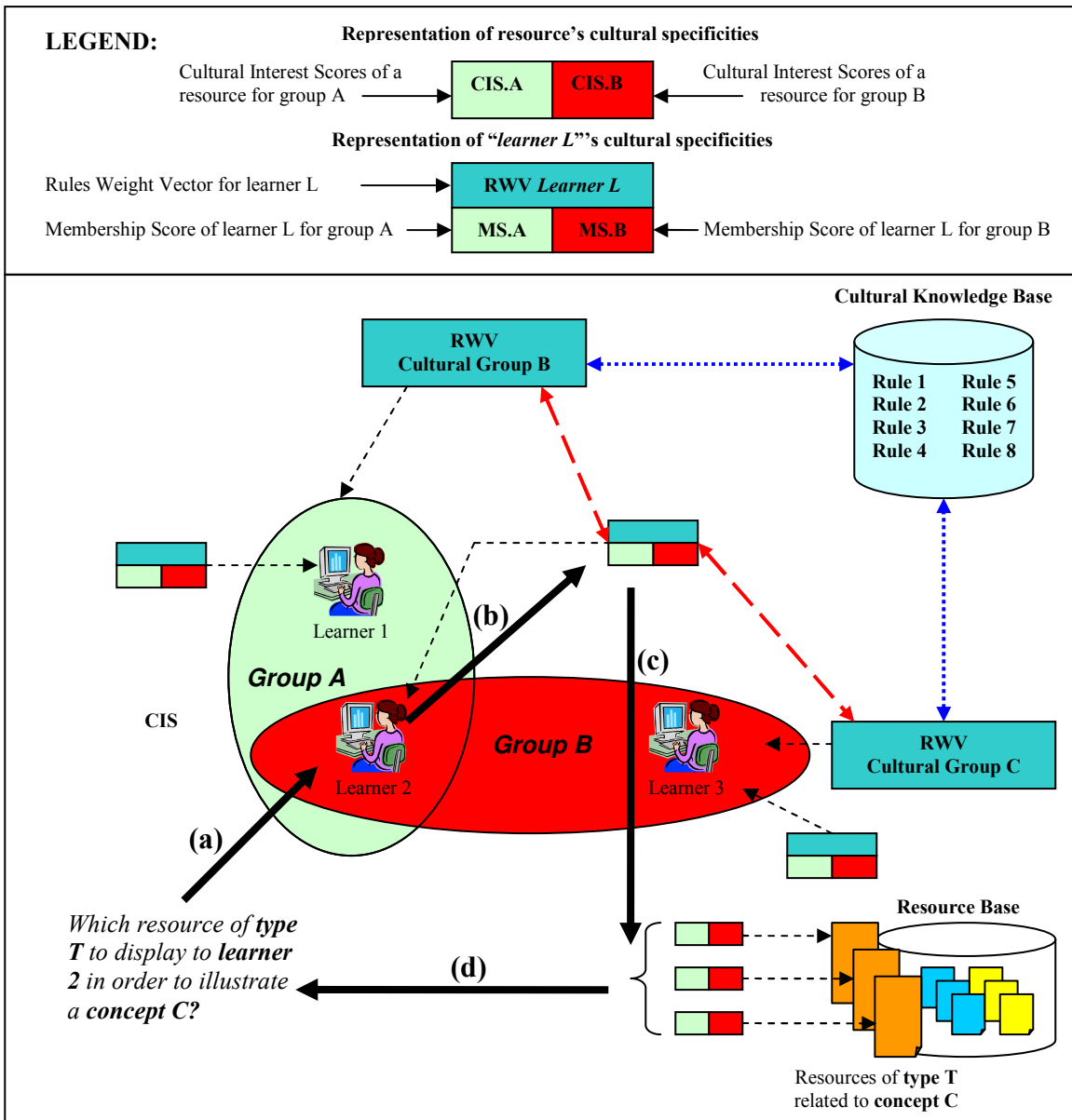


Figure 4: process of cultural adaptation of multimedia content

#### 4.1.3. Representing the Cultural Interest Score of a resource

As stated earlier, in a cultural template of a document, a resource is designated by a pair of values representing the type of the resource and the name of the concept the resource relates to. The Cultural Interest Score of a resource (CIS) represents the suitability of this resource for illustrating the concept to a given cultural group. Each resource has a CIS for each existing cultural group in the system (see the legend of figure 4). This score is a float number between 0 (not suitable to use this resource with this cultural group) to 1 (very suitable to use this resource with this cultural group). The evolution of the cultural interest score depends on the learner's results. If a learner belonging to a cultural group X uses this resource and succeeds in an activity, this resource's CIS increases for the cultural group X; if the learner fails, the CIS for the group X is lowered.

#### 4.1.4. Evolution of the Rules Weights Vector

Weights' evolution in the learner RWV depends on the learner's results. If a rule is used by the CAWAS in order to adapt its response to the learner and the learner succeeds in an activity, the weight associated to this rule will grow; if the learner fails, the weight is lowered.

Weights' evolution in the cultural group RWV depends on the RWV of the member of this group. Frequently, the CAWAS requests RWV of all the learners that belong to a cultural group. The new RWV for the group is obtained by calculating the average value for each weight of the RWV.

Frequently, the CAWAS runs learners' RWV through an unsupervised neural network: the Self Organizing Map [Kohonen, 1990]. Clusters thus obtained are composed of learners with similar RWV. If there is a sufficient number of learners in this group, the mean RWV is calculated and becomes the RWV for a new dynamic cultural group. By default, if needed, resources' CIS related to a newly discovered cultural group are initialized to 0.5.

## 4.2. Selecting the resource

As shown in figure 4, the process of selecting a resource is as following:

(a): The request for finding a resource of *type T* for a *concept C* for a *learner L* is initialized.

(b): The system obtains all of *learner L*'s membership scores.

(c): Then, for each of the resources of *type T* related to *concept C*, the system looks for Cultural Interest Scores for all the groups to which *learner L* belongs. For each of those resources, a Cultural Interest Score for the learner L (CIS.L) is determined, given the following formula:

$$CIS.L = \sum_{i=1}^n (MS.X_i \times CIS.X_i)$$

In this formula, **n** is the number of currently existing cultural groups, **MS.X<sub>i</sub>** is the Membership Score of *learner L* for the cultural group X<sub>i</sub> and **CIS.X<sub>i</sub>** is the Cultural Interest Score of the resource for the cultural group X<sub>i</sub>.

(d): The chosen resource i.e. the one with the biggest **CIS.L** value is inserted in the document deduced from the cultural template (for example, an HTML file).

## 5. Conclusion and future works

In this paper, we presented a methodology to culturally adapt multimedia documents. We introduced an authoring tool to create cultural templates of multimedia documents. Those templates are the foundations on which we can generate documents that are adapted in function of learners' cultural specificities. A cultural group is identified by a specific vector of weights related to cultural rules called a Rules Weights Vector. Each learner's is modelled with a similar of vector. A comparison of the Rules Weights Vector of a learner with that of a cultural group determines the level of belongingness of this learner to this cultural group. Matching the level of belongingness of a learner to a particular group with the

suitability of a resource to that group allow us to decide if that resource is indicated for the learner, given their cultural specificities.

Currently, the system is based on a representation of resources by a set of suitability weights that must be initialized manually. Yet, this method of initialization could be lightened and made more systematic. We are also looking at a methodology to make our system less centralized, maybe by using a grid topology.

## 6. References

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## 7. Acknowledgements

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