Cultural Adaptation of Pedagogical Resources within Intelligent Tutorial Systems

Franck Hervé Mpondo Eboa, François Courtemanche, and Esma Aïmeur

Department of Computer Science and Operations Research
University of Montreal, Quebec, Canada
{mpondoef,courtemf,aimeur}@iro.umontreal.ca

Abstract. Intelligent Tutoring Systems (ITS) are increasingly used for distance learning around the world. However, most systems present the learning content regardless of the learner's cultural background. This paper presents a resource personalization technique for cultural adaptation within ITSs. The approach is based on a collaborative filtering technique using an implicit cultural profile, which is automatically updated using the learner's interactions with the system.

Keywords: Cultural adaptation, collaborative filtering, user interaction.

1 Introduction

Despite many great successes, most intelligent tutoring systems for distance learning have an important limitation restricting worldwide scale use: the lack of pedagogical adaptation to the learner's *socio-cultural context* [3]. Specifically, the learning content is displayed to different learners regardless of their cultural environment. However, several researches [1, 2, 4] have highlighted the fact that our mental programming – how we act, think, learn and interpret – is conditioned by our social circle, the countries in which we grew up, etc. For instance, the word "football" has different meanings in North America (American football) than in Europe or South America (soccer). As the creation of homogenous cultural groups for cultural classification of learners requires an important and tedious survey process [3], we propose a cultural adaptation approach that bypasses this difficulty using a two-step technique: a) A minimal amount of information about the learner is recovered to initialize the adaptation process b) A *collaborative filtering* technique is used to adapt pedagogical resources using the learner's cultural profile, which is dynamically updated by his/her interactions with the system.

2 Adaptation Technique

In our ITS, each *problem* consists of a web page presenting a given topic. The domain knowledge included in a problem is presented using a series of *concepts*. In a problem a concept can be presented to the learner using different materials (images, texts or videos). We name *pedagogical resource* a particular material used to present a

V. Aleven, J. Kay, and J. Mostow (Eds.): ITS 2010, Part II, LNCS 6095, pp. 340–342, 2010.

concept. For example, in a problem about nutrition the concept of "Carbohydrate-rich foods" can be presented as an image of *maple syrup* (Canada), *bok choy* (China), *potatoes* (US) or *cassava* (Africa).

2.1 Knowledge Based Adaptation

Each pedagogical resource is tagged by a domain expert (arrow 1, Fig.1) in order to establish its relevance according to different nationalities. When logging for the first time, the learner provides his/her nationality in order to initialize a temporary cultural profile used to choose pedagogical resources at the beginning, effectively reducing the *cold start* effect (arrow 2, Fig.1).

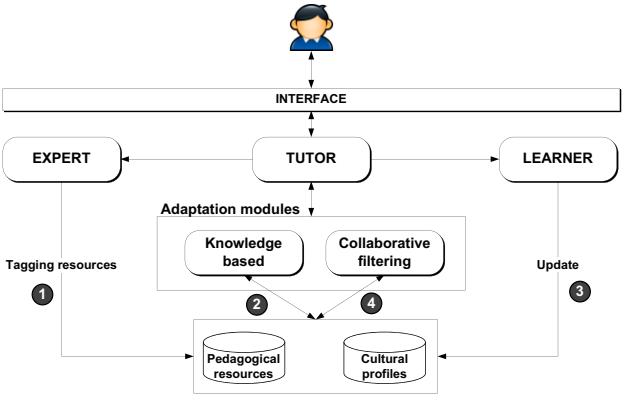

Fig. 1. System architecture

2.2 Collaborative Filtering Based Adaptation

A cultural background may depend on several factors including [4]: *the environment in which one spent most of adolescence*, *his/her hobbies*, *religion and degree of worship*, *countries of residence*, *etc*. It is therefore unwise to rely solely on nationality to determine a learner's cultural profile. The *Collaborative Filtering* (CF) adaptation module (Fig.1), based on CF technique, allows to implicitly infer the learner's cultural preferences over the pedagogical resources. The cultural profile used by the CF module contains the learner's appreciation (numeric value from 0 to 5) of pedagogical resources (Fig. 2).

During a learning session the learner can change directly in the problem interface a pedagogical resource that is not culturally suited, from a set of equivalent resources for the same concept (e.g.: changing a maple syrup image for a cassava image). The learner's cultural profile is then dynamically updated (arrow 3, Fig.1) incrementing by one the newly selected resource's scoring ($R_4 = 2+1 = 3$). As learners sharing the same cultural background understand concepts using the same frame of reference they will have similar resource scoring. To integrate the pedagogical resources in problems for a given learner, CF algorithm (in CF module) selects pedagogical resources that were appreciated by learners with the same or close cultural background (arrow 4,

Fig.1). A cultural similarity coefficient is computed between a target learner and all other learners using the *Pearson correlation* defined by the following equation:

$$\text{Sim}_{(t,u)} = \frac{\sum_{i=1}^{m}(s_{t,i} - r_t^?) \times (s_{u,i} - s_u^?)}{\sqrt{\sum_{i=1}^{m}(s_{t,i} - s_t^?)^2 \times \sum_{i=1}^{m}(s_{u,i} - s_u^?)^2}} \quad (1)$$

Where $s_{t,i}$ is the target learner's score for the resource *i* and $s_{u,i}$ stands for another learner's score for the same resource *i.* The cultural similarity coefficient is computed over the *m* resources in the domain knowledge.

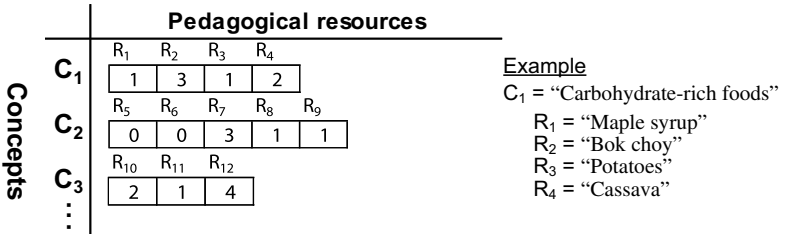

Fig. 2. Implicit cultural profile

3 Conclusion and Further Work

This paper presents an extension of the learner module within ITSs in order to dynamically adapt pedagogical resources to the learner's cultural profile. The adaptation technique is based on collaborative filtering and allows inferring cultural preferences which the system is unable to retrieve explicitly from the learner. The implicit cultural profile is automatically updated using the learner's interactions with the system throughout learning sessions. The update process is therefore transparent and requires less additional work for the learner than approaches based on an explicit cultural profile. An experimental validation is currently in progress.

References

1. Blanchard, E., Lajoie, P.: Learner-Concerned AIED Systems: Affective Implications when Promoting Cultural Awareness. In: 2nd International Workshop on Cultural-Aware Tutoring System (CATS), Brighton, pp. 13–23 (2009)
2. Hofstede, G.: Culture's Consequences: Comparing Values, Behaviors and Organizations across Nations (2003)
3. Savard, I., Bourdeau, J., Paquette, G.: Cultural Variables in the Building of Pedagogical Scenarios: the Need for Tools to Help Instructional Designers. In: 1st International Workshop on Cultural-Aware Tutoring System (CATS), Montreal, pp. 83–92 (2008)
4. Reinecke, K., Schenkel, S., Bernstein, A.: Modeling a User's Culture. In: The Handbook of Research in Culturally-Aware Information Technology: Perspectives and Models. IGI Global (2009)