A CULTURAL EDUCATION MODEL: DESIGN AND IMPLEMENTATION OF ADAPTIVE MULTIMEDIA INTERFACES IN eLEARNING

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ABSTRACT

This thesis presents research performed over the span of 9 years in the area of adaptive multimedia interfaces (specifically Adaptive Hypermedia in eLearning), with special focus on a *cultural education model*.

In particular, the thesis looks at how the adaptive interfaces can cater for cultural diversity in education, instead of presenting a homogenous delivery for the whole student population, regardless of their cultural background. Specifically, this research provides a *framework for cultural adaptation*, *CAE (Cultural Artefacts in Education),* based on Marcus & Gould's web model, as well as its source, Hofstede's indexes. This framework is supported by a questionnaire, the *CAE questionnaire*, a key product of this research, which has been shown to map on Hofstede's indexes, and which has been used to model features for personalised adaptive interfaces for different cultures. The questionnaire is in English language, but this work also presents a study showing to what extent the results obtained are similar to native language questionnaire results.

The CAE Framework is further extended by providing two ontologies, a full-scale ontology, called the *CAE-F ontology*, and a light-weight ontology, called the *CAE-L ontology*. These ontologies detail the HCI (Human Computer Interaction) features that need to be integrated into an adaptive system in order to cater for cultural adaptation. These features can be used for all types of adaptation, as defined in adaptive hypermedia. The latter ontology is then illustrated in a *study of eleven countries*, for the specific cultural adaptation case of interface adaptation, of which current research is extremely sparse.

These illustrations are further used in a formative evaluation, which establishes to what extent the cultural adaptation ontologies can be applied. This is followed by a summative, *real-life evaluation of cultural adaptation* for Romanian students, and the results are reported and discussed. This study validates the proof of concept for using CAE in a real world setting.

Finally, the overall achievements of this work are summarised, conclusions are drawn, and recommendation for further research are done.

PUBLISHED PAPERS LIST

These are the papers I've published during my thesis work, in direct relation to the thesis:

JOURNAL PAPERS

C. Stewart, "Authoring & Culture in Online Education", Journal of Universal Computer Science, special issue on Authoring of Adaptive and Adaptable Hypermedia (http://www.jucs.org/jucs_14_17), vol 14, issue 17, pp 2877, 2009.

Contribution: 100%

CONFERENCE PAPERS

M-L. Bourguet, C. Stewart, B. Cox and D. Lefevre, "Adaptive learning environments to overcome cultural and language barriers to learning", in the IADIS conference on Cognition and Exploratory Learning in Digital Age (CELDA) 2006, pp462-463, ISBN 972-8924-22-4, Barcelona, Spain, December 8-10, 2006.

Contribution: 30%

C. Stewart, "The Role of Culture in Online Education: as an input for the authoring process", in the User Modelling (UM) 2007 conference, A3H workshop, Corfu, Greece, June 25-29, 2007.

Contribution: 100%

C. Stewart, K. Chandramouli, A. Cristea, T. Brailsford and E. Izquierdo, "Cultural Artefacts in Education: Analysis, Ontologies and Implementation", in the IEEE International Conference on Information Technology in Education, (CITE 2008), Wuhan, China, IEEE, ISBN: 978-0-7695-3336-0, pp. 706-709, 2008.

Contribution: 95%

K. Chandramouli, C. Stewart, T. Brailsford and E. Izquierdo, "CAE-L: An Ontology Modelling Cultural Behaviour in Adaptive Education", in the IEEE 3rd International Workshop on Semantic Media Adaptation and Personalization, IEEE ISBN: 978-0-7695-3444-2, pp 183-188, 2008,

Contribution: 95%

C. Stewart, T. Brailsford, K. Chandramouli and A.I. Cristea, "The CAE-L Cultural Framework: Definition, Instances and Web Service", accepted for IEEE International Conference on Advanced Learning Technologies (ICALT) 2010, July, Tunisia, 2010

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Acronym	Expansion
AEH	Adaptive Educational Hypermedia
AEI	Adaptive Education Index
AH	Adaptive Hypermedia
AHS	Adaptive Hypermedia Systems
AI	Artificial Intelligence
ANOVA	ANalysis Of VAriance
API	Application Programming Interface
CAE	Cultural Artefacts in Education
CAE-F	Cultural Artefacts in Education - Full-scale
CAEI	Cultural Artefacts in Education Indices
CAE-L	Cultural Artefacts in Education - Lightweight
CAF	Common Adaptation Format
CATS	Culturally-Aware Tutoring Systems
CEI	Cultural Education Index
CSCL	Computer Supported Collaborative Learning
CSCW	Computer Supported Collaborative Work
DAML-S	DARPA Agent Markup Language - Services
DB	DataBase
DC	Dublin Core
EH	Educational Hypermedia
FTP	File Transfer Protocol
GAT	GRAPPLE Authoring Tools
GUMF	GRAPPLE User Model Framework
HCI	Human Computer Interaction
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
ICT	Information and Communication Technologies
IDV	Collectivism vs. individualism index
IMS	Instructional Management Systems
IMS QTI	IMS Question & Test Interoperability Specification
IT	Information Technology
ITS	Intelligent Tutoring Systems
K-W	Kruskal-Wallis one-way analysis of variance by ranks
LAG	Layer adaptation model
LAOS	Layered WWW AHS Authoring Model
LMS	Learning Management System
LTO	Long- vs. short-term orientation index
MAS	Femininity vs. masculinity index
MCP	Multiple comparison procedures

NRS	Next Recommended Step
OWL	Web Ontology Language
PC	Personal Computer
PDI	Power Distance Index
RDF	Resource Description Framework
RDFS	RDF Schema
SCORM	Sharable Content Object Reference Model
SGML	Standard Generalized Markup Language
SOAP	Simple Object Access Protocol
SPARQL	SPARQL Protocol and RDF Query Language
SQL	Structured Query Language
UAI	Uncertainty avoidance index
UDDI	Universal Description, Discovery and Integration
UM	User Model
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
UTF	Unicode Transcription Factor
VOIP	Voice Over Internet Protocol
VSM	Values Survey Module
WSDL	Web Services Description Language
WWW	World Wide Web
XHTML	eXtensible Hypertext Markup Language
XML	eXtensible Markup Language
XSD	Xschema Document

CHAPTER 1:

INTRODUCTION

1   INTRODUCTION

1.1   MOTIVATION

The main motivation for this research lies in the interface between 'Education', 'Information and Communication Technologies' and 'Culture'. With the globalization of education through the use of ICT (Information and Communication Technologies), the creation of cross-border online courses and lessons has taken vast leaps forward. However, the cultural background of a student population is often overlooked when authors create these online lessons, which can lead to an unintentional form of cultural imperialism. Students from around the world find themselves needing to adapt themselves, rather than having the lesson adapt to them.

The work presented in this thesis addresses this inequitable balance between the nature of the learning content and the student.
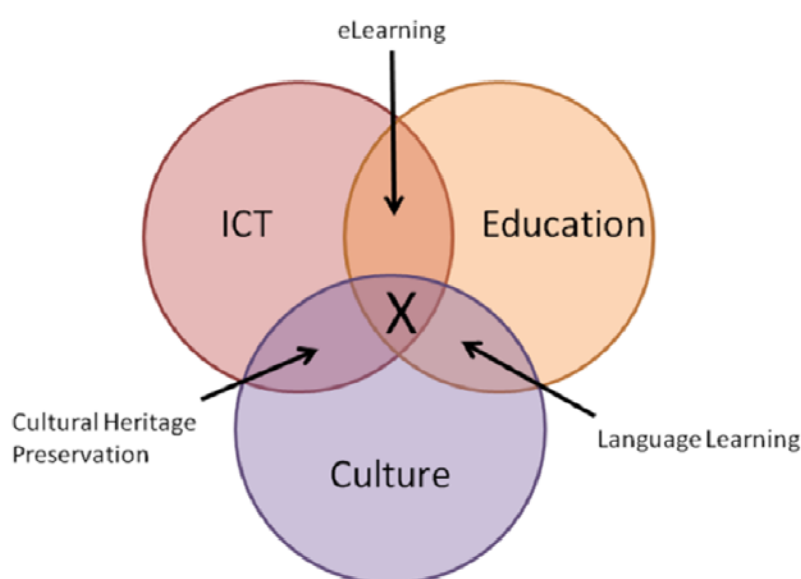
Figure 1.1: diagram showing the three major domains investigated within this thesis, along with their traditional cross-over sub-domains.

Traditionally (i.e., over the last 20 years) the interface between these domains can be categorised as seen in *Figure 1.1*.

> **eLearning:** with the rise of the new technologies broadly categorised as 'ICT', the teachers and researchers within education were some of the first to investigate how these could be used to enhance the teaching and learning processes. This use of new technologies, of course, goes back much further than modern ICT (e.g. the Hyalotype [Websters, 2011]) but has taken on a much greater dominance and penetration into the educational domain in recent years. The resultant field of 'eLearning' includes a great number of sub-disciplines, such as Computer Aided Learning, Computer Based Training, Computer Aided Assessment, mobile learning, virtual learning, etc... Of these, the research presented in this thesis focuses in (but could also be applied beyond) the area of Computer Aided Learning.

> **Language Learning:** the most common cross-domain interaction between 'Education' and 'Culture' is that of language learning. Culture is often used to enhance the teaching of a given language, e.g. through the use of audio tapes, videos, exchange trips and meeting native language speakers. However, the research presented in this thesis takes a different approach; rather than using culture as an aid to learn another language the goal here is to determine what effect a student's culture may have on their learning.

> **Cultural Heritage Preservation:** in recent years, it has become more popular for 'ICT' to be used as a means to preserve cultural heritage. The world's growing population, increased rate of pollution and environmental destruction has amplified the rate of loss of cultural heritage

sites and artefacts. In an attempt to save these for future generations, technology is being used to not only record them, but also to make them more available to the population at large.

The 'X' identified in *Figure 1.1* marks the location of the research described within this thesis. In targeting this cross-disciplinary focus, the research question addressed in this thesis is:

> *With the rapid spread of technologies whose development has been rooted in Western (US English) culture, how can the globalisation of education through eLearning be best brought back into a more cross-cultural balance, so that learners receive appropriately personalised online lessons?*

It is this question that motivates the research as outlined in this thesis. By bringing a more balanced and personal approach to eLearning through the application of cultural variables to a user model, the learner should receive a lesson that minimises (ideally even eliminates) cultural bias.

Imagine the following user case:

Sha Menghai (Chinese: 沙孟海) is a male Chinese literature student from Ningbo, accepted by a British university for a distance learning course. He can log into the system (which is prepared in English for a variety of students) and access the English materials. Whilst his English comprehension is adequate, his previous exposure to British culture is however almost non-existent. He is therefore surprised when working in a group that his peers often express their opinions in a loud and argumentative manner, even disagreeing with the teacher. Menghai's own upbringing has encouraged him to work towards group goals by calmly acknowledging disagreement and working with patience towards an understanding or compromise. As a result, his opinion is often lost in any open forum, due to his reticence to vocally disagree with his peers in a similar manner. He feels isolated and misunderstood, and his learning motivation drops.

Or in an example more directly addressed within this thesis:

Marcela Dragomir, is a female Romanian engineering student from Bucharest accepted into a distance learning course from an Irish university. Marcela is technically accomplished but is used to a high degree of support from her course tutor as well as a significant degree of 'Help' being available from the Learning management Systems that she has used in the past. However she is unused to the Irish educational cultural focus of being left to find her own way through the course materials. As a result, unlike her Irish colleagues, getting lost or diverted in her coursework undermines her confidence in her ability, which could potentially have a significantly detrimental effect on her final course mark.

Here are just two examples of how a student's learning efficiency can be reduced by being placed in non-ideal circumstances. Cultural barriers are only one aspect of cross-cultural eLearning that may happen to affect the student's final grade.

In adapting to a student's cultural background, it should be possible to reduce these barriers and increase learning efficiency and the learner's satisfaction within the adapted course.

The overall motivation and goals behind this research involve many other research fields, these goals are introduced in Section 1.2 below.

1.2 RESEARCH GOALS

The research presented in this thesis focuses on the problem of bringing the eLearning paradigm to a multicultural classroom. With the advent of the World Wide Web (WWW), the spread of internet access and the commoditization of learning and lifelong learning, the modern classroom is dramatically different from the traditional one and these factors have yet to be fully integrated together. There are many possibilities for research to advance our understanding of how the classroom of the future will look.

The research presented here addresses one aspect of this confusion of variables, namely if one is to have a classroom where each learner is presented with the materials that are best suited to their

learning preferences and styles, how best should these materials be created and presented to reflect the learners' cultural background?

To this end, the research presented in this thesis covers many high level aims which generate a specific list of target objectives. Those research aims and objectives are described here.

1.2.1 AIMS

(1) *Investigate culture-based personalisation techniques for education.* In any research into adaptive eLearning there will be feedback into the overall field of education and ICT (Information and Communication Technologies) theory and praxis. In this thesis this feedback will be of the nature of how best to use ICT in global education taking into account the learner's cultural background. These findings will be applicable to any level of education where there is a mix of cultures (be this amongst the students or the teachers).

An example can be observed in most distance learning classrooms where there is a growing mix of students from many different cultural backgrounds [HESA, 2005] (or even many traditional physically located classrooms; indeed the growing penetration of eLearning into traditional classrooms is blurring the distinction between the two).

Therefore there is a distinct and growing need for research into how a student's cultural background can and should be used in the learning process.

(2) *Identify the effect that culture has on a student's education.* In parallel to the growth of eLearning, the internationalisation of the student body is now firmly established at all levels of education. Previous research has shown that a student's home culture, particularly language, can interfere in an overseas learning environment [Xu, 1991]. These factors have been shown to affect performance at the Higher Education level [Morrison *et al*, 2005]. Therefore culture must be considered as an important user attribute in any comprehensive adaptive system. However, before adopting this new factor, several other research aims need to be addressed.

(3) *Create a test system that will allow for interface personalisation of educational materials according to the cultural stereotypes.* Once the user model variables defining cultural aspects have been identified, then an AEH system interface must either be created or modified, so that content can be delivered to a student that reflects this new layer of adaptation.

(4) *Evaluation of this new layer of adaptation and personalisation will be undertaken.* It is vital that students are able to access and learn using the culturally sensitive AEH system described above. Therefore, the research in this thesis will also undertake an initial evaluation into how a culturally adapted interface is perceived by the students and make recommendations for the future.

(5) *Investigate if there is a bias in the cultural questionnaire due to language.* Specifically if there is a bias if a student's first language is not English. Hence, this research investigates if there is a bias in the response to the CAE questionnaire when it is administered in English to non-native English speakers, compared to students from the same culture, who answer the same questionnaire administered instead in their mother tongue?

The next section 1.2.2 will detail the objectives identified within these areas in more detail.

1.2.2 OBJECTIVES

Using the more generic research aims outlined above, the specific objectives of the research presented in this thesis are listed here.

1. Investigate the current state of the art in eLearning, specifically focusing on adaptive systems. This is done in order to establish what mechanisms are applicable to cultural adaptation.

2. Investigate the current state of the art of cultural learning, in this case focussing on how a student's culture has been used to influence the delivery of a lesson.

3. Examine extant cultural indices for applicability in the educational domain. What previous research exists beyond the domain of education and how best can this be used in this research?

4. Investigate cultural groupings and effects through user examination. To investigate this the research presented here involved the creation of a questionnaire to gather the responses from students as to how their cultural background may affect their (e)learning.

   a. Are the extant cultural indices able to be mapped to the domain of education (this is required, as those indices will not have been created using the student population as a source)?

   b. Do students desire to be taught in the manner that they have been brought up with? Is there a cultural bias to education? Do students recognize this? Would they desire a different cultural bias to their own?

   c. Is a student's educational cultural bias resistant to change?

   d. Is there a cultural bias in the acceptance of openly acknowledged Adaptive Educational systems? For example: is there a cultural bias in the desire for AEH – do some cultures accept the teacher's viewpoint, no matter how it is presented, and would therefore resent it being 'changed'? Can this adaptation be hidden and therefore accepted? Do students want to conform or not?

5. Analyse the questionnaire responses and determine a list of cultural stereotypes (through the creation of a cultural modelling framework / ontology). The final goal of this aspect of the research is a list of user variables that can be used to define a student's cultural stereotype that can be used as a template for further adaptation in AEH systems.

6. Create or modify an AEH system interface so that the cultural templates can be used to create a new layer of adaptation that will personalise the delivery of educational content to a learner's cultural background.

7. Evaluate the usage of this adaptive cultural interface with learners. Use the findings of this evaluation to create a series of recommendations for future work.

8. Perform a small scale focused evaluation using qualitative techniques (such as structured interviews) to back up the findings presented in previous chapters.

9. Create one or two questionnaires based on the original English language version but written and delivered in the mother tongue of the respondents from the first version. Specifically:

   a. Identify one or two countries from the respondents of the first English questionnaire.

   b. Create questionnaires for each of these countries in their native language.

   c. Collate questionnaire responses and examine them against the findings of the English version of the questionnaire.

10. Discuss the results of the thesis and draw conclusions, including addressing future research efforts.

In section 1.3, the research directions within this thesis are placed into their overall background.

1.2.3 ASSUMPTIONS

Over the course of the research presented here in this thesis several assumptions are made and discussed. Here they are explicitly stated:

1) In any study of 'culture' the definition of culture must be made explicit, in the case of this thesis that definition is focused in the domain of education, hence ***The CAE definition of 'educational culture'*** *is:*

Educational Culture should be regarded as the set of distinctive intellectual features of society applied at the national level, and that it encompasses, in addition to traditional educational values, a learner's aims, goals, background knowledge, social preferences, and their location on Hofstede's VSM Indices.

This is a more restrictive definition than normally used in cultural studies; with the alterations here such as to focus on the intellectual, academic and educational aspects of society, specifically those of the learner. To this end the most notable addition is the inclusion of Hofstede's VSM indices, as these indices play a major role in the creation of the CAE learner model. This definition, as well as a more generic definition of 'culture' is included and expanded on in Chapter 2.

2) As the CAE questionnaire was written and delivered in English, that there is no significant difference between students who could read English and those who could not. For example an Indian student's responses would be the same if the questionnaire is written in English or Hindi. This assumption will be tested in Chapter 8.

3) The focus of this study is on learners from Higher Education, this was done for purely pragmatic reasons, in that there was easy and ready access to these students over the course of this research.

1.3 BACKGROUND

1.3.1 21ST CENTURY EDUCATION

Before describing the state of eLearning in the 21st Century it is useful to remember that not all educational advances have occurred through technological means. The methodologies used by pedagogues have changed (albeit at a slower pace) throughout the last two millennia, until one reaches the state that is recognised as 'modern' education. It is important to place the current changes in education into an overall context, as otherwise learning in the 21st century risks losing sight of the fundamentals in the rush to use the next technological advance. It is only by being aware of the past that it is possible to move towards a better future.

1.3.1.1 TRADITIONAL EDUCATION

In many countries traditional education can be split into two clearly distinct groups, that of the 'school' and that of the 'university'. These can be known by different names (such as 'academy' or 'college'), but are normally distinguished by the manner of student involvement. In a school, the student is young (normally a child) and is often forced (most commonly through legal means) to attend, whereas with a university the student (normally an adult) voluntarily attends. This leads to differing mind sets between the two types of institutions. Such a distinction is not universal (for example the US system may use the term 'school' to apply to education at all levels, including universities) but will be used throughout this thesis. The following section gives a short history of the creation and advancement of the educational systems from their inception until the late 1980s, to give context to the pedagogical procedures in use before the wide scale uptake of eLearning in the 1990s.

