Cultural Artefacts in Education: Analysis, Ontologies and Implementation

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Abstract

Adaptive web technologies are often used in distance learning scenarios with little regard for learners' cultural background. The CAE questionnaire determines the cultural artefacts that influence a learners behaviour within an educational environment. This paper presents the CAE-L cultural ontology along with an analysis of three countries (China, Ireland and UK). This ontology is instantiated to determine their 'cultural stereotype' which can then be used to define a layer of adaptation that traditional systems ignore.

1. Introduction

Adaptive Hypermedia (AH)[1] aims to deliver a personalised Web experience to each user. AH is considered the solution to the problems of traditional Hypermedia systems such as: static content, being "lost in hyper-space" and the "one-size-fits-all" approach. With the development of the Semantic Web [2] and the ongoing push to develop Ontologies [3] for knowledge domains the importance of AH has increased.

Adaptive Educational Hypermedia (AEH) [4] is, in principle, superior to regular educational hypermedia as it personalizes the educational experience. Educational systems that adapt to a learner improve the effectiveness of the learning process. In AEH, learning materials are delivered to the user dependant on a given series of user factors, such as: background education, goals, learning styles to name a few. With the widespread use of distance learning, and the many different learning systems (both adaptive and non-adaptive), the cultural background of a student may have a great impact on their ability and efficiency to learn a given set of content. In addition many distance learning classes (indeed even traditional classes) have a great mix of student cultures involved; this will affect the social interactions and therefore the learning effectiveness of the entire group.

This paper uses UNESCO's definition of 'culture':

"... culture should be regarded as the set of distinctive spiritual, material, intellectual and emotional features of society or a social group, and that it encompasses, in addition to art and literature, lifestyles, ways of living together, value systems, traditions and beliefs" [5]

Section 2 describes related work in this area, specifically the Hofstede's Indices; whilst Section 3 introduces the CAE questionnaire and the outcomes of the analysis of three countries respondents'. Section 4 will detail the CAE-L ontology that has been developed to describe the cultural variables and using these results Section 5 will describe an instance of this ontology for each of the three countries under investigation. Finally Sections 6 and 7 will discuss the future use of these ontologies and draw conclusions.

2. Related Work

There have been several projects concerning 'eCulture' [6,7], but these are focused on cultural heritage, specifically the gathering, storage, tagging and dissemination of cultural information (e.g., museum data). Within the domain of *education*, be it

adaptive or not, there is little work that can be used to study cultural effects. This paper address the lack of such work in this area by examining factors behind the adoption of a cultural stereotype in AEH systems.

In the domain of *business* (at IBM), Hofstede [8] demonstrated that any given culture could be defined by its position on five indices. The Values Survey Module (VSM) questionnaire [9] allows a person to be stereotyped within these indices and cultural 'zones'. The VSM Indices are: **PDI** (Power Distance Index); **IDV** (Individualism); **MAS** (Masculinity); **UAI** (Uncertainty Avoidance Index) and **LTO** (Long term Orientation). Table 1 shows an interpretation of Hofstede's VSM scores for the three countries investigated in our paper (with 'H' = high representing a VSM score > 60, 'L' = low < 40 and '--' = no data).

Table 1: Hofstede's Indices and the scores for China, Ireland and the United Kingdom

Country	PDI	IDV	MAS	UAI	LTO
China	H	L	H	L	H
Ireland	L	H	H	L	--
United Kingdom	L	H	H	L	L

Table 2: some of the implications for AEH systems inferred from Hofstede's indices.

a) Power Distance Index (PDI)

High Score	Low Score
• Deep hierarchies • Greater difference in status of experts • Strong focus on expertise (eg help) • Explicit & enforced barriers to access	• Shallow hierarchies • Less difference in status of experts • Weak focus on expertise (eg help) • Focus on freedom to roam (transparent access)

b) Masculinity (MAS)

High Score	Low Score
• Traditional gender/age distinctions	• Blurring of gender/age distinctions

c) Uncertainty Avoidance Index (UAI)

High Score	Low Score
• Simplicity with clear metaphors, limited choices and restricted amounts of data • Navigation focuses on not getting lost • Less ambiguity	• Complexity availability of choices and data • Navigation will allow for users to roam away from tightly controlled sequence • More ambiguity

Within the CAE-L ontology (described in Section 4) we focus on three of the VSM indices: PDI, MAS and UAI, as these are sufficient to deliver a culturally sensitive lesson to each of these countries. A short description of how a 'high' or 'low' score could affect a learner is given in table 2 (a, b and c).