1.3.1.2 SCHOOLS

The term 'school' (in its various translations) can be connected to many ancient institutions (such as Plato's Academy in Greece [University of St. Andrews, 2004], the Gurukul [Gurukul, 2011] in India and the Shūyuàn [Academies, 2011] in China); however these are generally what one would now consider establishments for higher education – i.e. 'universities'.

The earliest modern schools were those established by the Byzantine Empire, and they created a primary level of education in 425 CE, generally for those children destined to join the military or civil service. These were followed by the Islamic 'Maktab' (Arabic مكتـب) [maktab, 2012] which was

created as a means of primary education[1] around the 900s CE and then by the European schools (starting with The King's School, at Canterbury in the UK (established 597 CE), as it has been teaching students since its inception as an abbey by St Augustine).

What would now be considered the modern revival of the education system began in the 19th century, as it was closely tied to the idea of compulsory education. With modern civilisations coming to realise that it is economically profitable for each citizen to be able to communicate with or receive communications from others through the ability to read and write. To this end (and due to pressure from competing educational efforts, such as the Lancastrian System [Constitution Society, 2011]) governments started to establish state paid-for-and-run schools that aimed to educate children.

The form that teaching took in these schools, however, remained similar to those established earlier, with emphasis on didactic information exchange in the subjects of grammar, numeracy, literacy and writing. Changes in the methods of school education did not occur en masse until the 20th century. For example, John Dewey's (early 20th century) work in experiential education advocated the teaching of theory and practice at the same time ('learning by doing' often an important aspect of any (e)Learning systems).

The study of teaching, learning and education have all progressed rapidly towards the end of the 20th century, with the outcome that the cognitive and meta-cognitive models used by teachers and children are understood to a far greater degree. This has had a direct effect on modern teaching techniques.

The research presented in this thesis could help guide the future development of the school classroom as it moves into a more multicultural age. As country populations grow more diverse (especially in western countries, often due to their ex-colonial nature) so do the populations within their schoolrooms. It is only by being aware of these changes and how cultures have come together in the past that it will be possible to correctly and efficiently bring eLearning into the classroom.

1.3.1.3 UNIVERSITIES

Similar to the history of education at the level of the school, the history of adult or higher education is a varied one. Once again however knowledge of the past is important in determining the direction of education in the future, especially as university education has often been at the forefront of technological uptake.

The earliest educational establishments that could be considered universities were the Platonic Academy [University of St. Andrews, 2004] (c387 BCE[2]) and the Taixue (Chinese: 賓帔)(established in 3CE[3]), with the Nanjing University (Traditional Chinese: 营僖寯帥), which has been teaching students (although not awarding degrees) since 258 CE, the oldest continually running 'university' in the world.

Also worth mentioning is the ancient Indian university of Nalanda (Hindi: नालंदा) established 427 CE. This extremely large university accommodated up to 10,000 students and 2,000 teachers. The curriculum covered all aspects of learning (subjects both religious and secular) and attracted students from as far away as Japan, resulting in a very large multicultural student population, more akin to a modern university.

The manner of teaching (specifically, how students interact with teachers) in these universities can be considered to consist of three strands:

- Didactic: the teacher speaks and the students listen (e.g. lectures).

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[1] It is interesting to note that one of the foremost Islamic philosophers of the time (11th century), Ibn Sīnā (Arabic: ابـن سينا), wrote in his book "The Role of the Teacher in the Training and Upbringing of Children" that children learn best in classes rather than one-on-one with tutors, due to factors such as competition, emulation, discussion and debates, showing that fundamentally similar teaching issues and structures seem to have been a constant in education.

[2] Before Common Era – a global and secular version of BC (Before Christ)

[3] Common Era, a secular version of AD (Anno Domini)

- Discursive: the teacher initiates a discussion and the students join in (e.g. tutorials).

- Exploratory: the teacher sets a task and the students research it (e.g. experiments).

Such an approach to education has remained at the heart of university education since their creation.

During the 19th and 20th centuries, technology started to play a greater part in university education, with some aspects of education becoming wholly dependent upon certain technologies. Examples include microbiology, crystallography, spectroscopy, astronomy, medicine, and mechanical analogue computing (to name but a few).

However, in the latter half of the 20th century, digital computing started to play a larger role in university course teaching. Initially, this was of limited applicability for most subjects, and was mainly used in Computer Science (which was generally a sub-discipline of older subjects), but rapidly moved to become central in other areas (e.g., design, engineering and mathematics).

The use of these technologies can be considered extremely specialist, since they were not used for general teaching (such as lectures and tutorials), but mainly in laboratory experiments (even here they could be too expensive to use and often the teacher would just demonstrate their use).

Indeed, possibly the most common piece of equipment to directly affect student teaching in the modern university is the slide projector (specifically the Hyalotype [Websters, 2011], invented 1850 CE, which used glass slides, and was replaced by the film slide projector starting around the 1950s). They have played a vital role in the development of disciplines such as art and architectural history, making possible the detailed study of objects and sites from around the world.

1.3.1.4 THE LAST 20 YEARS: ELEARNING WAXING

Whilst various technologies have been used in classrooms over the last century, they have all been specialist in nature (with a few exceptions, such as audio-visual broadcasts using televisions and radios).

During the later days of the 20th century, the advent of the World Wide Web (WWW) changed all of this. Before the WWW, teachers were slow at accepting new technologies into the classroom as teaching aides, each new addition was considered carefully (both by the individual teacher for their own class, or by the government educational authorities for general recommendation). Once the WWW began to gain in popularity, a natural extension to many educational programmes (especially those of higher education) was to add a web component, be it in the form of a web based time table, revision notes or lecture slides/notes.

Unfortunately, these extensions were not planned or designed by pedagogues or educational psychologists, and they were, of course, limited by the then static nature of the WWW HTML and browser functionalities. The result of this initial uptake of education on the web was that of very static, information rich (often leading to information overload) webpages. These could be considered akin to the older style didactic lectures and classes of previous decades and centuries. However, the complimentary discursive and exploratory styles were often missing from these online educational efforts, a fact which severely limited their usefulness.

It should also be noted that before the advent of the World Wide Web, lessons were normally taught in a single classroom, and due to the normally homogenous nature of the student population, the learner's culture was not a major issue.

This summary, of course, ignores the advances in computerised education (in the fields of Artificial Intelligence (AI) and Intelligent Tutoring Systems (ITS)) over the previous 50 years, as these were often very limited in their extent and use within the general teacher and classroom populations. These advances as they pertain to the Related Work will be discussed further in Chapter 2.

It is worth noting, however the advantages and disadvantages that have been associated with the rise of eLearning, as they explain the prominence of eLearning in the 21st Century as well as why it is often flawed.

Advantages:

- *Student Numbers*: with growing student numbers, eLearning can aid in the delivery of lessons to numbers that a normal school or university would physically be unable to hold, thereby furthering the widespread uptake of education. This is especially evident in the success of 'open' online universities, such as the Open University in the UK, and the Open University in Netherlands, to name but two successful examples in Europe.

- *Greater penetration/distribution*: this represents one of the fundamentally beneficial aspects of an online education. Due to the open nature of the WWW, it is possible for anyone with an internet connection to access the same lesson. This is an extremely simple yet powerful fact. It means that potentially anyone may access high quality information (in the form of lessons) for free. See however the commercialisation disadvantage below.

- *Lifelong learning*: traditionally, quality education was undertaken at dedicated schools or universities, with the student entering into a full time course (part time courses were available, but were not a mainstream approach). As such, the student had to be co-located at the institution. This was not compatible with lifelong learning, where the student is often in full-time employment. eLearning opens the door to students who were already in full-time employment, so that they could 'top-up' their knowledge for business or pleasure, over longer, even ad-hoc, customized periods of time.

- *Lowering access barriers*: this is related to the previous two issues, however goes beyond both of them. Due to the potentially open and free nature of eLearning courses, many people who would never normally consider entering an educational course were now able to do so. For example, the disabled and the elderly, who may have been limited to their own homes or communities.

- *Distance/distributed learning possible*: Distance learning is an obvious aspect of eLearning, whereby a group of students who are not co-located are able to access a single online course, but also distributed learning becomes possible (or at least far easier and more feasible). Here, the students are all co-located and access a distributed information source, thereby potentially allowing a single group of students to access the best minds in various subjects from across the globe.

Disadvantages:

- *Commercialisation*: with the rapid uptake of distance learning by increasing numbers of people, this has lead not only to greater access to free education, but the commercialisation of educational markets, whereby the educational institutions can charge a fee for access.

- *Removing social discourse*: any interaction with a PC (Personal Computer) is normally performed by an individual; there is often no social interaction with other people (certainly not offline). As learning can be, in part, a social act, this can limit the effectiveness of the lesson.

- *Alienation and Loneliness*: following on from above not only can the lack of a social aspect to the lessons affect the overall effectiveness of a lesson, some individual students will suffer more than others from loneliness and alienation, which can be exacerbated by the lack of a traditional student support mechanism.

- *Lack of personal interaction between student and teacher*: With the greater student to teacher ratios involved with eLearning, the personal interaction between any given student and their teacher is often severely limited.

- *'One size fits all'*: The basic unit of the WWW is the webpage, which was initially a very limited structure (containing text, images and links). Therefore, teachers with a limited knowledge of pedagogy created a great number of lessons that presented one static view point on a subject. This would not change (unless the teacher was active, observant and had time, which was rare) regardless of the makeup of the student population.

- *Polarisation*: Often static webpages produce a polarisation of student results with the best students tending to do better and the worst students tending to do worse (this is to do with poorer students not coping as well outside of systems that offer them a flexible and comprehensive help, which static systems are not well designed to extend). Obviously the ideal is to allow all students to do better, no matter their starting point.

- *Cultural Issues*: As online learning materials can be accessed by anyone from anywhere (assuming an open system) it is likely that these materials are not designed for use by students other than those from the author's culture. This may mean that the students' different cultures are less effective at learning from these materials than home students (e.g., Chinese students accessing English content). This counters the 'Lowers access barriers' advantage stated previously and in fact eLearning may actually increase the barriers to access.

1.3.2 ADAPTIVE HYPERMEDIA SYSTEMS

Adaptive hypermedia (AH) [Brusilovsky, 2001a] started as a spin-off of hypermedia and Intelligent Tutoring Systems (ITS) [Murray, 1999]. Its goal was to bring the user model capacity of ITS into hypermedia and thereby address the 'one size fits all' disadvantage of standard eLearning systems. However, due to technical limitations, such as bandwidth and time constraints, AH only implemented simple user models. This simplicity also gave AH its power as, suddenly, there were many new application fields and also implementation was considerably easier. Early AH research concentrated on variations of simple techniques for adaptive response to changes in user model. Hence most AH development was research oriented and applied only to the limited domain of courses that the researchers themselves were giving (e.g., AHA!, [De Bra, 1998]; Interbook, [Brusilovsky *et al*, 1998]; TANGOW [Carro *et al*, 2001]). Firefly [Firefly, 2011], developed at MIT Media Lab and subsequently acquired by Microsoft, was a rare example of commercial development.

Recently, there has been a shift in attitude. The development of the Semantic Web [Berners-Lee, 2003] and the on-going push to develop Ontologies [Gruber, 1993] for knowledge domains has extended the importance of AH. Indeed, AH now appears to be the tool of choice for collating the static information of these new approaches and bringing them to life.

Moreover, AH is spreading from its traditional application domain—education—to others, especially the commercial realm which is eager to be able to provide personalization for its customers. Indeed, one often sees the phenomenon of other communities reinventing – rather than adapting – adaptive hypermedia for their own purposes and applications.

Adaptive Educational Hypermedia (AEH) [Brusilovsky, 2001b] is, in principle, superior to regular Educational Hypermedia (EH) as it allows for personalization of the educational experience. Regular EH, such as that delivered by WebCT and Blackboard, is not adaptive—exactly the same lesson is delivered to each student. Pedagogical research has shown that different learners learn in different ways [Coffield, 2004]. This is a truth self-evident to most teachers; if a student is having trouble learning a subject, then the teacher will alter the manner in which he or she is teaching it and try a different approach. Traditional EH systems could be compared to inflexible teachers who base their lesson mainly on drilling and repetition. Educational systems (real or virtual) that adapt their presentation to the needs of each learner aim to improve the efficiency and effectiveness of the learning process. If each learner has his or her own learning preferences or Learning Style [Coffield, 2004] and is given a set of resources specific to that particular style, then that learner will not only learn "better," but will be able to more effectively develop the given information into deeper understanding and knowledge. AEH systems seek to address the inflexibility of current EH methods. Systems such as My Online Teacher (MOT) [Foss & Cristea, 2010], AHA! [De Bra *et al* , 2003a], and WHURLE [Moore *et al*, 2001] all answer the need for an adaptive and flexible approach to teaching. They allow current online educational systems to break away from the "one-size-fits-all" mentality and move towards having an appropriate lesson for each student.

AEH systems aim to improve upon current static EH systems. That is not to say that AEH is the universal solution for online education. Education is not undertaken in a vacuum; the social aspect is also vital. It is essential for learners to be able to build common ground; to ask and answer (negotiate

meaning); to argue and debate; to explicate mental models; to share expertise; to collaborate; and to construct novel ideas and understanding. Work on computer-supported cooperative work (CSCW) addresses this side of the educational process, and often AEH systems will fold this research into them (for example, WHURLE can be used in such a social manner). Collaborative work can be encouraged by the use of simple online social tools: e-mail, for asynchronous communications; fora, for persistent asynchronous group discussions; and chat rooms, for synchronous group discussions. The addition of Adaptation to this whole structure is another improvement to the student's personal online educational experience. However, with increasing numbers of students and the resulting increase in class size of many learning bodies, traditional methods of education (such as the tutorial and the field trip) often become impractical in terms of time and cost. Online education can help to fill this need.

This thesis aims to address and extend the state of the art in AEH research via the work presented in Chapters 5 & 7.

1.3.3 CULTURE AND EDUCATION

Culture is a complex and broad concept, which can be defined in many ways. Most researchers agree that culture involves at least three components: what people think, what they do, and the material products they produce [Boldley, 2004]. A culture is a meme [Blackmore, 2003] [Dawkins, 1976] that is shared amongst members of the same society; this is done both consciously and unconsciously and affects concepts such as values, assumptions, perceptions and the behaviour of its members. Cultural influences can have a significant impact on a learner's ability (such as [Noguera, 2008]). Some of the important attributes affecting cultures are identified as emotion, learner preference for individual or collective work, anxiety and reward allocation.

The most common use of culture in education is in teaching languages: here being immersed in the target culture can dramatically help a student learn that language. The second most common use of 'culture' in education is in the area of 'cultural heritage'. Here culture is taken to mean a country's 'higher culture', such as its art, museums, historical artefacts and so forth.

Less commonly is culture used in education as an environmental variable. On the other hand a student's age, educational aims (passing an exam, gaining a certificate etc. …), learning ability (are they placed in the 'top' class or not), even their financial background, is more often considered when choosing how to teach a student than their cultural background. In fact often the culture of the teacher and their institution is considered more important. The British, American and German schools spread around the world are testament to the fact that students (and their parents) only thought about culture in their (offspring's') education is to discern which offers the best education and employment outlook (or at least has the best reputation)?

Of course this ignores the fact that a person's cultural background influences almost all aspects of their lives, how they react to authority figures, how they deal with uncertainty and stress, how they express themselves and so forth. In [Banks and Banks, 2009] the authors outline the issues and problems associated with creating a multicultural education that is equal for all, for example:

"In the early grades, the academic achievement of students of color such as African Americans, Latinos, and American Indians is close to parity with the achievement of White mainstream students. However, the longer these students of color remain in school, the more their achievement lags behind that of White mainstream students." [Banks and Banks, 2009][Steele and Aronson, 1995]

Online, personalised educational systems, whilst not a universal panacea, could certainly help in overcoming at least some of these issues. To this end the focus of this aspect of the research in this thesis is in the area of identifying how a culture may affect a student's learning efficiency when used in an online environment.

This area of research is specifically addressed in Chapter 3 , although this topic relates to the majority of the work presented in this thesis.

1.3.4 CULTURE AND AHS

With the widespread use of distance learning, and the many different learning systems (both adaptive and non-adaptive) that provide this service, the cultural background of a student can 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, which will affect the social interactions and therefore the learning effectiveness of the entire group.

Thus it seems a reasonable conclusion that the user factor of 'cultural background' should be added to an AEH's User Model. A user model is a map of the various factors that are used to create a model of a systems user. In the case of Adaptive Educational Hypermedia systems these user factors may include, background knowledge, test scores, lessons completed, lesson goals, learning styles, etc… However as stated above, any addition to the user model may greatly increase the complexity of the content creation problem, and any such addition should be carefully studied to see if this change is both desirable and worthwhile.

The research for this area affects the modelling and implementation issues involved in using any adaptive hypermedia system and are presented in Chapters 4, 5 & 6.

1.4   THESIS CONTRIBUTIONS

The research presented in this thesis offers specific advancements to the research fields shown in *Figure 1.1* through the following contributions:

1) Validation of the Marcus and Gould extension of Hofstede's Cultural Indices into the field of web design, specifically use of this extension in the Educational domain [Stewart, 2007][Stewart, 2009][Bourguet *et al*, 2006].

2) The CAE questionnaire is a key contribution of this thesis, as it binds several disparate elements, HCI, Web Design, Adaptive Interfaces, eLearning and Cultural Studies. This questionnaire will bring a lasting body of research work well beyond the lifetime of this thesis and will benefit eLearning generally.

3) Creation of the CAE framework and ontology, designed to model the cultural factors of a learner that may determine the HCI elements of educational materials given to them, specifically cultural factors affecting eLearning in Higher Education [Chandramouli *et al*, 2008] [Stewart *et al*, 2008] [Stewart, 2009].

4) Creation and validation of specific cultural template for eleven countries using the CAE ontology.

5) Creation of the CAE repository (containing the eleven CAE instances), which is made freely available to all [Stewart *et al*, 2010].

6) An adaptive cultural interface is designed, investigated and evaluated in the classroom; this thesis validates the proof of concept for using CAE in a real world setting.

1.5   THESIS OUTLINE

Having outlined the aims and objectives for the research presented in this thesis, the remainder of the thesis is structured as follows:

- in Chapter 2, the areas of research related to the problem space outlined in this chapter are introduced and discussed. (Objectives O1, O2, O4)

- in Chapter 3, the CAE questionnaire is presented, its design, data collection process, data analysis and the results. (Objectives O3, O4)

- in Chapter 4, using the findings from the previous chapter, the CAE questionnaire results are used to create two cultural ontologies for use in educational settings. Then eleven ontology instances are presented for eleven different countries. (Objective O5)

- in Chapter 5, the CAE ontology instances detailed in Chapter 4 are used to create an implementation and repository of the CAE stereotypes. (Objective O6)

- in Chapter 6, the proposed implementation from Chapter 5 is evaluated (formatively) with a questionnaire and the responses to this questionnaire are analysed and discussed with recommendations presented. (Objective O7)

- in Chapter 7, following on from the formative evaluation presented in Chapter 6, a summative evaluation is performed in a real world setting, along with a small scale qualitative evaluation. (Objectives O7, O8)

- in Chapter 8, the assumption that there is no difference between a student's response to the CAE questionnaire if they answer it in English or their mother tongue is investigated. (Objective O9)

- in Chapter 9, the conclusions are drawn and future work discussed. (Objectives 10)

- References, contains the references listed throughout the thesis.

- Appendix A, shows the three different versions of the CAE questionnaire.

- Appendix B, the CAE-L XML instance files are listed.

- Appendix C, the XML Schema for CAE-L is presented.

- Appendix D, the Web Service Definition Language file for CAE-L is presented.

- Appendix E, the structured interview questionnaire results are given.