3. CAE Analysis

The CAE (Cultural Artefacts in Education)[10] questionnaire is designed to gather the information required to determine if there is a cultural bias within online education, specifically Adaptive Educational Hypermedia (AEH)[4]. This questionnaire is based upon the cultural indices of Hofstede (described in Section 2) and the interpretation of those indices relevant for web based systems as given by Marcus & Gould [11]. The user focus of the questionnaire is upon the *educational* domain, hence students or researchers within academia. This is to complement Hofstede's VSM questionnaire [9], which is designed to determine cultural values within a *corporate* setting (specifically that of IBM). The CAE questionnaire is designed to investigate the following four hypotheses:

H1: Hofstede's cultural dimensions also apply to the educational domain.
H2: Students desire to be taught in the manner that they have been brought up with.
H3: A student's educational cultural bias is resistant to change.
H4: There is a cultural bias in the acceptance of (openly acknowledged) Adaptive Educational systems.

Each hypothesis had a series of questions designed to gather data that allows for an investigation into the truth of the hypothesis. The responses from students from universities around the world have been recorded. The CAE questionnaire makes no distinction between undergraduates and postgraduates, but does record if a respondent is an academic. The initial sample size examined in this paper is 145 (14 of which were academics). These respondents were from a mix of cultures, ranging from German to Chinese to Burmese – a total of 47 countries in total. The three countries chosen for further analysis in this paper are China, Ireland and the United Kingdom. They were chosen as they display a range of values for use within he CAE-L ontology described in Section 4. The numbers of respondents from each of these countries are: China = 6; Ireland = 23; UK = 29.

The data was analysed (using a one-way ANOVA) to determine differences in the responses between countries. The results (table 3) are compared to Hofstede's VSM Indices, with 'H' = high, 'L' = low, 'In' = Inconclusive and '--' = no data.

The dark grey cells in table 3 highlight the CAE results that do *not* match Hofstede's cultural index. For example, China has a 'low' UAI (Uncertainty Avoidance), and yet CAE question 10, 11 and 12 all

show that the CAE responses from Chinese students all concur with those expected from 'high' UAI cultures. Such as for Q11 "*I prefer to reduce complexity by using smaller, limited amounts of information*", high UAI cultures will tend to agree with this statement, which the Chinese respondents do so. The white cells indicate those areas where the CAE responses match those expected from Hofstede's Indices.

Table 3: summary of the CAE results for the three countries under investigation.

Country	PDI	UAI	MAS	IDV	LTO
China (CHN)	H	H	L	L	H
Ireland (IRL)	L	H	L	H	--
UK (GBR)	L	L	L	H	L

4. CAE Ontologies

The adoption of Semantic Web Technology into education gave rise to education ontologies: these are ontologies that encapsulates the knowledge of an education system and related pedagogical information. Recent developments in educational ontologies have focused on delivering educational services and description of educational content [12]. A number of ontology names can be found in numerous research works and several systems or tools are developed to fulfil particular education purposes. However, ontology development in the area of CAE is still under investigation. To this effect, in this paper, we present an overview of a light-weight ontology to represent the cultural artefacts investigated by the CAE questionnaire, the CAE-L Ontology framework (figure 1). By analyzing the CAE results, and linking this to the Hofstede indices the CAE-L User Model Ontology has been developed. This ontology consists of five interrelated sub-ontologies, namely (1) Authority, (2) Group, (3) Language, (4) Lesson and (5) Data. Figure 1 details these four sub-ontologies along with their associated concepts (and concept values), for example the CAE-L 'Data' ontology is described by the '*hasDataSecurity*' relationship with the possible values of 'present' or 'absent'.

- **Authority Ontology:** This ontology describes concepts which are related to the 'authority' of actors and data within AEH. For example how much faith does a learner inherently place in their peers and teachers?
- **Group Ontology:** This ontology provides description for the separation of tasks according to gender preference.
- **Language Ontology:** The language ontology provides concept description for language and cultural modelling while presenting the education content.
- **Lesson Ontology:** This ontology describes the presentation of a lesson, module or series of tasks.
- **Data Ontology:** This ontology is related to the security of data for the learners.