The relationship between the chapters is shown in the *Figure 1.2* below.
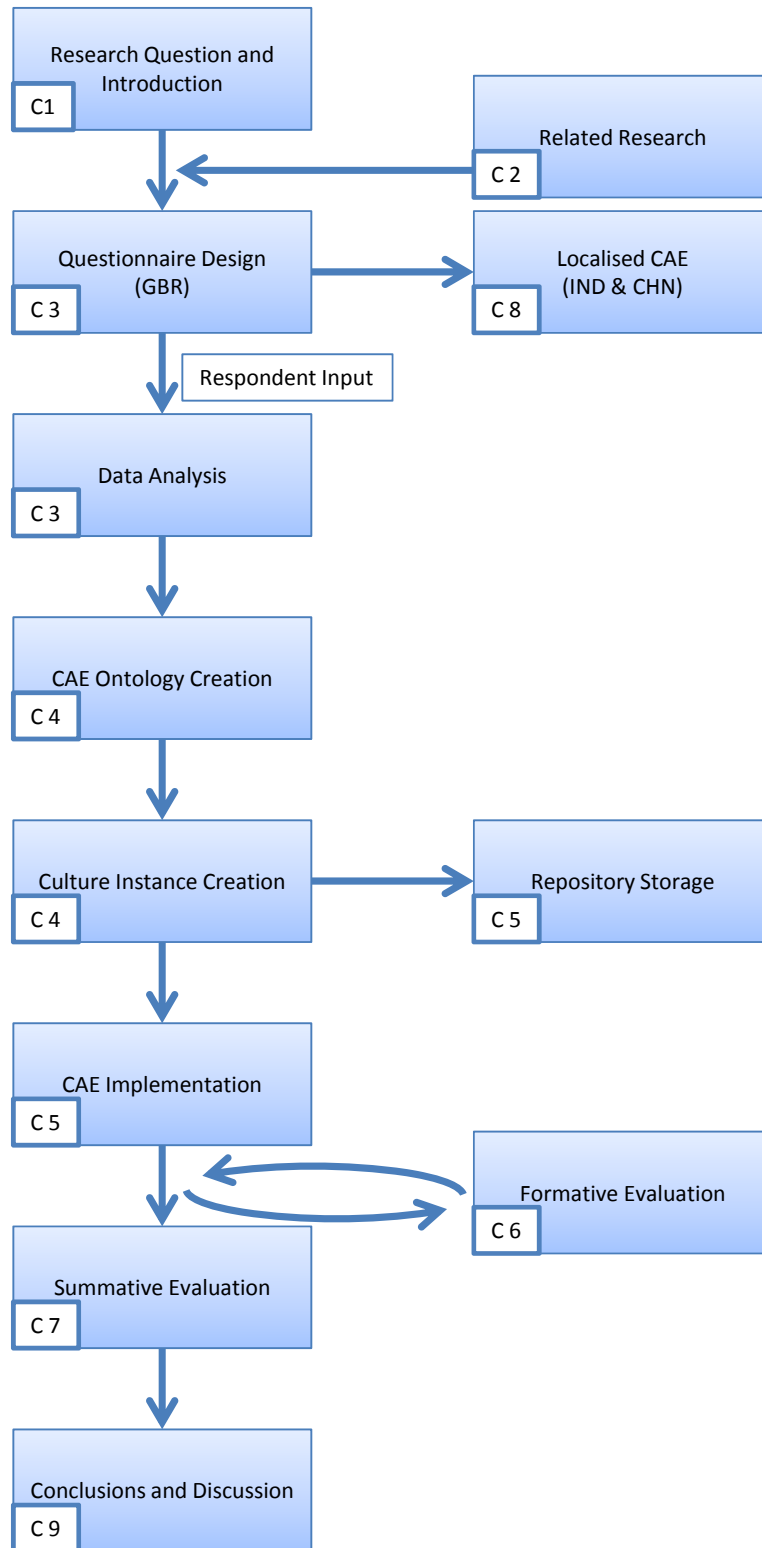
Figure 1.2: thesis structure diagram, linking research themes with the Chapter it can be found in (e.g. 'Research Question and Background' in 'C 1', chapter 1)

CHAPTER 2:

RELATED RESEARCH

2 RELATED RESEARCH

2.1 INTRODUCTION

In this section, an overview of relevant research discussed in this thesis is presented. The first section presents the developments related to Adaptive Hypermedia, focusing on e-learning systems. Concerning culture in eLearning, a breakdown of the research in this area is given, and this is then followed by an introduction to the approaches to structuring cultural variables. Finally, an overview of the ontology engineering techniques used in this thesis is presented.

2.2 ADAPTIVE HYPERMEDIA

Personalisation of presentation has always been important in any consumer industry. With the expansion of the WWW into our everyday life, education has become increasingly a consumer commodity. Today's learners expect high quality, relevant educational materials, delivered to them in a timely and appropriate manner. Adaptive educational hypermedia (AEH) [Brusilovsky, 2001b],[Adey *et al*, 1999] systems aim to personalise the delivery of educational materials to the needs of the user – both to their stated requirements as well as to their less obvious desires. This has led to the development of many on-line educational delivery systems (e.g., Interbook [Brusilovsky *et al*, 1998], AHA! [De Bra *et al*, 2003a], TANGOW [Carro *et al*, 1999a], WHURLE [Moore *et al*, 2001]). Many of these systems adapt their educational content to different dimensions of each learner, such as: current knowledge levels, computed user goals, immediate tasks, educational context (e.g., are they in school, university, or learning from home?), and learning styles in adaptive hypermedia (e.g., LSAS [Bajraktarevic *et al*, 2003]). Each of these AEH systems uses its own content model, coding methodology, and style.

Brusilovsky [Brusilovsky, 1996c] describes adaptive hypermedia as follows:

"By adaptive hypermedia systems we mean all hypertext and hypermedia systems which reflect some features of the user in the user model and apply this model to adapt various visible aspects of the system to the user. In other words, the system should satisfy three criteria: it should be a hypertext or hypermedia system, it should have a user model, and it should be able to adapt the hypermedia using this model."

Adaptive hypermedia has expanded in scope from its initial starting point of combining Intelligent Tutoring Systems (ITS), hypermedia and user modelling to include a vast number of separate disciplines. Examining the keyword list of the recent book 'The Adaptive Web' [Brusilovsky, 2007] shows that there are 36 different subjects included, such as: Web based systems; e-commerce; information retrieval; machine learning; ontologies; semantic web; tutoring systems and virtual environments.

2.2.1 ADAPTIVE METHODS

Not only are many different subjects involved in Adaptive Hypermedia (AH) research, but there can be many different forms of adaptivity provided by an Adaptive Hypermedia System (AHS), generally grouped into two types: Adaptive Navigation and Adaptive Presentation [Brusilovsky, 1996c][Brusilovsky, 2001a]. Generally, Adaptive navigation support is about links and Adaptive presentation about content.

- Adaptive Presentation

  Here, the content is presented in an adaptive manner, in that appropriate materials are delivered to the user at the right time and in the correct way. An example of this based on 'device adaptation' is if the user is reading a website from a laptop vs. a mobile phone – the presentation adaptation layer of the system should deliver smaller chunks of information to the mobile phone when compared to those delivered for the laptop. Another example would be if a page contained information for beginner and expert learners. Then, depending on the background knowledge of the learner, different parts of that page would be presented. Brusilovsky's taxonomy details several types of Adaptive presentation, the most commonly implemented of these is the 'Canned text adaptation' subset of the 'Adaptive Text Presentation' section. The various types of 'Canned text adaptation' are:

- o Adaptive Insertion & Removal – uses the insertion and/or removal of information to adapt the overall content of the lesson.
- o Adaptive Sorting – reorders the text of a lesson as required for each specific user.
- o Adaptive Altering – may involve altering the text of each chunk of information.
- o Stretchtext – for example if more information was available for advanced students it could be delivered by 'stretching' a key word of phrase.
- o Dimming fragments – fragments of text that are not appropriate could be dimmed, rather than removed.
- Adaptive Navigation Support

  On the other hand, adaptive navigation support is concerned with the 'structure' of a lesson rather than the contents. This structure can be manipulated, so that only appropriate links are given to each user. Following on from the example above, if a learner is an expert in a lesson's subject, then the navigation bar could include links to additional materials for the learner to read, whereas these links would not be included in the navigation support for a beginner learner. The various types of adaptive navigation support are:
  - o Adaptive Link Annotation
  - o Adaptive Link Hiding
  - o Adaptive Link Generation
  - o Map Adaptation
  - o Adaptive Link Sorting
  - o Direct Guidance

2.2.2 ADAPT TO WHAT?

Beyond the methods of adaptivity available for use within AH systems and the multidisciplinary nature of that research, there is also the issue of what the AEH system is to adapt to. Here, the AEH's user model comes into play; the methods for adaptation require a user variable, an adaptation rule and the content before they can be effectively used.

As an example: imagine an AEH system that uses 'Direct Guidance' (from adaptive navigation support). This involves recommending a link (or series of links) to a user. However, the only way for the system to determine which links to recommend is for a user profile to have been created. Within this profile is the description of that user, in this case, their domain background knowledge (i.e. how much do they know about the current lesson subject?). Before performing any adaptation, the system interrogates the user profile, obtains their background knowledge level (for example 'low'), applies an adaptation rule (e.g., "if the knowledge level is low then show link <Z>") and then adapts the link structure displayed on the screen appropriately.

The user variables that make up a system's user model can vary greatly between systems; here are some examples.

- Background Knowledge (normally arranged in subject domain)
- User Aims and Goals
- Learning Style
- Cognitive Style
- Motivation
- Device context (may include bandwidth issues)
- User settings (date of birth, age etc. …)
- Language
- Course structure (e.g. the user is in lesson 3 of 5)

In the case of the research presented in this thesis, it is important to allow for a wide range of adaptations, using 'Adaptive Navigation Support', 'Adaptive Presentation' and, more specifically, a seldom implemented approach that allows the user interface to be adapted.

To further explore how these AEH notions have been implemented in practice and to choose a system to use in the implementation of the CAE results, there now follows an overview of some of the many AEH systems that have been developed since adaptive hypermedia arose.

2.2.3 AEH SYSTEMS

2.2.3.1 WHURLE

The WHURLE system embodies an open learning pedagogical model, and provides the student with an interactive learning space. The architecture is open, in order for a wide variety of tools and services to be used to facilitate independent study. WHURLE implements a highly constrained model of hierarchical hypertext in which, from the learners perspective, each lesson consists of a traversable hierarchy of pages.

The learner's interactions with the system are guided by learning objectives that encourage self-paced reflective engagement with the content. This content consists of information, problems, simulations and assignments. Although the nodes have a default sequence that corresponds to the narrative of the author, each node is semantically autonomous and no pathway is imposed upon the learner. This is a much more constrained model of hypermedia than is typically employed in many systems, but it avoids most of the problems of cognitive distraction that can so easily occur in highly open learning systems.

WHURLE is a content-free shell, designed to accommodate a distributed model of development and delivery. It is important that non-IT (Information Technology) literate subject specialists should be able to both author content and deliver it in a customised local teaching environment.

2.2.3.2 MOT

MOT [Cristea and De Mooij, 2003a][Cristea *et al*, 2009b][Foss, 2010] is the first and up-to-date the only delivery system independent AEH web-authoring environment, constructed based on the LAOS framework for authoring [Cristea and De Mooij, 2003c][Cristea and Kinshuk, 2003d][Hava Muntean *et al*, 2007][Cristea and Ghali, 2011] and LAG (the three-layer model for authoring adaptation) frameworks, as introduced in [Cristea and Calvi, 2003b] and extended in [Cristea, 2009]. MOT implements the LAOS framework: it contains a domain model in the form of a conceptual hierarchical layer (of atomic and composite concepts, built of a number of attributes). This is the part of the implementation that contains the learning resources, annotated with the respective metadata. The second part, also implemented from LAOS, is the goal and constraints model, in the form of a lesson layer, dealing with alternative presentation of contents at attribute level or above. This part of the implementation contains instructional material and instructional metadata. This structure conforms to the requirements of the W3C towards the Semantic Web.

MOT also implements the LAG model [Cristea and De Mooij, 2003a], this means that the adaptation itself follows a three-layer granularity structure: direct adaptation techniques and rules; an adaptation language; and adaptation strategies. Moreover, adaptation strategies can be saved as adaptation procedures and reused within other adaptation strategies, in the same way the adaptation language is re-used. In this way, the adaptation language can be extended and refined. The adaptation language and the adaptation strategies aim to reflect recurrent patterns in adaptive hypermedia authoring, so that the authors are spared the repetitive call to use low level adaptation techniques.

This means that authors can create either the static element of their courseware (i.e., the educational resources) or the dynamic element (i.e., the adaptation and personalization behaviour requirements), or both. They don't have to author everything, because emphasis is on reuse, both for static as well as for dynamic material. This gives authors the freedom to make their own choices, according to their experience and preferences.

2.2.3.3 AHA!

AHA! [De Bra and Calvi, 1998] is one of the oldest of the AEH systems, it can indeed be said to have been instrumental in spurring the development of the adaptive hypermedia field which has become

so popular over the last decade. It is an implementation of the Adaptive Hypermedia Application Model (AHAM) [De Bra *et al*, 2002a] framework which is itself based on the Dexter model [Halasz and Schwartz, 1990] (although the first version of AHA! predates the AHAM, this was later updated).

AHA!, like most other AEH systems, presents a series of webpages containing educational content, with the latest version being version 3.0, released in 2007. This system has been designed to be extremely flexible in the style and types of adaptation allowed. However, authoring for it is no easy task (although the release of a graph authoring tool [De Bra *et al*, 2003a] does help considerably). On the other hand, from a user's point of view AHA! can be very simple to use.

At its simplest, AHA! displays pages (written in XHTML) that contain concepts (which are defined using fragments within the page) – this can be at the level of one concept per page or there can be many more concepts in a page. Creating these pages in XHTML can be quite straightforward. Once this is done, the relationships between the pages need to be written. This is often equivalent to the navigation tree/domain structure present in many other AEH systems, but does not have to be so. Using the pages/concepts and the relationship diagram AHA! then uses adaptation rules (also defined within the page) to control how the pages/links are adapted for display to the user (for example through the link colour or if the concept is rendered invisible). These adaptation rules not only determine how the educational materials will be adapted, but detail what user model updates need to be made.

For example, an adaptation rule could be that every time a user reads (i.e., visits) a page then the user profile will be updated to reflect this fact. This could be done by increasing the domain knowledge user profile concept for the domain covered by that page. As the user reads more and more pages it is a reasonable assumption that their expertise in that subject is in fact increasing – as reflected by this user model update function.

2.2.3.4   ISIS-TUTOR

The ISIS-Tutor [Brusilovsky and Pesin, 1994] was the first AH system, and as such it does not describe itself as an adaptive hypermedia system, but states that its design principle comes from integrating *"the capabilities of hypermedia, learning environments, and intelligent tutoring systems"* [Brusilovsky and Pesin, 1994].

This tool was developed with the goal of bringing the mutually complementary approaches of exploratory learning (from educational hypermedia systems) and directed guidance (from Intelligent Tutoring Systems) together into a single system. The system structure uses a domain model, as well as a student and tutor model (user model) to enable the adaptive functionality of ISIS-Tutor. It also has a hypertext component which refers to the student model to provide adaptive navigation support. Finally, there was the learning environment, which allowed the student to explore the functionalities within the system (whose actions can also be referred to the Student model).

This work was followed on by the adaptive textbook systems of ELM-ART [Brusilovsky *et al*, 1996b] [Weber and Brusilovsky, 2001] and Interbook [Brusilovsky *et al*, 1996a], also created under the direction of Peter Brusilovsky.

2.2.3.5   TANGOW/WOTAN

TANGOW (Task-based Adaptive learNer Guidance On-Web) [Carro *et al*, 1999b] was created to provide differing course views depending on a series of teacher defined parameters (adaptation rules). These parameters affect the display of the system's 'tasks', which are usually seen as webpages. A task may contain other tasks (so defining the content's navigation structure) and 'fragments'. These fragments are the smallest content items. They are designed to be easily reusable and allow for various types of multimedia.

TANGOW has been updated several times, with the third version being renamed as WOTAN [WOTAN, 2007]. This last update has altered the manner in which the system data is maintained (in XML files rather than a database) in an attempt to simplify the development of lessons (it was hoped that this would also give some increase in performance). Along with other various changes (such as the location and use of administration scripts), the WOTAN system is a major update of the original software and system organization. However, the basic structure of tasks and fragments remains the same.

2.2.3.6 ALE

ALE (Adaptive Learning Environment) [Specht *et al*, 2002] was created as part of the WINDS EU project as a pedagogically sound content management and authoring system. The content focus was on the creation and reuse of learning objects, with a learning object being either a 'unit' or a 'page'. The basic 'units' were 'Learning elements', which were the equivalent of AHA! or WOTAN's fragments, and the 'Learning Units', which (along with the top level 'Course Units') provided the means for course structuring. Another learning object type that the previous systems did not have was the 'Index Terms' unit, which defined the common glossary for the course.

From a modern perspective, ALE is just another AEH system, except for the fact that it had a far more advanced authoring system than was usual for the time [Kravcik and Specht, 2004]. MOT authoring was certainly an equivalent but few others were (AHA!'s graph author was not as complete or simple to use).

2.2.3.7 APELS

The APeLS (Adaptive Personalized eLearning Service)[Conlan *et al*, 2002][Conlan and Wade, 2004] adaptive hypermedia environment was developed to address the often blatant lack of pedagogical underpinnings to most other AEH systems (ALE being one of the few exceptions). Until this time many AEH systems were developed by computer scientists and whilst being extremely flexible were very difficult to create pedagogical scenarios for (such as AHA!).

APeLS approached this issue by making a clear distinction between the educational content, the learner, the narrative (the pedagogical flow of the lesson) and the adaptive engine. The novel aspect here is of course that by having a separate narrative it was possible to divorce the pedagogical semantics from the more standard adaptation rules (this is a more specialist version of that which is possible using the LAG grammar [Cristea, 2009]) thereby not only allowing but enforcing an entirely new focus on the pedagogy within an AEH lesson.

APeLS uses Learning Objects of varying granularity in its content models, with smaller objects being preferred as they are more flexible when it comes to re-use, although this creates a new set of narrative issues (if a small fragment of a page is used as a learning object, then taking it out of context may cause problems).

In other developments, an investigation into an APeLS and Moodle integration was carried out [Tiarnaigh, 2005]. This involved identifying the required data transfer points between the two systems. Three such areas were acknowledged: pre-test data, post-test data and tracking data. For the tests, the actual test module was created in Moodle and the results of the quiz were passed to APeLS via an XML file. With the tracking module then the pages visited in the APeLS AEH system were tracked and passed to the Moodle tracking database. The rest of the adaptive functionality remained separate from Moodle. The end result however was a Moodle extension that acted as an access portal to APeLS and could store some of the user interactions (tracking) whilst updating the user profile in APeLS with others (quiz results).

2.2.3.8 ADAPTIVE VIBE

One of the more recent research output from the PAWS group [PAWS, 2011] (Personalized Adaptive Webs Systems) is the 'Adaptive VIBE' project [Ahn and Brusilovsky, 2009][Brusilovsky *et al*, 2006]. This uses a novel visualization approach to peruse spatially orientated reference points. Using this, the users can 'see' the relations between their own interests (which can be depicted through their user profile reference points) and the material on offer. If the educational material is closely related to their interests, then the reference point for that material appears closer to their areas of interest. This visualization technique is rather uncommon in AH systems but offers a very powerful navigation and indexing technique.

2.2.3.9 GALE

In recent years, the rate of development of new AEH systems has slowed as the field has matured, with fewer separate areas being developed, but with more effort put into each. Two main areas of recent development have been in the expansion of extant LMSs such as Moodle, such as with APeLS

above [Tiarnaigh, 2005], with the second being in creating a single AEH built using the expertise gathered from previous efforts.

GALE (GRAPPLE Adaptive Learning Environment) is one such AEH system, produced as part of the GRAPPLE [Grapple, 2011] EU project, which brings experts in AEH development from across Europe. Whilst the types of adaptation remain those described by Brusilovsky, this is not the main focus of the GALE effort. As with the APeLS interaction with Moodle, the GALE system's goal is to act as an adaptive interface for extant (and non-adaptive) Learning Management Systems, such as Moodle [Moodle, 2011], Sakai [Sakai, 2011] IMS-CLIX and Elex [GRAPPLE, 2009].

This integrative effort looks promising for the future. The advantage of integrating an AEH with the extant LMSs is that it is an ideal way to bring adaptive learning to the mass market. Moodle is one of the largest learning management systems in use around the world, with over 72,000 active sites [Moodle Sites, 2011], compared to the AEH community penetration which has barely spread beyond the academic community.

The way forward for AEH systems would seem to be tied up with non-adaptive systems, and GALE is an example of this.

2.2.3.10 ADE

The *Adaptive Display Environment* (ADE)[ADE, 2011][Scotton and Cristea, 2010][Scotton *et al*, 2011] is an adaptation delivery engine using the LAOS framework for authoring and delivery of adaptive hypermedia (AH). It builds on existing delivery engines, by extending the adaptation behaviours that can be used in AH systems, as well as increasing the reusability of adaptation specifications and content.

ADE is designed to be a modular adaptive hypermedia system which supports multiple types of content formats and adaptation languages. It is based on the LAOS framework for AH systems, which enforces a strict separation between the content and adaptation specifications, using the CAF content format and the LAG adaptation language [Cristea 2007, 2009].

The CAF format stores adaptive content in a two-layered content structure. The first layer, the Domain model, contains a conceptual hierarchy and the actual content of the course. The second layer, the Goal and constraints model, stores pedagogical information about the course contents and groups the concepts from the Domain model in "lessons", which correspond to pages in an adaptive system.

Additionally to previous adaptive delivery systems, ADE has a compiler module, which can compile, in principle, any adaptation language, into an internal representation format. Also, ADE has preview functionality, a self-explanatory user interface, the possibility to display external variables, and, due to a modular structure, a great variety in allowing for adaptation types beyond the Brusilovsky taxonomy (e.g., adaptation to bandwidth [Hava Muntean *et al*, 2007] or device, to name but a few).

2.2.3.11 WHICH AEH?

As can be seen from the above sample of AEH systems, there has been a wide ranging research effort over the last decade and a half expanding into areas that initially were not considered part of the traditional AEH remit. However, with the expansion, acceptance and desire for personalisation in online systems (be they educational or not, for example a system like Amazon [Amazon, 2011] is incorporating adaptive collaborative filtering) AEH systems have continued to expand their research horizons until they are now approaching the stage where they could break out of their traditional academic environments.

Hence ADE was the chosen [Scotton 2010, 2011] AEH system, as it has the potential to be of wide ranging use, allowing the implementation of standard adaptive techniques (such as presentation and navigation), but also moving into areas that current research has barely scratched the surface of, such as adaptive user interfaces. In implementing the results from this thesis, this flexibility was of great importance.

It should be noted that another advantage was the close connection between this authors research endeavours and those of the ADE creator. The ADE implementation efforts are not part of this thesis as they were contributed by colleagues but my research findings were pivotal in the design criteria of

the later developments of the ADE system. This close research effort between the research detailed in this thesis and the ADE design has allowed the collaborative creation of a novel expansion to ADE. The results of this collaboration are discussed and presented in Chapter 7.

2.3   CULTURE AND ELEARNING

As described earlier, there has been a great deal of research effort involved in the relatively new field of AH and AEH, but little of this has focused on the learner's cultural background, with few exceptions. One of them is the ALEKS system [Doignon and Falmagne, 1999]), which focuses more on a culture as a collection of specific weights and measures, language and idioms, rather than a more global approach to understanding the underlying learning preferences.

There have also been several projects concerning 'eCulture' (such as [DigiCULT, 2003] and [CHIP, 2008]), but these are focused on the field of cultural heritage, specifically the gathering, storage, tagging and dissemination of cultural information (e.g., museum data). Using a learner's cultural background as part of an AEH user model has yet to be investigated by this community.

In other areas, culture has been considered as a vital part of the development cycle, with the development of internationalisation [Internationalization, 2011] and localisation as growing areas in software development [Sun, 2008][Chan, 2006]. Knowing who your user is, is vital, and their cultural history is an important aspect of that background.

Culture is a complex and broad concept, which can be defined in many ways. Most researchers agree that culture involves at least three components: what people think, what they do, and the material products they produce [Boldley, 2004]. Culture is shared among society members consciously and unconsciously, shapes, values, assumptions, perceptions and behaviours of its members. Research [Xu, 1991][Morrison *et al*, 2005] in e-learning systems has shown that cultural influences, among others, have a significant impact on a learner's ability. Some of the important attributes affecting cultures are identified, such as, emotion, learner preference for individual or collective work, anxiety and reward allocation.

Even such simple factors such as colour may have a significant effect on a student's user experience. [Barber and Badre, 1998] created a colour meaning chart (*Table 2.1*) to help guide website design.

Colour	China	Japan	Egypt	France	United States
Red	Happiness	Anger Danger	Death	Aristocracy	Danger Stop
Blue	Heavens Clouds	Villainy	Virtue Faith Truth	Freedom Peace	Masculine
Green	Ming Dynasty Heavens	Future Youth Energy	Fertility Strength	Criminality	Safety Go
Yellow	Birth Wealth Power	Grace Nobility	Happiness Prosperity	Temporary	Cowardice Temporary
White	Death Purity	Death	Joy	Neutrality	Purity

Table 2.1: Colour meaning tables from [Barber and Badre, 1998]

The work by Emmanuel Blanchard is one of the few to address culture in learning, specifically in Intelligent Tutoring Systems. In [Blanchard and Frasson, 2005], the author presents a "Culturally AWAre System (CAWAS) which is centred on Culturally Intelligent Agents (CIA). The agents are able to understand and adapt to the cultural specificities of learners. CAWAS considers two attributes for cross-cultural adaptation, namely emotions and learner preference for individual or collaborative work (this is linked to a single question in a questionnaire to the Hofstede IDV index, see the Section 2.4.1 for more details). The authors also present an authoring tool to create cultural templates of multimedia documents.

In [Blanchard and Mizoguchi, 2008] the author lists as one of the major issues of Culturally-Aware Tutoring Systems:

"Existing cultural data is not always reliable for educational use. Preeminent cross-cultural studies have mainly been developed for and within the context of leadership or business researches …. Legitimate concerns can be raised on how (and if) findings can be transferred and used within educational settings." [Blanchard and Mizoguchi, 2008]

This issue is central to Chapter 3 of this thesis: can the previous studies into cultural stereotypes be used within a domain that they were not designed to investigate?

The CATS (Culturally-Aware Tutoring Systems) workshop is a new series of workshops and only [Blanchard and Allard, 2008], [Blanchard *et al*, 2009] and [Blanchard *et al*, 2010] have been held so far. Within these workshops, many subjects have been covered that are relevant to cultural studies in eLearning; two of the most typical are:

Computer Assisted Language Learning [Allard *et al*, 2008] – how cultural differences can affect language learning. This is one of the more traditional areas of cultural investigation in eLearning. Here, the authors map the knowledge of cultural differences to second language learning, when considering the learner's first language. Mapping these issues will allow for future learners with the same mother tongue to avoid many of the same pitfalls.

The Culture Based Model [Young, 2009]: as culturally-aware eLearning systems begin to become better known, these models are being incorporated into extant training systems, such as ELECT BiLAT [Hill *et al*, 2006], Tactical Iraqi [Johnson *et al*, 2007] and Vector [Barba *et al*, 2006]. Using the results of these integrations, the author (Young) extrapolates a Culture Based Model that can be used in the future for further implementations. The focus here it should be noted is on computer based training systems, which have different requirements to AEH systems (which are much more open), however this model may be amenable to adoption in the AEH community with some modifications.

Overall, the work in the Culturally-Aware Tutoring Systems workshops is very promising, but many major issues remain (some of which are addressed in [Blanchard and Allard, 2010]). The research presented here in this thesis expands on the use of prior cultural studies in eLearning.

2.4   CULTURAL INDICES

In the research presented in this thesis there needed to be chosen a series of cultural indexing values, as it would be against these values that any adaptation would occur. This level of stereotyping has obvious applications within AEH: if a user's cultural values can be estimated through the use of a cultural stereotype, then the AEH system can better adapt the educational experience. For example, this could be done by automatically assigning a default cultural stereotype to a new user. This stereotype would obviously just be the starting point for the personalised delivery of content, but could take into account that an 'individualised' web experience may not be desired equally by all cultures. Some users may not want to be separated or singled out from their fellows in such a manner.

There have, however, been several cultural studies that have each developed their own cultural classification system, and whilst there is some overlap in a few cases, in others there is little similarity.

As such, this section outlines three of the better known cultural classification schemes and explains why the scheme used in Chapter 3 was chosen.

2.4.1   HOFSTEDE'S VALUE SURVEY MODULE

Hofstede's results [Hofstede, 1980] is one of the most influential cultural classifications performed. The original study included over 100,000 responses (although these were not well spread over the countries studied, with Thailand, e.g., having only 74 responses) and this has been the most quoted and used survey of its type.

Hofstede collected and analysed data gathered from IBM employees between 1967 and 1973. He is considered to have performed the most comprehensive study of how business values can be affected by intercultural differences. The study originally covered more than 70 countries and identified four

indices by which a culture could be measured (the index definitions given below are from Hofstede's website [Hofstede, 2011]):

- **Power-distance index (PDI)**

  "Power Distance Index, that is the extent to which the less powerful members of organizations and institutions (like the family) accept and expect that power is distributed unequally. This represents inequality (more versus less), but defined from below, not from above. It suggests that a society's level of inequality is endorsed by the followers as much as by the leaders. Power and inequality, of course, are extremely fundamental facts of any society and anybody with some international experience will be aware that 'all societies are unequal, but some are more unequal than others'."

- **Collectivism vs. individualism index (IDV)**

  "Individualism on the one side versus its opposite, collectivism, that is the degree to which individuals are integrated into groups. On the individualist side we find societies in which the ties between individuals are loose: everyone is expected to look after him/herself and his/her immediate family. On the collectivist side, we find societies in which people from birth onwards are integrated into strong, cohesive in-groups, often extended families (with uncles, aunts and grandparents) which continue protecting them in exchange for unquestioning loyalty. The word 'collectivism' in this sense has no political meaning: it refers to the group, not to the state. Again, the issue addressed by this dimension is an extremely fundamental one, regarding all societies in the world."

- **Femininity vs. masculinity index (MAS)**

  "Masculinity versus its opposite, femininity, refers to the distribution of roles between the genders which is another fundamental issue for any society to which a range of solutions are found. The IBM studies revealed that (a) women's values differ less among societies than men's values; (b) men's values from one country to another contain a dimension from very assertive and competitive and maximally different from women's values on the one side, to modest and caring and similar to women's values on the other. The assertive pole has been called 'masculine' and the modest, caring pole 'feminine'. The women in feminine countries have the same modest, caring values as the men; in the masculine countries they are somewhat assertive and competitive, but not as much as the men, so that these countries show a gap between men's values and women's values."

- **Uncertainty avoidance index (UAI)**

  "Uncertainty Avoidance Index deals with a society's tolerance for uncertainty and ambiguity; it ultimately refers to man's search for Truth. It indicates to what extent a culture programs its members to feel either uncomfortable or comfortable in unstructured situations. Unstructured situations are novel, unknown, surprising, different from usual. Uncertainty avoiding cultures try to minimize the possibility of such situations by strict laws and rules, safety and security measures, and on the philosophical and religious level by a belief in absolute Truth; 'there can only be one Truth and we have it'. People in uncertainty avoiding countries are also more emotional, and motivated by inner nervous energy. The opposite type, uncertainty accepting cultures, are more tolerant of opinions different from what they are used to; they try to have as few rules as possible, and on the philosophical and religious level they are relativist and allow many currents to flow side by side. People within these cultures are more phlegmatic and contemplative, and not expected by their environment to express emotions."

The original IBM questionnaire was further developed into the VSM 80 (Values Survey Module, 1980) questionnaire which, along with the updated VSM 81 and VSM 82 questionnaires, contained questions used to analyse business populations along the four indices described above.

These early VSM versions contained questions specific to the business populations (for example one concerning the behaviour of the 'boss') and as such were invalid for the general population. The later VSM 94 [Hofstede & Hofstede, 2011] corrected this (by adapting to respondents without a paid job – however, it was still employment focussed) and also added a fifth index:

- **Long- vs. short-term orientation (LTO)**

  "Long-Term Orientation (LTO) versus short-term orientation: this fifth dimension was found in a study among students in 23 countries around the world, using a questionnaire designed by Chinese scholars It can be said to deal with Virtue regardless of Truth. Values associated with Long Term Orientation are thrift and perseverance; values associated with Short Term Orientation are respect for tradition, fulfilling social obligations, and protecting one's 'face'. Both the positively and the negatively rated values of this dimension are found in the teachings of Confucius, the most influential Chinese philosopher who lived around 500 B.C.; however, the dimension also applies to countries without a Confucian heritage."

This index was added as a result of the work by Michael Bond [Bond, 2010][Chinese Culture Connection, 1987], a psychologist at the Chinese University of Hong Kong. He created the Chinese Value Survey in part to address some of the limits inherent to the VSM, which was created by Western researchers. Bond determined that the UAI is not relevant to the Chinese culture, and may be replaced by 'Confucian Dynamism' which was identified with long-termism. This finding was absorbed into the VSM 94 and used to create the LTO index [Bond, 1988][Bond and Hofstede, 1989]. It should be noted that Bond's original work was performed on students from 23 countries, but focused on the Chinese cultural differences to other cultures – as such, again, the survey was not specific to education.

The most recent iteration of the VSM [Hofstede, 2008] has added two further dimensions:

- Indulgence versus Restraint Index (IVR)

  Indulgence stands for a society which allows relatively free gratification of some desires and feelings, especially those that have to do with leisure, merrymaking with friends, spending, consumption and sex. Its opposite pole, Restraint, stands for a society which controls such gratification, and where people feel less able to enjoy their lives.

- Monumentalism Index (MON)

  Monumentalism stands for a society which rewards people who are, metaphorically speaking, like monuments: proud and unchangeable. Its opposite pole, Self-Effacement, stands for a society which rewards humility and flexibility.

Both of these indices are experimental at the time of this research, and for this reason, the CAE research does not take these into account.

There are, nevertheless, issues with this survey [McSweeney, 2002], and for the purposes of this thesis the main problem is with the sample population. Hofstede's study was based on a sample where all subjects were employees of a single organization (i.e., IBM). [Hofstede, 1991] argues that the single organizational design is actually a strength of his study, as it allows for minimizing the effects of cross-organizational differences. However, IBM has a strong and distinct organizational culture and this impact on employees' work-related values is a potential problem. As [Nakata and Sivakumar, 1996] discusses, IBM's "organizational culture may be so strong that national culture traits are overshadowed. Ignoring the potential interactions between the two may lead to erroneous conclusions".

Moreover, respecting and understanding different cultures in teaching is being addressed [NWT, 2008][Stephens, 2007] but in a limited and non-adaptive manner. Therefore, in the domain of education, the assumptions and conclusions of Hofstede (performed as they were in an entirely different milieu) cannot be simply adopted as they stand, and would need to be first tested, and potentially extended, to be useful.

2.4.2 SCHWARTZ'S VALUE INVENTORY

[Schwartz, 1992] took a different approach to determining the values of a given culture. Instead of asking for a preferred outcome (as Hofstede did) he required respondents to rank in importance certain values (to determine their guiding principles).

Schwartz gained 60,000 respondents from all areas of endeavour, not just business, and from these responses he outlined ten cultural value types, divided into two groups:

Individual Interest: Power, Achievement, Hedonism, Stimulation, Self-direction

Collective Interest: Universalism, Benevolence, Tradition, Conformity, Security

These value types were further aggregated into four high level groups:

- *Openness to change*: Stimulation, self-direction and some hedonism.
- *Self-enhancement*: Achievement, power and some hedonism.
- *Conservation*: Security, tradition and conformity.
- *Self-transcendence*: Universalism and benevolence.

Whilst Schwartz's survey does seem to have a more applicable sample population than Hofstede, the results from this study are not widely dispersed, and using them as a set of variables for an AEH adaptation layer would not be feasible. This proves to be less of a problem due to the findings of [Smith and Bond, 1998] (see Section 2.4.4 below).

2.4.3 INGLEHART'S WORLD VALUES SURVEY

The Inglehart Values Map [World Values Survey, 2011] shows the results and placement of the 80 countries analysed along the two indices of "Traditional – to – Secular/Rational values" and "Survival – to – Self Expression values". The former reflects the difference in countries in the importance of religion, traditional family ties and deference to authority. The latter shows the countries desire for basic survival (food and shelter), against their desire for self-expression and equal rights.

This particular study has not only addressed the classification of cultures at a single point (most other studies are over a long time period, with no temporal boundaries) but also the classification of cultural boundaries over time. There have to date been five studies performed which show changes in values over time, a factor that none of the other cultural studies have taken into account.

2.4.4 SURVEY CHOICE - WHY HOFSTEDE?

The three examples discussed above indicate that there is a great deal of variation in the findings between each of these surveys. However [Smith and Bond, 1998] after a detailed examination of these theories concluded that all of them have produced convergent results:

> *"The three major surveys of values published since the time of Hofstede's project have thus sustained and amplified his conclusions rather than contradicted them."*

The work of Hofstede and the VSM questionnaires continues apace – there has been over 40 years of research associated with these findings, along with several iterations of the basic questionnaire. This consistency and convergence to a stable form is a major reason of why the CAE research agenda in this thesis chose to build on Hofstede's work. This was selected, due to the fact that it has the greatest pedigree, as well as having a solid foundation in investigating culture at the national level. Moreover, although it is the oldest (with all of the issues that brings – such as cultural change over time) it has the greatest associated research and findings, and therefore will be the most useful in any long-term research applications.

As the VSM research has often focused on the employment sector (a reasonable decision in general, as the majority of people will be employed at one time or another and the research/consultant fields of business culture is a booming market in increasingly globalised markets) this may mean, however, that these findings are not applicable for adoption and use in eLearning. The CAE study, on the other hand, focuses on the educational sector, to determine the intercultural differences *before* most people enter the job market. Hence the decision was made that the CAE questionnaire would not use the VSM questionnaire, but would build upon the interpretation of Marcus & Gould [Marcus, 2000a], as detailed in the next section.

2.5.1   CULTURE?

Culture can be defined in many ways: it can be considered as a collection of attitudes or mores, basically a way of thinking (which leads to patterns of action and belief) that may be linked to a social structure.