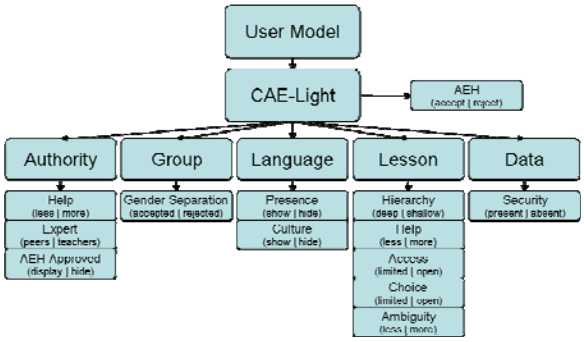
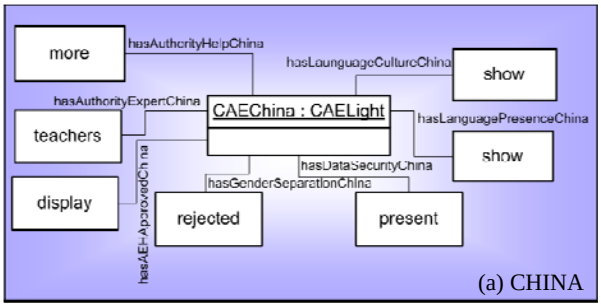
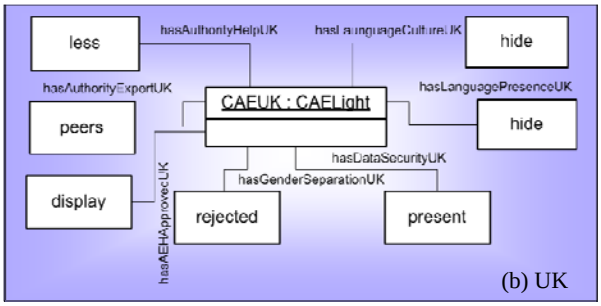


Figure 1: CAE-L Ontology Framework

5. CAE User Model Instances

By applying the results described in table 3 within the CAE-L ontology we can describe a stereotypical series of values for each learner in the three countries under study. These ontology instances are show in figure 2 (a, b and c). The relationships of the CAE-L ontology for a given country (such as *CAEChina*) and the concepts as described in Figure 1 are shown. For example the value for the 'Authority' sub-ontology concept of 'Help', is shown through the relationship "*hasAuthorityHelpChina*" as 'more' (in Figure 1 we can see that the 'Help' concept has two potential values: 'less' and 'more', illustrating that Chinese students want more help from authority figures).





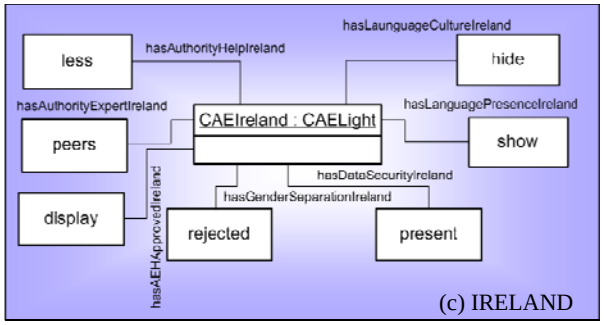


Figure 2: Instance Diagram of the CAE-L Ontology for: (a) China; (b) UK & (c) Ireland.

The same figure 2a shows that, *in general*, Chinese learners consider teachers only to be an 'authority' (through the *hasAuthorityExpertChina* relationship), whilst UK or Irish students both consider peers and teachers to be authorities (marked as 'peers' in Figure 2b and 2c). Within the 'Language' sub-ontology we can see that Chinese students are open to receiving learning materials in a language other than their own (*hasLanguagePresenceChina*), and are happy to be exposed to other cultures (*hasLanguageCultureChina*). The Irish (2b) are also content to be exposed to other cultures, but they do not wish to be taught in foreign languages. Finally, the British students (2c) prefer not to be exposed to other languages or cultures.

6. Future Work

With the development of CAE-L as a culturally sensitive ontology for use in Adaptive Hypermedia it is possible to create a template for the culture of learners to be used for stereotypical adaptation. For each of the three countries analysed in Section 5, the next stage is to use the ontology instances (figure 2) as templates within an AEH and allow students to use them. The next stage in this work will be to enfold these templates into MOT [13] and WHURLE [14], two AEH systems, MOT specialising in AEH authoring, the contents of which can then be transformed for use in other systems, and WHURLE in AEH delivery.

7. Conclusions

This paper presents some of the results of the CAE questionnaire, designed to identify the cultural values within the domain of *education*. Three countries were chosen to determine a cultural stereotype for each that may be used as a guideline to pre-adapt learning materials, when nothing is known about the students, other than their cultural background. It should be emphasized that this initial cultural adaptation does not exclude the use of other adaptation systems, but can be used to enhance them, giving a more valuable personal learning experience to every user.

8. Acknowledgements

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