Definitions include:

Cultures can be *"understood as systems of symbols and meanings that even their creators contest, that lack fixed boundaries, that are constantly in flux, and that interact and compete with one another"* [Findley and Rothney, 2006]

A *"Culture or civilization, taken in its wide ethnographic sense, is that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society."* [Tylor, 1874]

"Culture is the collective programming of the mind which distinguishes the members of one category of people from another." [Hofstede, 1984b]

"Culture: learned and shared human patterns or models for living; day- to-day living patterns. these patterns and models pervade all aspects of human social interaction. Culture is mankind's primary adaptive mechanism". [Damen, 1987]

"Culture consists of patterns, explicit and implicit, of and for behaviour acquired and transmitted by symbols, constituting the distinctive achievements of human groups, including their embodiments in artifacts; the essential core of culture consists of traditional (i.e. historically derived and selected) ideas and especially their attached values; culture systems may, on the one hand, be considered as products of action, and on the other as conditioning elements of further action." [Kroeber and Kluckhohn, 1952]

In choosing to investigate the possibility of using a learner's cultural background as a dimension for adaptation, it is necessary to define what is meant by 'culture' for the purposes of this thesis. This definition used here is based on that given by UNESCO [UNESCO, 2002]:

"... 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"

The CAE definition of 'culture':

> *Culture should be regarded as the set of distinctive spiritual, material, intellectual and emotional features of society or a social group applied at the national level, and that it encompasses, in addition to art and literature, education, lifestyles, ways of living together, value systems, traditions and beliefs.*

As can be seen, the UNESCO definition has been simplified by the inclusion of the idea of culture and nationality being equivalent. This is obviously a simplification, as the two are not always the same; culture can be applied at many levels beyond that of just a nation. For example, a nation or country may contain more than one nationality (e.g., the UK with England, Scotland, Wales and Northern Ireland, each with their own distinct national identity). Each nation can often be sub-divided into separate sub-national cultures (regions), for example Spain is dominated by the Castilian culture but also includes: Basque Country, Catalonia, Galicia, Andalusia, Asturias, Navarre, Balearic Islands, Valencia, Cantabria, Rioja, Aragon, and Extremadura. These cultures all co-exist (with some varying degree of nationalist sentiment) under the heading of 'Spain'. The reason behind inserting this addition (and to some degree overly limiting the CAE definition of culture) is purely practical – whilst the CAE questionnaire (see Chapter 3) does have a section for gathering finer gradations of culture other than '*nationality*' (specifically: '*Ethnic Background*'), it was expected that the sample size gathered to accurately analyse these national sub-divisions would be far too small at the outset of the data gathering operation. Indeed this has proven to be the case, in some cases the data gathered at the 'nation' level being at the low end of the spectrum for significant analysis. However, as further

data is gathered, the design of the CAE questionnaire allows for future flexibility in analysis, opening up the possibility of a finer grained analysis than has been currently performed.

The second alteration to the UNESCO definition is the specific mentioning of 'education' as a feature of a society - this is far less controversial and is more easily accepted.

Therefore is the narrowing of the UNESCO definition a step too far? For the purposes of this research it is not. Indeed for the purposes of this thesis it still remains a very broad definition, to this end a more specific definition of educational culture is used within this thesis.

The CAE definition of 'educational culture':

> *Educational Culture should be regarded as the set of distinctive intellectual features of society applied at the national level, and that it encompasses, in addition to traditional educational values, a learner's aims, goals, background knowledge, social preferences, and their location on Hofstede's VSM Indices.*

Here is a far more restrictive definition; the alterations here are such as to focus on the intellectual, academic and educational aspects of society, specifically those of the learner. To this end the most notable addition is the inclusion of Hofstede's VSM indices, as these indices play a major role in the creation of the CAE learner model.

Ultimately the aim of this research is to discover how to use a learner's cultural background as a first step in a personalised educational environment (such as an AEH system). By creating an educational cultural stereotype model that will perform high level adaptation to an eLearning lesson, the learner will receive a lesson that is *generically appropriate* to them. This high level cultural adaptation is not designed to create a completely personal lesson by itself, it should work alongside other more traditional forms of adaptation (both stereotype and overlay models) [Kay, 2000]. For example, an AEH system could determine a learner's culture (nationality) and therefore make some initial high level decisions as to how the educational materials are to be delivered. These could then be altered/over-ridden at a later date by the system, as it gathers more learner specific information. This approach would address one of the major criticisms against Hofstede's work – namely that analysing culture at the national level is too simplistic, and that individuals are far more complex than their nationality and should be addressed on a more personal level.

2.5.2 HOFSTEDE ON THE WEB: THE MARCUS [MARCUS & GOULD, 2000A] INTERPRETATION

Aaron Marcus [Marcus, 2011] graduated from Yale in 1967, since then he has worked extensively in the field of user interfaces and graphic design, within these and related fields he has written over 150 articles and (co-) written 5 books. As such he has a great deal of experience of designing and creating user interfaces, with special focus on web interfaces for the last ten years [Marcus, 2006]. Beyond this he has also a great deal of interest in cultural anthropology. This lead to his work with Emilie Gould – Dr Gould works on intercultural research, with a focus on usability design [Gould, 2009] – together they examined Hofstede's cultural indices and interpreted these with an expert eye to how these may be represented using web interfaces.

The results of this analysis were presented in [Marcus and Gould, 2000a], and can be summed up as follows in the subsections below.

2.5.2.1 Power Distance Index:

In web Human Computer Interfaces (HCI) the Power Distance Index (PDI) covers issues such as the structure of data; use of hierarchies (both of data and access); degree of expertise/authority desired; degree of barriers to access. Extrapolating these factors for both low and high PDI instances, the following table (*Table 2.2*) gives examples of how a learner may desire different web interfaces depending on their culture's PDI.

As an example, a learner from a low PDI culture, such as many Western countries (e.g., the UK, Ireland and The Netherlands) is less accepting of 'power' differences, they are more likely to consider

themselves equals (for example a BSc student would not consider themselves to be dramatically different to a MSc or PhD student – after all they are all 'students'). A learner from a high PDI culture (such as China or India) would consider inequality a more desirable trait – for example as a professor is much further up the hierarchy than themselves, they expect them to set barriers to access (such as frequent tests) which will be removed as their own degree of expertise increases.

High	Low
• Deep hierarchies	• Shallow hierarchies (data and access)
• Greater difference in status	• Less difference in status
• Equality = bad (inequalities expected)	• Equality = good
• Significant emphasis on order	• Less significance on order
• Strong focus on expertise (e.g. for help)	• Weak focus on expertise (e.g. for help)
• Focus on explicit, enforced and frequent barriers to access	• Focus on freedom to roam (transparent access)
• Frequent use of social order to organise information	• Infrequent use of social order to organise information

Table 2.2: The effect of the PDI on web interfaces

2.5.2.2 Collectivism vs. individualism index

In web HCI the Collectivism versus Individualism (IDV) index covers issues such as personal vs. group outcomes; argumentative vs. subdued interaction; youth vs. experience; novelty vs. tradition. The following table (*Table 2.3*) describes how a culture's IDV index could affect web interface factors.

Therefore a low IDV culture (such as China) would be expected to value group work over individual efforts, and respect experience & tradition. Compared to a high IDV value culture (such as the UK) where the opposite is more likely to be the case. When discussing 'truth' vs. 'harmony', a high IDV culture is more in favour of a 'harsh truth' rather than 'comforting lie', i.e., the truth is valued and should be told even if it causes pain or disharmony.

High	Low
• Emphasis on personal challenges and freedom	• Emphasis on groups over individuals
• Value truth over harmony (relationships)	• Value harmony (relationships) over truth
• Images of 'self' or individual success	• Images of 'other' (e.g. organisation, nationalism) or group success
• Tolerance for extreme views and argument	• Focus on subdued speech and hyperbole
• Respect to youth and action	• Respect to age and experience
• Emphasis on novelty and change	• Emphasis on tradition and order

Table 2.3: The effect of the IDV on web interfaces

2.5.2.3 Femininity vs. masculinity index

In web HCI the Feminity versus masculinity (MAS) index covers issues such as gender distinctions; task separation; (strong vs. weak) cooperation vs. small limited tasks. The following table (*Table 2.4*) describes how a culture's MAS index could affect web interface factors.

High	Low
• Traditional gender/age distinctions	• Blurring of gender/age distinctions
• Individual achievement even at the expense of others	• Mutual cooperation and support
• Attention gained through games and competitions	• Attention gained through aesthetics and appeals to unifying values

Table 2.4: The effect of the MAS on web interfaces

A high MAS rating identifies cultures (such as Austria) that accept role distinctions, for example due to gender and age. For instance, in many cultures it is still accepted that nurses should be women, and firemen should be men. Hofstede gives the example that women dominate the medical profession in the Soviet Union, while men dominate it in the USA. In the Netherlands (a low MAS rated culture)

these distinctions may still exist, but they are not accepted and indeed are often legislated against. A highly masculine culture is more likely to accept attention gained through assertive actions (on the web these may competitive games, and high test rankings – when compared to others), compared to a low MAS culture which would prefer less assertive or aggressive (which typically masculine traits) actions, such as poetry and other aesthetic methods.

2.5.2.4   Uncertainty avoidance index

In web HCI the Uncertainty avoidance (UAI) index covers issues such as simplicity vs. complexity; degree of choice available; forecasting of outcomes/results; help in navigation; level of error accepted; degree of ambiguity accepted. The following table (*Table 2.5*) describes how a culture's UAI could affect web interface factors.

Different cultures collectively handle uncertainly or ambiguity in different ways. High UAI rated cultures prefer to 'control' how such ambiguity is presented. On the web this would mean a low cognitive overhead, and plenty of additional supporting structures – such as clearly presented rules and regulations, recourse to expert help, and web systems that help the reader with clear navigation and redundant cues. The low UAI cultures are more willing to be left to explore a web system with fewer external aides, indeed too many cues or support mechanisms can be seen as detrimental, as they hold back the user and reduce the effectiveness of the information.

High	Low
• More formal rules • Tactical operations • Shun ambiguous situations • Teachers know all the answers • Simplicity with clear metaphors, limited choices and restricted amounts of data • Desire to forecast results of an action before performing it • Navigation focuses on stopping the user getting lost • Use of redundant cues to reduce ambiguity	• Informal rules • Strategic operations • Less openly anxious • Teachers may not know all the answers • Complexity with maximum availability of choices and data • Acceptance of risk, with a stigma on over protection • Navigation will allow for users to roam away from tightly controlled sequence (even off topic) • Less redundant cueing (maximise potential information available)

Table 2.5: The effect of the UAI on web interfaces

2.5.2.5   Long- vs. short-term orientation

In web HCI the Long versus short term orientation (LTO) index covers issues such as acceptance of unequal relations; relationships vs. rules as source of information/credibility; immediacy of results. The following table (*Table 2.6*) describes how a culture's LTO index could affect web interface factors.

High	Low
• Content focuses on practical concerns • Use relationships as a source of credibility • Patience in achieving goals	• Content focuses on underlying 'truth' (hypotheses, frameworks, methodologies etc. …) • Use rules as a source of credibility • Desire for immediate achievement of goals

Table 2.6: The effect of the LTO on web interfaces

Therefore high LTO cultures would emphasize practical (learning) materials, and patience in achieving the content's aims and objectives. Compared to low LTO cultures that require immediate feedback on how the user/learner is doing in working through the content.

2.6 ONTOLOGIES IN EDUCATION

The adoption of Semantic Web Technologies into education gave rise to the notion of an Education Ontology: an Ontology that encapsulates the knowledge of an education system and related pedagogical information. Recent examples of education ontologies are: EduOnto – An Ontology for Educational Resources [Qin and Hernandez, 2004]; OntoEdu – Ontology based Education Grid System for e-Learning [Guangzuo *et al*, 2004]; OntoGeo – Geography Ontology. Educational sites that make use of Ontologies include The Gateway to Education Materials [GEM, 2011] and The Open Directory Project [dmoz, 2011]. OntoWeb [OntoWeb, 2002] is an ontology based portal which serves the academic and industrial communities with Ontology based information sources for knowledge management and electronic commerce. In recent educational technology development, adaptation support to assist in learning is identified as a primary challenge in online educational systems. Education ontologies provide a promising solution to this challenge. In an educational ontology, educational resources are organised in a "conceptual domain presentation" fashion. Concept-based course sequencing was featured to allow adaptive courseware authoring, concept-based navigation, and searching for courseware and Topic Maps [Widhalm and Mueck, 2003], which organise Learning Objects (LO) by topic.

In [Motz and Guzman, 2005], authors present an overview of cultural aspects used for retrieving relevant documents. In a typical information retrieval system, together with a collection of documents and a query, the objective of a search strategy is presented to the system, based on which the system returns a set of documents which are deemed relevant to the input query set. Although modelling user's information need still remains an open challenge, several initiatives have been proposed to assist users in defining search strategy. To this effect, "the use of cultural aspects" has been studied [Motz and Guzman, 2005], using the following set of features: (1) Degree of Impatience, (2) Attitude, (3) Treatment, (4) Language, (5) Learning Styles and (6) Activity. The cultural aspects which are modelled by the Ontology were used to generate the user profile and to refine the resources search strategy, thus, updating the search strategy and in effect enhancing the search results. However, within the education domain, be it adaptive or not, there is limited work that can be used to study cultural effects. Hence, following the success of ontologies in other areas, the work in Chapter 4 presents a formalisation of an ontology model for representing stereotype cultural artefacts.

2.7 ONTOLOGY ENGINEERING

Chapter 5 presents an implementation of the CAE ontology. To understand how and why this has been done, it is necessary to give some further background material on ontology building, which is introduced here.

2.7.1 SEMANTIC LANGUAGES AND EXPRESSIVENESS

The World Wide Web affords unprecedented access to globally distributed information. Metadata, or structured data about data, improves discovery of and access to such information. The effective use of metadata among applications, however, requires common conventions about semantics, syntax, and structure. Individual resource description communities define the semantics, or meaning, of metadata that address their particular needs. Syntax, the systematic arrangement of data elements for machine-processing, facilitates the exchange and use of metadata among multiple applications. Structure can be thought of as a formal constraint on the syntax for the consistent representation of semantics.

2.7.2 RESOURCE DESCRIPTION FRAMEWORK (RDF)

The Resource Description Framework [RDF, 2010], developed under the auspices of the World Wide Web Consortium [W3C, 2011], is an infrastructure that enables the encoding, exchange, and reuse of structured metadata. This infrastructure enables metadata interoperability through the design of mechanisms that support common conventions of semantics, syntax, and structure. RDF does not stipulate semantics for each resource description community, but rather provides the ability for these communities to define metadata elements as needed. RDF uses eXtensible Markup Language [XML,

2003] as a common syntax for the exchange and processing of metadata. The XML syntax is a subset of the international text processing standard: *Standard Generalized Markup Language* [SGML, 2011] specifically intended for use on the Web. The XML syntax provides vendor independence, user extensibility, validation, (arguably) human readability, and the ability to represent complex structures. By exploiting the features of XML, RDF imposes structure that provides for the unambiguous expression of semantics and, as such, enables consistent encoding, exchange, and machine processing of standardized metadata.

RDF supports the use of conventions that will facilitate modular interoperability among separate metadata element sets. These conventions include standard mechanisms for representing semantics that are grounded in a simple, yet powerful, data model discussed below. RDF additionally provides a means for publishing both human-readable[4] and machine-processable vocabularies. Vocabularies are the set of properties, or metadata elements, defined by resource description communities. The ability to standardize the declaration of vocabularies is anticipated to encourage the reuse and extension of semantics among disparate information communities. For example, the Dublin Core Initiative [DCI, 2011], an international resource description community focusing on simple resource description for discovery, has adopted RDF [DC-RDF, 2006]. Educom's IMS Instructional Metadata System [IMS, 2011], designed to provide access to educational materials, has adopted the Dublin Core and corresponding architecture and extended it with domain-specific semantics. RDF is designed to support this type of semantic modularity by creating an infrastructure that supports the combination of distributed attribute registries. Thus, a central registry is not required. This permits communities to declare vocabularies which may be reused, extended and/or refined to address application or domain specific descriptive requirements.

In short, RDF provides a common framework for expressing this information, so it can be exchanged between applications without loss of meaning. In addition, RDF supports the evolution of schemas over time, requiring all the data consumers to be merged. RDF extends the linking structure of the Web to use URI's to name the relationship between things as well as the two ends of the link (this is usually referred to as a triple). Using this model, it allows structured and semi-structured data to be mixed, exposed and shared across different applications. The linking structure forms a directed graph, where the edges represent the named link between two resources, represented by the graph nodes. While RDF provides a link between different resources online, RDF Schema (RDFS) extends the vocabulary of RDF to allow describing taxonomies of classes and properties.

RDF (and RDF(S))provided thus a candidate for representing the concepts developed for the cultural adaptation. However, a more powerful approach is to use a fully-fledged web ontology language, as described below.

2.7.3   WEB ONTOLOGY LANGUAGE (OWL)

The expressivity of RDF and RDFS is deliberately very limited: RDF is (roughly) limited to binary ground predicates, and RDFS is limited to a subclass hierarchy and a property hierarchy, with domain and range definitions of these properties. The Web Ontology Language [OWL, 2004] is designed for use by applications that need to process the content of information instead of just presenting information to humans. OWL facilitates greater machine interpretability of Web content than that supported by XML, RDF, and RDF Schema (RDF-S) by providing additional vocabulary along with a formal semantics. OWL has three increasingly expressive sublanguages: OWL Lite, OWL DL, and OWL Full.

OWL Full: The entire language is called OWL Full and uses all the OWL language primitives. It also allows for the combination of these primitives in arbitrary ways with RDF and RDFS. This includes the possibility to change the meaning of predefined primitives to each other. For example, in OWL Full it's possible to impose cardinality constraint on the class of all classes, essentially limiting the number of classes that can be described in any Ontology. The advantage of OWL Full is that it is fully upward compatible with RDF, both syntactically and semantically. However, the disadvantage of OWL Full is that the language has become so powerful as to be undecidable, removing any hope of complete reasoning support.

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[4] To some extent, as XML is *not* created for human consumption.

OWL DL: In order to regain computational efficiency, OWL DL (Description Logic) has been created, and is a sublanguage of OWL Full which restricts the way in which the constructors from OWL and RDF can be used. The advantage is that it permits efficient reasoning support. However, the disadvantage is the loss of full compatibility with RDF: an RDF document will in general have to be extended in some ways and restricted in others before it is a legal OWL DL document. Conversely, every legal OWL DL document is still a legal RDF document.

OWL Lite: adds additional restriction limits on top of OWL DL to create a light-weight subset of the language constructors. For example, OWL Lite enumerated classes, disjointsness statements and arbitrary cardinality are dropped. The advantage of this language is that it's easier to implement reasoning algorithms. The disadvantage is, of course, a restricted expressivity.

OWL documents are usually called OWL ontologies, and are RDF documents. So the root element of an OWL ontology is an rdf:RDF element which also specifies a number of namespaces:

```
<rdf:RDF

    xmlns="http://cae-light.qmul.net/CAE-L.owl#"

    xmlns:protege="http://protege.stanford.edu/plugins/owl/protege#"

    xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"

    xmlns:xsd="http://www.w3.org/2001/XMLSchema#"

    xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"

    xmlns:owl="http://www.w3.org/2002/07/owl#"

  xml:base="http://cae-light.qmul.net/CAE-L.owl">
```

An OWL Ontology starts with a collection of assertions for house-keeping purposes. These assertions are grouped under owl:Ontology element which contains comments, version control and inclusion of other ontologies:

```
  <owl:Ontology rdf:about="">

    <owl:imports rdf:resource="http://cae-light.qmul.net/Authority.owl"/>

    <owl:imports rdf:resource="http://cae-light.qmul.net/Data.owl"/>

    <owl:imports rdf:resource=""/>

    <owl:imports rdf:resource="http://cae-light.qmul.net/Language.owl"/>

    <owl:imports rdf:resource="http://cae-light.qmul.net/Lesson.owl"/>

  </owl:Ontology>
```

Only one of these assertions has any consequences for the logical meaning of the Ontology, this is the owl:imports assertion. This lists other ontologies whose content is assumed to be part of the current document. Imported ontologies provide definitions that can be used. Usually there will be an import element for each used namespace, but it is possible to import additional ontologies, for example ontologies that provide definitions without introducing any new names. Also note that owl:imports is a transitive property: if Ontology A imports ontology B and Ontology B imports ontology C then Ontology A also imports Ontology C.

Due to the power of expressivity of OWL, and its much richer development potential for the future, it was selected as the language of choice to represent the cultural framework for adaptation as presented in this thesis. Ontologies in OWL can be written with any text editor, but dedicated tools make the process much quicker and easier. The most famous such tool is shortly introduced below.

2.7.4   PROTÉGÉ AND OWL

Protégé [Protégé, 2011] is a free, open-source platform that provides a growing user community with a suite of tools to construct domain models and knowledge-based applications with Ontologies. At its core, Protégé implements a rich set of knowledge-modelling structures and actions that support the creation, visualisation and manipulation of ontologies in various representation formats. Protégé can be customised to provide a domain-friendly support for creating knowledge models and entering

data. For this reason, Protégé was used in the creation of the ontologies developed within this research.

2.7.5 SESAME

Sesame [OpenRDF, 2011] is an open source RDF framework with support for RDF Schema inferencing and querying. Sesame has been designed with flexibility in mind. It can be deployed on top of a variety of storage systems (relational databases, in-memory, file systems, keyword indexers, etc.), and offers a large set of tools to developers to leverage the power of RDF and RDF Schema, such as a flexible access API, which supports both local and remote (through HTTP or RMI) access, and several query languages, of which SPARQL is the most powerful one, as well as the standard RDF query language since 2008.

2.8 SUMMARY

In this chapter the materials, research and knowledge needed to complete the research given in this thesis have been presented. In summary, Adaptive Hypermedia research was introduced along with a short exploration of the AEH systems. At the end of this, a decision was made as to which AEH system (ADE) to use (as further detailed in Chapter 7) when implementing some of the research findings of this thesis.

I then moved on to discuss the use of 'culture' in eLearning, and presented some of the most common cultural indices in use today. At the end of this, a decision was made as to which cultural index to use (Hofstede), which was then discussed in more detail, along with the work presented by Marcus and Gould [Marcus and Gould, 2000a] and how this would affect web user interfaces. Finally, the current use of educational ontologies was introduced, along with a discussion on how to go about creating and engineering such an ontology, the results of which can be seen in Chapter 5.

Based on this background research, decisions about the instruments to be used in the research of this thesis were taken. Marcus and Gould's assumptions will be used, to be further mapped into the educational domain. Ontologies will be used to create the new index for educational cultural personalisation, in order to gain from a richer structure, and to highlight inter-relations between concepts. The ontologies will be created via the Protégé tool.

2.9 NEXT

The next chapter takes the findings of Hofstede and Marcus & Gould and present the experimental examination of how these may be used to further the state of the art in educational ontologies. To this end, three experimental hypotheses will be given, along with the experimental design used to investigate them.

CHAPTER 3:

THE CAE QUESTIONNAIRE

3 THE CAE QUESTIONNAIRE

3.1 INTRODUCTION

This chapter presents the CAE questionnaire, a questionnaire designed as a result of the work in this thesis, to test three hypotheses, as introduced later in this chapter, which allow further exploration of how a student's culture may affect their learning, as well as how an educational environment can affect them depending on their home culture. To this end the questionnaire's responses are examined, and the conclusions are used to create a set of cultural stereotypes that can later be used as part of a user model to guide adaptation within an AEH system.

3.2 DESIGN

The CAE (Cultural Artefacts in Education)[CAE, 2010] questionnaire, a major product of the work of this thesis (see Appendix B for the full questionnaire), was designed to gather the information required to determine if there is a *cultural bias* towards online education, specifically Adaptive Educational Hypermedia (AEH)[Brusilovsky, 2001b].

This questionnaire is based upon the cultural indices of Hofstede and the interpretation of those indices relevant for web based systems as given by Marcus & Gould [Marcus and Gould, 2000a][Marcus and Gould, 2000b] (as explained in sections 2.4 & 2.5). However, Hofstede's VSM questionnaire [Hofstede, 1994] is designed to determine cultural values within a corporate setting (specifically that of IBM). On the other hand, the user focus of the questionnaire created in this thesis is upon the educational domain, more specifically, students or researchers within academia. This restriction is used to extract clear results for this sub-population of the educational sphere, of which it is relatively easy for the author to gather the data. The same methodology can be used to evaluate other sub-populations, and results can be extrapolated.

To determine if it is possible to map Hofstede's indices for use within the educational domain, the existing questionnaire was analysed, as well as related research. Marcus & Gould's interpretation of how Hofstede's findings could be applied for the use on the World Wide Web was used, specifically for web interface concerns. As Marcus & Gould's interpretation has direct relevance to the use of AEHs systems (all of which are digital and web based) in education, but there is no specific questionnaire created by them, creating a new series of questions based on their set of indexes, rather than using the original VSM survey questions, was deemed the most appropriate methodology. However, these questions are not only appropriate for the Marcus & Gould indexes, but also tuned to an application in web education, and in personalised education.

Therefore, each question was designed with the information presented in *Table 2.2* to *Table 2.6* carefully considered from the point of view of an education context. For example, one of the conclusions in *Table 2.5* (detailing the affect that a high or low UAI culture may have on web design issues) deals with how an individual from a low UAI culture behaves (that is they are more accepting of being in ambiguous or less strictly controlled situations) in that:

"Navigation will allow for users to roam away from tightly controlled sequence (even off topic)"

This resulted in the creation of a question to investigate the questionnaire respondents' attitudes to this issue. Question 10 is the result:

"There should be as much structure and directions in a lesson as possible to ensure that there is no ambiguity."

It is worth noting that when designing questionnaires, it is important to avoid a bias in the question responses, due to the effect of the expected answer. Thus, positive questions show an expectation of a positive answer, and negative questions show an expectation of a negative one. In order to avoid this effect, one technique (used also by the famous SUS questionnaire (download the file at [Brooke, 1996]), is to alternate positive and negative questions. This is the balancing technique used in designing the CAE questionnaire, where an equal number of positive and negative questions were created, and then they were randomly assigned a position in the questionnaire. So, for example, with Question 10, the expectation is that it would be answered positively (agreement) from a culture that wishes to avoid uncertainty (high UAI), whereas with Question 2:

"I enjoy learning from my mistakes and dislike being 'protected' from making them."

the expectation is for it to be answered negatively from those same respondents. This design concern means that respondents are not allowed to easily predict the expected overall polarity of the survey, which may introduce a response bias to the survey.

Once the CAE questions were created in this way, they were evaluated by members from the target respondents. The draft version of the questionnaire was given to seven students from various cultures, so that their feedback on the quality and clarity of each question could be taken into account for the published version of the questionnaire. Moreover, these questions were shown to Dr. Gary Burnett (School of Computer Science, University of Nottingham), with his expertise in Human Factors and HCI, for feedback.

Once this evaluation process of the questionnaire was concluded, the questionnaire was made available both online and in a printed format and the collection procedure was initiated. This process involved both direct requests for responses (for example, from the University of Nottingham's postgraduate classes – the teacher for the class would include a printed version of the questionnaire with the lesson materials and ask the students to complete this by the end of the class) and by advertisements (for example contacts at the universities of Dublin, Hong Kong and Ningbo [China] were asked to advertise the online version of the questionnaire to their students). The exact number of responses from each country will be detailed in further sections.

The final (post-evaluation) CAE questions that form the link between Marcus & Gould's interpretations, eLearning and Hofstede are more detailed in Section 3.3 below.

The CAE questionnaire is designed to investigate the following three hypotheses:

Hypothesis 1: Hofstede's cultural dimensions apply to the educational domain. (Hofstede's cultural dimensions were extracted from data from the corporate world; can they be mapped from this domain to the educational domain? More precisely, does the identified set of cultural adaptation features as informed by Marcus's assumptions correctly map back to Hofstede's Index?)

> *Hypothesis 1.1*: does the identified set of features as informed by Marcus's assumptions correctly map back to Hofstede's Power Distance Index (PDI) and apply to the educational domain.
>
> *Hypothesis 1.2*: does the identified set of features as informed by Marcus's assumptions correctly map back to Hofstede's Collectivism vs. individualism Index (IDV) and apply to the educational domain.
>
> *Hypothesis 1.3*: does the identified set of features as informed by Marcus's assumptions correctly map back to Hofstede's Femininity vs. masculinity Index (MAS) and apply to the educational domain.
>
> *Hypothesis 1.4*: does the identified set of features as informed by Marcus's assumptions correctly map back to Hofstede's Uncertainty avoidance Index (UAI) and apply to the educational domain.
>
> *Hypothesis 1.5*: does the identified set of features as informed by Marcus's assumptions correctly map back to Hofstede's Long vs. short term orientation Index (LTO) and apply to the educational domain.

Hypothesis 2: Students desire to be taught in the manner that they have been brought up with. (Is there a cultural bias to education? Do students recognize this? Would they desire a different cultural bias to their own?)

Hypothesis 3: There is a cultural bias in the acceptance of openly acknowledged Adaptive Educational systems. (Is there a cultural bias in the desire for AEH – do some cultures accept the teacher's viewpoint no matter how it is presented and would therefore resent that being 'changed'. Can this adaptation be hidden and therefore accepted? Do students want to conform or not?)

Each hypothesis had a series of questions designed to gather the data that will allow for an investigation into the truth of the hypothesis. Those groupings are detailed in Sections 3.3, 3.4 and 3.5.

Each of the CAE questions was answered using a Likert scale and the responses ranked according to the information given in *Table 3.1* (a Likert scale was chosen as it allows for a reasonable degree of answer differentiation, whilst remaining simple for the questionnaire respondents to use. Also, a

Likert scale allows for the results to be analysed to determine if the response spread is parametric or not). Please note that such a mapping of scores is based on two assumptions:

a) that there is a monotonous increase from one response to another (e.g., 'Agree' > 'Strongly Agree');

b) that these possible responses are equidistant (e.g., the distance between 'Agree' and 'Strongly Agree' is equal to the distance between, say, 'Strongly Disagree' and 'Disagree');

c) sometimes, a third assumption is also added, that of symmetry. The point of symmetry is the 'Neither agree or disagree' answer. Thus this assumes that 'Agree' is the exact opposite of 'Disagree', and 'Strongly Agree' is the exact opposite of 'Strongly Disagree'.

All of these assumptions are strong assumptions. However, they are made by all studies using a Likert scale, and they are quite plausible. Nevertheless, they only can be considered assumptions, without a precise study of the exact intent of respondents when using one or the other response – study which is however beyond the scope of this thesis.

Possible Response	Score assigned to the response
Strongly Agree	1
Agree	2
Neither agree or disagree	3
Disagree	4
Strongly Disagree	5

Table 3.1: the Likert scale used by respondents to the CAE questionnaire and the score assigned

In reality, as my questions are based on Marcus's assumptions, but mapped onto educational domain, the questionnaires built would check:

a. If Marcus's assumptions work (if the features they mapped for each index of Hofstede are correct)

b. If my extension to the educational domain is correct

If there are differences in time for various countries, from the initial findings of Hofstede, or if different sub-populations have different sub-cultures, again, the results can vary. In this limited-scale study, several assumptions were made, which would simplify the process, and represent also avenues for further research:

a) one assumption is that Marcus's assumptions for the web interface domain work;

b) the second assumption is that there are no time variations of cultural preferences (this is the same assumption that Hofstede makes);

c) the third assumption is that sub-cultures can be disregarded (this was also explained earlier in the thesis).

With these assumptions, it is possible to concentrate on the main purpose of this thesis, to determine if the extension of Marcus's model is correct. These assumptions are reasonable assumptions (b is made also by Hofstede, c) is explained previously, and a) is reasonable, as the current research doesn't set out to validate or invalidate Marcus's research). However, some of the results obtained later in the thesis open up the question on the validity of these assumptions again.

Before detailing the hypotheses and the questions used to examine them, sections below will briefly reiterate Hofstede's cultural dimensions as well as introduce the novel CAE Indices. The CAE questions will then be listed according to the hypotheses that they are to be used to investigate.

3.2.1   RECAP HOFSTEDE INDICES

The five cultural indices identified are:

•   Power Distance (PDI): "the extent to which the less powerful members of organizations and institutions (like the family) accept and expect that power is distributed unequally."

- Individualism/Collectivism (IDV): "the degree to which individuals are integrated into groups, is the focus on the individual or the group?"

- Masculinity/Feminity (MAS): "the distribution of roles between the genders, masculine countries show a gap between men's values and women's values."

- Uncertainty Avoidance (UAI): "a society's tolerance for uncertainty and ambiguity."

- Long Term Orientation (LTO): "focuses on the degree the society embraces, or does not embrace long-term devotion to traditional, forward thinking values."

3.2.2 THE CAE INDICES

The CAEI are the two 'Cultural Artefacts in Education Indices', the first being the CEI (Cultural Education Index) and the second being the AEI (Adaptive Education Index). These two separate indices have been created to examine the respondent's values to cover the following issues:

The CEI (addressing Hypothesis 2) deals with issues such as:

- The learner's acceptance of being taught in another language;

- The learner's acceptance of presence/availability to access other languages;

- Access/separation of cultures different to the learner's own.

A culture with a low CEI value represents one that is open to other cultures, and so would be accepting of being taught in another language; would prefer having access to other languages (this covers languages for additional materials even if they are not being used for core teaching) and are in favour of accessing different cultures to their own. A high CEI culture is the opposite, rebuffing learning in another language or culture.

Therefore a low CEI culture's web based learning environment may include the following:

- Core teaching materials in a language other than the learner's mother tongue

- Additional teaching materials in a second language whilst the core materials are in the first language

- Additional links that will support the learner in accessing and understanding new languages (such as help materials)

- Links that bring external materials in other languages and cultures to the current teaching context (for example an Indian student learning Chinese literature, the core content may be in Hindi, but links can add depth to the learning experience by linking directly to Chinese literature websites)

A high CEI culture would have a much more focused set of content, with as few additional learning materials and links to other languages as possible. For example, a UK student (which are later in the thesis shown to have a high CEI) studying Chemistry would not desire any additional links, even if they are in context (such as concerning Lavoisier [Lavoisier, 2011] in French).

The AEI (addressing Hypothesis 3) deals with issues such as:

- Do the learners actively desire an AEH education?

- How important is the security of their data?

- Are there concerns over the type of data being collected and stored?

- Do they require access to and control over this data?

- Should an AEH lesson always be noticeably teacher approved?

A high AEI culture is accepting of the principle behind AEH systems – that an adaptive learning environment delivering a personalised lesson is the best form of online learning. There are, of course, issues surrounding this core principle (the type and security of user data being two) and they are to be examined as well. A low AEI culture is not accepting of AEH systems, preferring instead the more limited 'one size fits all' approach common to most online learning systems today.

The effect of this index on AEH system design can be seen in the following example. A high AEI rated culture would involve, amongst others:

- No need to hide the fact that the learner is receiving a personalised lesson

- No need to detail the type of user data being collected up front,
- The learner does not need ready access to their user profile.

With a low AEI culture it might well be inadvisable to start the lesson with any personalisation at all, and only gradually introduce this as the learner wishes.

Even if the teacher wishes to push an AEH learning environment on their students, then in a low AEI culture it may be best to hide the fact that the students are using such a system, whilst emphasising the fact that the lesson is teacher approved.

3.3 *HYPOTHESIS 1*: HOFSTEDE'S CULTURAL DIMENSIONS APPLY TO THE EDUCATIONAL DOMAIN.

To investigate this hypothesis fully, it was necessary to create questions that will allow the five of Hofstede's cultural dimensions to be individually targeted. By using the relations highlighted by Marcus [Marcus and Gould, 2000a] between the Hofstede Indices and web-based systems (typically, their appearance) the following questions were devised (*Table 3.2*; the process for devising these questions has been detailed above).

Question	Question text	HI
Q1	Education should not take into account social & moral values of society.	PDI
Q2	I enjoy learning from my mistakes and dislike being 'protected' from making them.	UAI
Q3	Salary is a better indicator of personal success than social standing	IDV
Q4	In achieving my educational goals I would rather be presented with a series of 'bite-size' tasks, which will allow me rapid mastery of a subject.	MAS
Q5	Teachers / trainers should act as friends not gurus?	PDI
Q6	When exploring a topic, I prefer a teacher to direct and limit my discoveries.	MAS
Q7	When given educational information I prefer it presented in a tightly structured and regulated manner.	PDI
Q8	In gaining the respect and attention of my peers I prefer non-competitive activities (such as painting or writing poetry) rather than competitions and games.	MAS
Q9	I prefer to study with a teacher rather than with my peers.	PDI
Q10	There should be as much structure and directions in a lesson as possible to ensure that there is no ambiguity.	UAI
Q11	I prefer smaller, limited amounts of information to reduce complexity.	UAI
Q12	I think that 'understanding' should be the goal of education, not the completion of 'learning tasks' and 'exams'.	UAI
Q13	I prefer lessons that emphasise practice and practical values rather than abstract theories and 'truth'.	LTO
Q14	I work best when members of the opposite gender are not present. Separation of the genders in education enables more effective teaching, with a teacher better able to target each group.	MAS
Q15	I concentrate on each educational task separately and require immediate results to gauge my success.	LTO
Q16	I prefer to be patient and respectful of others when engaging in discussion, rather than being forward with my own point of view.	IDV

Question	Question text	HI
Q17	**When it comes to completing my educational goals, I prefer to work slowly and patiently, to achieve a better understanding.**	**LTO**
Q18	**My motivation is based around personal goals and not those of my group of peers.**	**IDV**

Table 3.2: The 18 questions used to investigate hypothesis 1 (HI, Hofstede's Index).

These questions are re-grouped by HI (Hofstede's Indices) into tables *Table 3.3* to *Table 3.7* below, to map them on the sub-hypotheses of hypothesis 1 they are used to confirm/refute.

Question	Question text	HI
Q1	**Education should not take into account social & moral values of society.**	**PDI**
Q5	**Teachers / trainers should act as friends not gurus?**	**PDI**
Q7	**When given educational information I prefer it presented in a tightly structured and regulated manner.**	**PDI**
Q9	**I prefer to study with a teacher rather than with my peers.**	**PDI**

Table 3.3: The questions used to investigate hypothesis 1 (HI, Hofstede's Index) along Hofstede's Power Distance Index.

These questions are designed to identify how hierarchically minded the students are. For example, do they consider themselves as part of an academic 'chain of authority'? Do they consider their own view point equal in value (if not in experience) to their teachers? When being taught, do they prefer a tightly structured course, where the teacher rigidly defines their learning?

Question	Question text	HI
Q2	**I enjoy learning from my mistakes and dislike being 'protected' from making them.**	**UAI**
Q10	**There should be as much structure and directions in a lesson as possible to ensure that there is no ambiguity.**	**UAI**
Q11	**I prefer smaller, limited amounts of information to reduce complexity.**	**UAI**
Q12	**I think that 'understanding' should be the goal of education, not the completion of 'learning tasks' and 'exams'.**	**UAI**

Table 3.4: The questions used to investigate hypothesis 1 (HI, Hofstede's Index) along Hofstede's Uncertainty Avoidance Index.

Hofstede's Uncertainty Avoidance Index concerns a person's like or dislike for degrees of uncertainty, or how well they cope with the unknown. This also addresses issues such as how they desire to be taught, for example do they wish to be given a high level subject and given time to work their own way through it (which could create a high amount of uncertainty)(low UAI score) or do they wish to be given a highly structured series of small set tasks and a clearly defined learning path to achieve that task (high UAI score)?

Question	Question text	HI
Q3	**Salary is a better indicator of personal success than social standing**	**IDV**
Q16	**I prefer to be patient and respectful of others when engaging in discussion, rather than being forward with my own point of view.**	**IDV**
Q18	**My motivation is based around personal goals and not those of my group of peers.**	**IDV**

Table 3.5: The questions used to investigate hypothesis 1 (HI, Hofstede's Index) along Hofstede's Individualism Index.

The Individualism Index addresses how a person interacts within groups, do they desire to place themselves forward at the expense of others, or are they willing to work as part of a team with the potential reward of increased social standing?

Question	Question text	HI
Q4	**In achieving my educational goals I would rather be presented with a series of 'bite-size' tasks, which will allow me rapid mastery of a subject.**	**MAS**
Q6	**When exploring a topic, I prefer a teacher to direct and limit my discoveries.**	**MAS**
Q8	**In gaining the respect and attention of my peers I prefer non-competitive activities (such as painting or writing poetry) rather than competitions and games.**	**MAS**
Q14	**I work best when members of the opposite gender are not present. Separation of the genders in education enables more effective teaching, with a teacher better able to target each group.**	**MAS**

Table 3.6: The questions used to investigate hypothesis 1 (HI, Hofstede's Index) along Hofstede's Masculinity Index.

In Hofstede's definition the 'Masculinity Index' addresses the respect held for the traditional separation of tasks across the genders within a culture. This raises issues such as how much competition should be encouraged and the level of guidance to be offered for each gender.

Question	Question text	HI
Q13	**I prefer lessons that emphasise practice and practical values rather than abstract theories and 'truth'.**	**LTO**
Q15	**I concentrate on each educational task separately and require immediate results to gauge my success.**	**LTO**
Q17	**When it comes to completing my educational goals, I prefer to work slowly and patiently, to achieve a better understanding.**	**LTO**

Table 3.7: The questions used to investigate hypothesis 1 (HI, Hofstede's Index) along Hofstede's Long Term Orientation Index.

The Long Term Orientation Index concerns divergence in priority between 'virtue' and 'truth', which for the purposes of education translate to 'practice' versus 'theory' [Marcus and Gould, 2000a]. This obviously is an important consideration for any adaptive system, which can automatically cater for such preferences.

3.4 *HYPOTHESIS 2*: STUDENTS DESIRE TO BE TAUGHT IN THE MANNER THAT THEY HAVE BEEN BROUGHT UP WITH.

The questions used to examine this hypothesis are detailed in *Table 3.8*.

Question	Question text	CEI
Q19	**I would prefer to be educated in my own language**	**CEI**
Q20	**Given the chance, I would prefer to be educated in another country**	**CEI**
Q21	**In choosing a university, the ability to practice languages other than my own is important**	**CEI**
Q22	**I respect the manner in which my teachers have taught me**	**CEI**
Q23	**I often feel constrained by the pace of my teaching**	**CEI**
Q24	**Different perspectives are important to me in my education**	**CEI**
Q25	**I enjoy experiencing other cultures**	**CEI**

Table 3.8: The questions used to investigate hypothesis 2 (CAEI, CAE Index, in this case CEI, or Cultural Education Index).

The CAEI are the two 'Cultural Artefacts in Education Indices', the first being the CEI (Cultural Education Index discussed here, the second being the AEI (Adaptive Education Index) discussed below. The CEI deals with issues such as:

- acceptance of being taught in another language;
- acceptance of presence/availability to access other languages;
- access/separation of other cultures

Learners from different backgrounds may have different attitudes to the above issues. Questions 19 to 25 of the CAE questionnaire are designed to elucidate if the differing cultures have different responses to Hypothesis 2.

3.5 *HYPOTHESIS 3*: THERE IS A CULTURAL BIAS IN THE ACCEPTANCE OF OPENLY ACKNOWLEDGED ADAPTIVE EDUCATIONAL SYSTEMS.

Hypothesis 3 is examined through questions 26 to 32. The students read a short text concerning adaptive educational hypermedia; that text is:

"Adaptive Education System is an on-line system that will measure your personal behaviours and preferences, store them and use these to alter the nature of the education given to you. The aim is to deliver a personalised and unique education to you - and in so doing give you the best education you can receive."

After which they proceed to answer questions 26 to 32, which are detailed in *Table 3.9*.

Question	Question text	CAEI
Q26	**I think the idea of an Adaptive Education System is a good one**	**AEI**
Q27	**I do not have concerns about the type of the personal data that is gathered**	**AEI**
Q28	**Security of my personal data is of utmost importance**	**AEI**
Q29	**I would rather that the lesson the teacher has written is not altered in any way**	**AEI**
Q30	**I would like to have control over the level of alteration that the Adaptive Education System makes**	**AEI**
Q31	**I would be very happy to receive a 'personal' education but only one approved by the teacher**	**AEI**
Q32	**I would prefer a personalised education even if it differs from that received by my peers**	**AEI**

Table 3.9: The questions used to investigate hypothesis 3 (CAEI, CAE Index, in this case AEI, or Adaptive Education Index).

The AEI (Adaptive Education Index) is the second of the two CAEI indices introduced here, the first being the CEI index discussed above. It has been designed with Hypothesis 3 in mind: are there differing responses at the cultural level when it comes to acceptance of adaptive hypermedia in education? Further issues are:

- Do they actively desire an AEH education?
- How important is the security of their data?
- Are there concerns over the type of data being collected and stored?
- Do they require access to and control over this data?
- Should an AEH lesson always be obviously teacher approved?

3.6 SURVEY RESULTS

Sampling of students from universities around the world has taken place, from Hong Kong to Saudi Arabia to Ireland. The CAE questionnaire makes no distinction between undergraduates and postgraduates, but does record if a respondent is a professional academic. The initial sample size examined in this work is 186 (14 of which were academics). These respondents were from a mix of cultures, ranging from German, to Chinese to Burmese – a total of 49 countries in total. The eleven countries chosen for further analysis in this thesis are Austria, China, France, Germany, Greece, India, Ireland, the Netherlands, Romania, Saudi Arabia and the United Kingdom, as they all passed the

threshold for the numbers of respondents (i.e. n>=6). The numbers of respondents from each country are shown in *Table 3.10*.

Country	N
Austria	6
China	7
France	6
Germany	6
Greece	6
India	12
Ireland	23
Netherlands	6
Romania	37
Saudi Arabia	6
United Kingdom	29

Table 3.10: the number of respondents ('n') from the eleven countries examined in this chapter

Whilst a sample size of 6 is very small, this was chosen so as to include as reasonable number of countries for inclusion in the investigation. Obviously this is far too small a number to draw any firm conclusions concerning these responses (for example, to adequately draw any conclusions on the UK's university population, of ~2.5 million students [UK Universities, 2009], at 95% confidence and a 5% margin for error, would require a sample size of 384 [Research Advisors, 2006] UK students), therefore it should be emphasised that any conclusions from such a small sample size are tentative at best. However, it should be noted that this aspect of the research is to map the CAE findings onto the Hofstede results (which has a far larger sample size and greater statistical body of research behind it). As such, if the sample size **does not** result in a seemingly random allocation of student responses to the questionnaire, then these tentative conclusions would indicate a valid mapping from the CAE population sample to the Hofstede population sample. That is, if the CAE findings match the Hofstede findings, then greater weight can be given to the CAE results, even considering the sample size concerns. Of course, in an ideal world more responses would be gathered (ideally over 384 students per country), but due to cost and time constraints this was not possible within the timescale of this thesis.

Country	Power Distance	Individualism	Masculinity	Uncertainty Avoidance	Long term orientation
Arab World	80	38	52	68	--
Austria	11	55	79	70	--
China	80	20	66	30	118
France	68	71	43	86	--
Germany	35	67	66	65	31
Greece	60	35	57	112	--
India	77	48	56	40	61
Ireland	28	70	68	35	--
Netherlands	38	80	14	53	44
Romania*	82	32	45	69	35
United Kingdom	35	89	66	35	25

Table 3.11: the Hofstede scores for the countries under investigation (, the scores given here are gathered by* [Neculaesei and Tatarusanu, 2008] *using Hofstede's VSM 08).*

The Hofstede scores for the *eleven* countries analysed are given in *Table 3.11* below. When examining these scores, it should be remembered that Hofstede's original analysis resulted in placing each country on a gradient from 0-100, with 0 being low and 100 being high. However, his later analyses have resulted in this original 0-100 score being superseded, with some cultures having scores beyond this range – such as China's LTO and Greece's UAI. Generally, however, for the purposes of this study a score of less than fifty is considered 'low', and greater than fifty is considered 'high' as this two-state categorisation will maintain a degree of simplicity when comparing and evaluating the CAE and

Hofstede responses, as well as the potential types of adaptation that results from these categories (the increase in user variables and values for those variables that are created result in an almost exponential rise in complexity in creating adaptive behaviours in an AEH).

The first part of this study was to determine if there was a statistical difference between each of the *eleven* countries' responses to each question. To do this, the data were initially analysed with a Kruskal-Wallis (K-W) one-way analysis of variance by ranks [NIST, 2003] (this test was chosen as it is a non-parametric method for testing equality of population medians among groups; a non-parametric approach was required for all of the CAE analyses due to sample size restrictions). This test determined if there were any significant differences between the responses for a question based on the respondents' country. The result of the test gives a 'p' value which indicates the significance of the difference between the sets of data within the group.

The Null Hypothesis for analysing these data was that there is no significant difference between each of the country's respondents, when it comes to answering the CAE questions.

The results from the K-W test for each question are shown in *Table 3.12*. These results show that there exists a statistical difference (at the $p \leq 0.05$ boundary) for questions 5, 7, 10, 11, 12, 13, 14, 15, 19, 20, 21 and 22. Further information on the analysis for each question follows in *Table 3.12*, with a detailed analysis in the following sections.

Question	'p' value
Q1: "Education should not take into account social & moral values of society"	0.088
Q2: "I enjoy learning from my mistakes and dislike being 'protected' from making them"	0.762
Q3: "Salary is a better indicator of personal success than social standing"	0.107
Q4: "In achieving my educational goals I would rather be presented with a series of 'bite-size' tasks, which will allow me rapid mastery of a subject"	0.219
Q5: "Teachers / trainers should act as friends not gurus"	0.000
Q6: "When exploring a topic, I prefer a teacher to direct and limit my discoveries"	0.054
Q7: "When given educational information I prefer it to be presented in a tightly structured and regulated manner"	0.013
Q8: "In gaining the respect and attention of my peers I prefer non-competitive activities (such as painting or writing poetry) rather than competitions and games"	0.365
Q9: "I prefer to study with a teacher rather than with my peers"	0.174
Q10: "There should be as much structure and directions in a lesson as possible to ensure that there is no ambiguity"	0.000
Q11: "I prefer to reduce complexity by using smaller, limited amounts of information"	0.004
Q12: "I think that 'understanding' should be the goal of education, not the completion of 'learning tasks' and 'exams'"	0.016
Q13: "I prefer lessons that emphasise practice and practical values rather than abstract theories and 'truth'"	0.000
Q14: "Separation of the genders in education enables more effective teaching, with a teacher better able to target each group"	0.001
Q15: "Separation of the genders in education enables more effective teaching, with a teacher better able to target each group"	0.004
Q16: "I prefer to be patient and respectful of others when engaging in discussion, rather than being forward with my own point of view"	0.326
Q17: "When it comes to completing my educational goals, I prefer to work slowly and patiently, to achieve a better understanding"	0.473
Q18: "My motivation is based around personal goals and not those of my group of peers"	0.081
Q19: "I would prefer to be educated in my own language."	0.000
Q20: "Given the chance, I would prefer to be educated in another country"	0.000

Q21: "In choosing a university, the ability to practice languages other than my own is important."	0.000
Q22: "I respect the manner in which my teachers have taught me"	0.009
Q23: "I often feel constrained by the pace of my teaching"	0.571
Q24: "Different perspectives are important to me in my education."	0.577
Q25: "I enjoy experiencing other cultures"	0.266
Q26: "I think the idea of an Adaptive Education System is a good one."	0.408
Q27: "I do **not** have concerns about the *type* of the personal data that is gathered."	0.800
Q28: "*Security* of my personal data is of utmost importance."	0.520
Q29: "I would rather that the lesson the teacher has written is not altered in any way."	0.340
Q30: "I would like to have control over the level of alteration that the Adaptive Education System makes."	0.372
Q31: "I would be very happy to receive a 'personal' education but only one approved by the teacher."	0.770
Q32: "I would prefer a personalised education even if it differs from that received by my peers."	0.279

Table 3.12: the CAE questions and the 'p' value (significance) determined from the null hypothesis when using a Kruskal-Wallis *test*

3.6.1   RESULTS: NO STATISTICAL DIFFERENCE BETWEEN COUNTRIES (P>0.05)

Table 3.13 below shows the summary data for each question analysed. Note that the questions that have proven statistical differences within them (Qs 5, 7, 10, 11, 12, 13, 14, 15, 19, 20, 21 and 22) are included, but will be discussed in more detail in Section 3.6.2.

The analysis starts by looking into the issues that may be causing the lack of statistical significance in some of the answers, beside the scarcity of the data, as well as at conclusions which may be drawn from these results. Lessons may still be drawn from the questions that have no significant difference between the distribution of responses for each country. The summarized results for all of the questions are presented in *Table 3.13*, and examined in further detail (for those questions with a result of p>0.05) in *Table 3.14* to *Table 3.33*.

Note that when determining the 'Closest Interpretation' for each question (and each country within a given question) the median is used. Hence, a median response of 2, gives a closest interpretation of 'Agree'. If however the median is not an integer, then the mean is used in addition to determine what the closest interpretation should be. For example, a median of 2.5 could be either 'Agree' or 'Neither', but if the mean is 2.2 then the interpretation is set to 'Agree'.

Question	Mean	StDev	Median	Range	Closest Interpretation
Q1	3.423	1.205	4	4	Disagree
Q2	2.1119	0.8648	2	4	Agree
Q3	3.3636	1.0651	3	4	Neither
Q4	2.3357	0.8797	2	4	Agree
Q5	2.2394	0.9597	2	4	Agree
Q6	3.2128	1.0611	4	4	Disagree
Q7	2.2238	1.0643	2	4	Agree
Q8	3.3986	1.001	4	4	Disagree
Q9	3.1399	0.9465	3	4	Neither
Q10	2.1538	1.0022	2	4	Agree
Q11	2.6972	1.0035	2	4	Agree
Q12	1.493	0.7317	1	3	Strongly Agree
Q13	2.2535	1.0748	2	4	Agree
Q14	3.9437	1.1221	4	4	Disagree
Q15	2.8156	0.9681	3	4	Neither

Q16	2.3099	0.9162	2	4	Agree
Q17	2.3662	0.9414	2	4	Agree
Q18	1.9577	0.9739	2	3	Agree
Q19	2.594	1.217	3	4	Neither
Q20	2.5455	1.0597	2	4	Agree
Q21	2.608	1.262	2	4	Agree
Q22	2.3706	0.932	2	4	Agree
Q23	2.8592	0.9646	3	4	Neither
Q24	1.6783	0.6235	2	4	Agree
Q25	1.6713	0.6794	2	4	Agree
Q26	2.0282	0.7984	2	4	Agree
Q27	3.1888	1.113	3	4	Neither
Q28	1.7413	0.8858	2	4	Agree
Q29	3.0638	0.9652	3	4	Neither
Q30	2.0979	0.7441	2	4	Agree
Q31	2.4755	0.9256	2	4	Agree
Q32	2.5571	0.9235	2	4	Agree

Table 3.13: median scores and interpretation for all other questions not previously examined

Question 1: With a median score of 4 (+/- 1.2), it seems that the majority of respondents disagree with the statement "Education should not take into account social & moral values of society".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	3.167	1.329	3	Neither
China (CHN)	3.857	1.345	4	Disagree
France (FRA)	3.833	0.983	4	Disagree
Germany (DEU)	3.833	0.983	4	Disagree
Greece (GRC)	3.833	0.753	4	Disagree
India (IND)	3.25	1.765	3.5	Neither
Ireland (IRL)	3.565	0.992	4	Disagree
Netherlands (NLD)	3.833	0.983	4	Disagree
Romania (ROU)	4.6	0.894	5	Strongly Disagree
Saudi Arabia (SAU)	2.892	1.22	2	Agree
United Kingdom (GBR)	3.464	1.071	4	Disagree

Table 3.14: median scores and interpretation for Q1

This result indicates that no matter the cultural background the respondents believe that education should be socially and morally appropriate to society. *Table 3.14* shows that only the Saudi students have a median score that differs from this, indicating that for these students the social and moral values of a culture *may* be a more important factor than for the others in the study.

Question 2: With a median score of 2 (+/- 0.9), it seems that the majority of respondents agree with the statement "I enjoy learning from my mistakes and dislike being 'protected' from making them".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	2.5	0.837	2	Agree
China (CHN)	1.857	1.069	2	Agree
France (FRA)	1.833	0.408	2	Agree
Germany (DEU)	2.667	1.211	2.5	Neither
Greece (GRC)	2	0.632	2	Agree
India (IND)	1.833	0.577	2	Agree
Ireland (IRL)	2.174	0.937	2	Agree
Netherlands (NLD)	1.833	0.408	2	Agree

Romania (ROU)	2.2	1.643	1	Strongly Agree
Saudi Arabia (SAU)	2.135	0.855	2	Agree
United Kingdom (GBR)	2.138	0.833	2	Agree

Table 3.15: median scores and interpretation for Q2

This question was designed to detect the learner's Uncertainty Avoidance Index. However, in the case of this particular question all of the respondents are in agreement with the statement. Although all this response can tell us is that the students think that they would enjoy being free to roam in any given educational situation, the truth may be that in such a situation they dislike the lack of guidance.

Question 3: With a median score of 3 (+/- 1.1), the majority of respondents neither agree nor disagree with the statement "Salary is a better indicator of personal success than social standing".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	3.167	1.169	3.5	Neither
China (CHN)	3.714	0.488	4	Disagree
France (FRA)	3.667	0.816	3.5	Disagree
Germany (DEU)	3.667	1.211	3.5	Disagree
Greece (GRC)	3.833	0.983	3.5	Disagree
India (IND)	3.083	1.084	3	Neither
Ireland (IRL)	3.087	1.164	3	Neither
Netherlands (NLD)	3.833	0.753	4	Disagree
Romania (ROU)	4	1.225	4	Disagree
Saudi Arabia (SAU)	2.973	0.986	3	Neither
United Kingdom (GBR)	3.724	1.066	4	Disagree

Table 3.16: median scores and interpretation for Q3

This was a surprising response, as it was thought that students from a more materialistic society (such as the UK) would agree with this statement. However, although the overall median score for this question is 3, many of the countries investigated disagree with this statement (*Table 3.16*). The underlying cause for this result remains unknown, but it may be related to a combination of the perception of self-esteem of the subjects, feeling they need to aim at social standing materialistic considerations. Especially in the area of higher education and academia, often a sense of pride is taken from a perceived higher elevation of the educational status. Academia in particular offers jobs of notoriously low salary but of high social status (e.g., in the UK, an academic is one of the few professions accepted to countersign legal documents such as applications for a first passport).

Question 4: With a median score of 2 (+/- 0.9), it seems that the majority of respondents agree with the statement "In achieving my educational goals I would rather be presented with a series of 'bite-size' tasks, which will allow me rapid mastery of a subject".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	2.167	0.408	2	Agree
China (CHN)	2.714	0.951	2	Agree
France (FRA)	2.333	1.033	2	Agree
Germany (DEU)	2.5	1.378	2	Agree
Greece (GRC)	2	0	2	Agree
India (IND)	2.5	0.798	2	Agree
Ireland (IRL)	2.174	0.778	2	Agree
Netherlands (NLD)	2.833	0.753	3	Neither
Romania (ROU)	2.2	0.447	2	Agree
Saudi Arabia (SAU)	2.081	0.862	2	Agree
United Kingdom (GBR)	2.621	1.015	2	Agree

Table 3.17: median scores and interpretation for Q4

Q4 was meant to examine the MAS index of a learner, in that those from a high MAS background should prefer quick results from limited tasks and conversely those from a low MAS culture should prefer results from less defined tasks. This question however has not elucidated any such distinction between the CAE respondents. This may either be due to the fact that:

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a) the reasoning behind the MAS index does not hold true for education; or

b) this particular question is not couched in such a way as to gather the required information.

Considering that the other questions used to examine the MAS index have shown differences between countries it is likely that explanation (b) above is the true one. This means that in later versions of the CAE questionnaire, this question needs further work to be effective.

Question 6: With a median score of 4 (+/- 1.1), it seems that the majority of respondents disagree with the statement "When exploring a topic, I prefer a teacher to direct and limit my discoveries".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	2.833	1.329	3	Neither
China (CHN)	3.571	0.787	4	Disagree
France (FRA)	3.333	1.033	4	Disagree
Germany (DEU)	2.5	1.049	2.5	Agree
Greece (GRC)	3.833	0.753	4	Disagree
India (IND)	3.333	1.073	4	Disagree
Ireland (IRL)	3.261	0.864	4	Disagree
Netherlands (NLD)	3.5	1.225	4	Disagree
Romania (ROU)	2.8	1.643	2	Agree
Saudi Arabia (SAU)	2.784	1.134	2	Agree
United Kingdom (GBR)	3.704	0.775	4	Disagree

Table 3.18: median scores and interpretation for Q6

Question 6 was designed to examine the MAS index in education. Here, the high MAS countries should prefer to respect the traditional distinctions of being led/limited by a teacher, whilst low MAS countries are happy to ignore such distinctions when required.

Although there is no significant difference between the countries responses, *Table 3.18* above does give some indication that perhaps such a distinction may exist. Both Germany and Saudi Arabia are high MAS countries (although Romania also 'agree's with this question, they are a low to middling MAS culture) and they both tend to 'agree' with the Q6 statement. Of course this is not enough evidence to draw any firm conclusions, but it does indicate that with more data gathered that such a distinction may be found.

Question 8: With a median score of 4 (+/- 1.0), it seems that the majority of respondents disagree with the statement "In gaining the respect and attention of my peers I prefer non-competitive activities (such as painting or writing poetry) rather than competitions and games".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	3.667	0.816	3.5	Disagree
China (CHN)	2.857	1.464	4	Disagree
France (FRA)	2.5	1.049	2.5	Agree
Germany (DEU)	3.667	1.033	4	Disagree
Greece (GRC)	4.167	0.408	4	Disagree
India (IND)	3.5	0.674	4	Disagree
Ireland (IRL)	3.304	1.02	4	Disagree
Netherlands (NLD)	3.667	1.033	4	Disagree
Romania (ROU)	3.2	0.837	3	Neither
Saudi Arabia (SAU)	3.459	0.96	4	Disagree
United Kingdom (GBR)	3.379	1.083	4	Disagree

Table 3.19: median scores and interpretation for Q8

High MAS cultures should prefer gaining attention through more traditional competitions and activities. It was expected that low MAS cultures (such as the Netherlands and France) should agree with this statement. Indeed, in the case of France this is what has been found (also Romania is a low MAs culture and does not 'disagree' with the statement), but not at a statistically significant level. More information needs to be gathered before any further conclusions can be drawn from the responses to this question.

Question 9: With a median score of 3 (+/- 0.9), the majority of respondents neither agree nor disagree with the statement "I prefer to study with a teacher rather than with my peers".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	3	1.265	3.5	Neither
China (CHN)	3.571	0.787	4	Disagree
France (FRA)	3.333	0.516	3	Neither
Germany (DEU)	3.833	0.408	4	Disagree
Greece (GRC)	3.5	1.049	3.5	Neither
India (IND)	2.75	0.866	2.5	Neither
Ireland (IRL)	3.261	0.864	3	Neither
Netherlands (NLD)	3.667	0.516	4	Disagree
Romania (ROU)	3.2	1.304	4	Disagree
Saudi Arabia (SAU)	2.865	1.159	3	Neither
United Kingdom (GBR)	3.103	0.724	3	Neither

Table 3.20: median scores and interpretation for Q9

This is another question designed to examine the influence the PDI may have in various cultures and education. High PDI countries should prefer to be taught by teachers rather than their peers – hence countries like Saudi Arabia, Romania, China and India, were expected to agree with this statement. This is obviously not the case here, which may be due to a lack of sufficient data to tease out these attitudes in the cultures examined, or it may show a tendency overall in education to work both with teachers and with peers. Looking at the educational system, this is not that surprising, as both types of work are routinely asked from students in higher education.

Question 16: With a median score of 2 (+/- 0.9), it seems that the majority of respondents agree with the statement "I prefer to be patient and respectful of others when engaging in discussion, rather than being forward with my own point of view".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	2.667	1.033	2	Agree
China (CHN)	2.429	1.134	2	Agree
France (FRA)	1.667	0.516	2	Agree
Germany (DEU)	2	0.632	2	Agree
Greece (GRC)	2	0	2	Agree
India (IND)	2.167	1.267	2	Agree
Ireland (IRL)	2.435	0.896	2	Agree
Netherlands (NLD)	2	1.095	2	Agree
Romania (ROU)	2.2	1.095	2	Agree
Saudi Arabia (SAU)	2.297	0.996	2	Agree
United Kingdom (GBR)	2.536	0.693	2	Agree

Table 3.21: median scores and interpretation for Q16

As an examination of IDV index attitudes, Q16 has failed to highlight any differences between cultures. High IDV cultures should contain individuals that prefer to state their own point of view rather than listen to others. This question almost certainly needs to be redesigned – as at the moment the respondents are possibly focusing on their polite attitudes in answering, rather than their attitudes to an open discussion between their peers.

Question 17: With a median score of 2 (+/- 0.9), it seems that the majority of respondents agree with the statement "When it comes to completing my educational goals, I prefer to work slowly and patiently, to achieve a better understanding".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	3	1.095	3	Neither
China (CHN)	1.857	0.378	2	Agree
France (FRA)	2	0.632	2	Agree
Germany (DEU)	2.667	0.816	2.5	Neither
Greece (GRC)	2.667	1.211	2.5	Neither

India (IND)	2.25	1.138	2	Agree
Ireland (IRL)	2.522	0.846	2	Agree
Netherlands (NLD)	2.167	1.169	2	Agree
Romania (ROU)	2	1.225	2	Agree
Saudi Arabia (SAU)	2.324	1.029	2	Agree
United Kingdom (GBR)	2.393	0.786	2	Agree

Table 3.22: median scores and interpretation for Q17

This question was designed to examine the LTO index, and to see if cultures preferred to have rapid gains when learning (at the expense of understanding), as would be expected for low LTO cultures. There seems to be little to be drawn from the answers to this question, other than possibly that Austrian learners may have a high LTO (Hofstede does not examine Austria for their LTO attitudes, so there is no data to confirm or deny this)

Question 18: With a median score of 2 (+/- 1.0), it seems that the majority of respondents agree with the statement "My motivation is based around personal goals and not those of my group of peers".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	1.667	1.033	1	Agree
China (CHN)	2.714	1.113	3	Neither
France (FRA)	2.667	1.033	3	Neither
Germany (DEU)	2.333	1.506	2	Agree
Greece (GRC)	2.5	1.049	2.5	Agree
India (IND)	2.083	1.24	2	Agree
Ireland (IRL)	2.043	0.928	2	Agree
Netherlands (NLD)	1.333	0.516	1	Strongly Agree
Romania (ROU)	2	0	2	Agree
Saudi Arabia (SAU)	1.676	0.915	1	Agree
United Kingdom (GBR)	1.857	0.756	2	Agree

Table 3.23: median scores and interpretation for Q18

The IDV index that this question examines would suggest that low IDV cultures should disagree with this statement whilst high IDV ones should generally agree. However, in the case of Q18, the majority of countries examined agree with this statement – thus such no conclusions concerning IDV can be drawn from the responses to this question. Clearly, the strong independent attitude of the Dutch respondents is highlighted, and countries like China, from where one would expect a more collaborative attitude, seem more balanced in their response, as somewhat expected. The more cooperative attitude of French students, as opposed to the rest of the European students, is somewhat surprising. Thus, this is another question that may well need to be amended to target more discerning responses, as well as further data.

Question 23: With a median score of 3 (+/- 1.0), it seems that the majority of respondents neither agree nor disagree with the statement "I often feel constrained by the pace of my teaching".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	3.333	1.033	3	Neither
China (CHN)	3.143	0.69	3	Neither
France (FRA)	2.8	0.837	3	Neither
Germany (DEU)	3.167	1.169	3	Neither
Greece (GRC)	2.833	1.169	3	Neither
India (IND)	2.75	0.754	3	Neither
Ireland (IRL)	3	0.798	3	Neither
Netherlands (NLD)	2.667	1.366	3	Neither
Romania (ROU)	2.568	0.929	3	Neither
Saudi Arabia (SAU)	2.4	1.14	2	Agree
United Kingdom (GBR)	3.333	1.033	3	Neither

Table 3.24: median scores and interpretation for Q23

The expectation was that most students would be happy with the pace of their own teaching, as it is the manner in which they have been brought up. Oddly, the respondents had no strong feelings when answering this question at all. The only exception is Saudi Arabia, where the students often do feel constrained by the pace of the education received. From the way the question was set, this would imply that Saudi students feel that their educational process is too slow and limiting. However, a more in-depth analysis of the Saudi-Arabian curriculum, as well as the students' perceptions, would be necessary to establish why this is the case.

Question 24: With a median score of 2 (+/- 0.6), it seems that the majority of respondents agree with the statement "Different perspectives are important to me in my education".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	1.333	0.516	1	Strongly Agree
China (CHN)	1.429	0.535	1	Strongly Agree
France (FRA)	1.667	0.516	2	Agree
Germany (DEU)	1.5	0.548	1.5	Strongly Agree
Greece (GRC)	1.793	0.559	2	Agree
India (IND)	1.667	0.816	1.5	Agree
Ireland (IRL)	1.417	0.515	1	Strongly Agree
Netherlands (NLD)	1.739	0.541	2	Agree
Romania (ROU)	1.757	0.796	2	Agree
Saudi Arabia (SAU)	1.667	0.516	2	Agree
United Kingdom (GBR)	1.8	0.447	2	Agree

Table 3.25: median scores and interpretation for Q24

This question has the smallest small Standard Deviation (StDev) of all the question responses, which implies that students not only 'agree' with this statement, but that there are fewer than normal dissidents from this common norm.

All cultures therefore emphatically agree with this statement, different perspectives *are* important, be they from another culture of not.

Question 25: With a median score of 2 (+/- 0.7), it seems that the majority of respondents agree with the statement "I enjoy experiencing other cultures".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	1.833	0.408	2	Agree
China (CHN)	1.429	0.535	1	Strongly Agree
France (FRA)	1.5	0.837	1	Strongly Agree
Germany (DEU)	1.5	0.548	1.5	Strongly Agree
Greece (GRC)	1.833	0.577	2	Agree
India (IND)	1.696	0.822	2	Agree
Ireland (IRL)	1.667	0.516	2	Agree
Netherlands (NLD)	1.811	0.811	2	Agree
Romania (ROU)	1.69	0.541	2	Agree
Saudi Arabia (SAU)	1.2	0.447	1	Strongly Agree
United Kingdom (GBR)	1.833	0.408	2	Agree

Table 3.26: median scores and interpretation for Q25

Again the small StDev (0.68) and a mean of 1.7, suggests that the majority of students agree with this statement, with fewer dissenters than average.

Taken along with Q24, this shows that for most students examined differing cultural perspectives would be welcomed by learners in an educational environment.

Question 26: With a median score of 2 (+/- 0.8), the majority of respondents agree with the statement "I think the idea of an Adaptive Education System is a good one".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	2.167	0.753	2	Agree
China (CHN)	1.857	0.69	2	Agree

France (FRA)	2.667	1.033	2	Agree
Germany (DEU)	2.333	1.366	2	Agree
Greece (GRC)	2.167	1.472	2	Agree
India (IND)	2.083	0.669	2	Agree
Ireland (IRL)	1.826	0.576	2	Agree
Netherlands (NLD)	2.667	1.033	2	Agree
Romania (ROU)	1.6	0.548	2	Agree
Saudi Arabia (SAU)	1.865	0.631	2	Agree
United Kingdom (GBR)	2.107	0.786	2	Agree

Table 3.27: median scores and interpretation for Q26

The standard attitude by AEH researchers is that a personalised education is not only pedagogically sound, but that it would also be desired by the learners themselves. This has not often been tested beyond positive feedback for specific system user trials. Here however the majority of students from the countries examined do believe that AEH is a good idea.

Question 27: With a median score of 3 (+/- 1.1), the majority of respondents neither agree nor disagree with the statement "I do **not** have concerns about the *type* of the personal data that is gathered".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	3.333	1.506	4	Disagree
China (CHN)	2.857	1.345	3	Neither
France (FRA)	3.333	1.033	4	Disagree
Germany (DEU)	3.5	1.378	3.5	Neither
Greece (GRC)	3.167	1.472	3.5	Neither
India (IND)	3.083	0.9	3	Neither
Ireland (IRL)	2.826	1.029	3	Neither
Netherlands (NLD)	3.5	0.837	4	Disagree
Romania (ROU)	3.6	1.14	4	Disagree
Saudi Arabia (SAU)	3.135	1.032	3	Neither
United Kingdom (GBR)	3.414	1.211	4	Disagree

Table 3.28: median scores and interpretation for Q27

This is interesting, as it seems that students care less concerning the type of data gathered for an AEH system than they do about the security of that data (see Q28). Although there are signs that for at least 5 countries (Austria, France, Netherlands, Romania and the UK) the data type gathered itself may be an issue (they do have concerns over the type of data collected) there are currently no statistically significant results for this question.

Question 28: With a median score of 2 (+/- 0.9), it seems that the majority of respondents agree with the statement "*Security* of my personal data is of utmost importance".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	1.167	0.408	1	Strongly Agree
China (CHN)	1.333	0.516	1	Strongly Agree
France (FRA)	2.143	1.069	2	Agree
Germany (DEU)	1.667	0.816	1.5	Agree
Greece (GRC)	1.333	0.516	1	Strongly Agree
India (IND)	1.833	0.937	2	Agree
Ireland (IRL)	1.783	1.126	1	Strongly Agree
Netherlands (NLD)	1.833	0.753	2	Agree
Romania (ROU)	1.4	0.548	1	Strongly Agree
Saudi Arabia (SAU)	1.73	0.769	2	Agree
United Kingdom (GBR)	1.931	0.998	2	Agree

Table 3.29: median scores and interpretation for Q28

Unsurprisingly, the majority of students attach a great deal of importance to the security of their data, and possibly as a consequence do not seem to care about the type of data (as long as it is secure)(Q27). An interesting aside is that the range for this question is 4. Considering the strong feelings that this question is bound to raise, it is surprising that there are still students that do not care about the security of their data.

Question 29: With a median score of 3 (+/- 1.0), the majority of respondents neither agree nor disagree with the statement "I would rather that the lesson the teacher has written is not altered in any way".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	3	0.894	3	Neither
China (CHN)	3.571	0.787	4	Disagree
France (FRA)	2.6	1.14	3	Neither
Germany (DEU)	3.333	1.211	3.5	Neither
Greece (GRC)	2.8	1.304	3	Neither
India (IND)	2.917	0.9	3	Neither
Ireland (IRL)	2.957	1.107	3	Neither
Netherlands (NLD)	3.667	0.816	4	Disagree
Romania (ROU)	3.4	0.894	4	Disagree
Saudi Arabia (SAU)	2.838	1.014	3	Neither
United Kingdom (GBR)	3.276	0.702	3	Neither

Table 3.30: median scores and interpretation for Q29

Considering that most students have not experienced an AEH system the response for this question is not too surprising. As has been seen from Q26, learners think that the idea of a personalised education is a good one, but their experience has been with non-adaptive lessons fixed by teachers. This leads to an uncertain response for this statement – they neither agree nor disagree that a lesson *should* be altered. Some countries (China, Netherlands and Romania) however do tend to disagree with the statement, indicating that they would rather a lesson *was* altered for their convenience; therefore they would seem to be accepting of AEH lessons. Especially the response of China is somewhat surprising, as it moves away from a strongly hierarchical perception.

Question 30: With a median score of 2 (+/- 0.7), the majority of respondents agree with the statement "I would like to have control over the level of alteration that the Adaptive Education System makes".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	1.667	0.516	2	Agree
China (CHN)	2.286	0.756	2	Agree
France (FRA)	2	0.632	2	Agree
Germany (DEU)	1.667	0.516	2	Agree
Greece (GRC)	2	0.632	2	Agree
India (IND)	2.417	0.793	2	Agree
Ireland (IRL)	1.957	0.767	2	Agree
Netherlands (NLD)	1.833	0.753	2	Agree
Romania (ROU)	2.4	0.894	2	Agree
Saudi Arabia (SAU)	2.108	0.774	2	Agree
United Kingdom (GBR)	2.241	0.739	2	Agree

Table 3.31: median scores and interpretation for Q30

This result certainly bears out previous work that, whilst students agree to receiving personalised lessons, they still want to control the level of adaptation that takes place.

Question 31: With a median score of 2 (+/- 0.9), the majority of respondents agree with the statement "I would be very happy to receive a 'personal' education but only one approved by the teacher".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	2.667	0.816	2.5	Neither
China (CHN)	2.286	1.113	2	Agree
France (FRA)	2.167	0.983	2.5	Neither

Germany (DEU)	2.5	1.049	2.5	Agree
Greece (GRC)	2.333	1.506	2	Agree
India (IND)	2.667	0.888	3	Neither
Ireland (IRL)	2.217	0.902	2	Agree
Netherlands (NLD)	2.167	0.408	2	Agree
Romania (ROU)	2.6	0.894	2	Agree
Saudi Arabia (SAU)	2.541	1.016	2	Agree
United Kingdom (GBR)	2.655	0.769	2	Agree

Table 3.32: median scores and interpretation for Q31

Generally, all learners agree with this statement. previous questions show that, as long as certain considerations (such as data security) are taken into account, the respondents are happy to use an AEH – this question adds 'teacher approved' to that list of considerations.

Question 32: With a median score of 2 (+/- 0.9), the majority of respondents agree with the statement "I would prefer a personalised education even if it differs from that received by my peers".

Country	Mean	StDev	Median	Interpretation
Austria (AUT)	2.5	0.837	2	Agree
China (CHN)	1.857	1.069	2	Agree
France (FRA)	3	1	3	Neither
Germany (DEU)	3	1.095	3	Neither
Greece (GRC)	2.667	1.506	2	Agree
India (IND)	2.909	0.701	3	Neither
Ireland (IRL)	2.522	0.898	2	Agree
Netherlands (NLD)	2.5	0.837	2	Agree
Romania (ROU)	3	1	3	Neither
Saudi Arabia (SAU)	2.351	0.889	2	Agree
United Kingdom (GBR)	2.643	0.826	2.5	Neither

Table 3.33: median scores and interpretation for Q32

Both Q31 and Q32 support the introduction of AEH systems into educational settings, given the reservations expressed in the previous questions. As the response to these questions is not statistically significant, it shows that perhaps the learners of some countries are more reticent in their approval of this statement and may well need more support if an AEH system is introduced.

3.6.2   RESULTS: STATISTICAL DIFFERENCE BETWEEN COUNTRIES (P<=0.05)

The Kruskal-Wallis (K-W) one-way analysis of variance test determined if there was a significant difference (p<=0.05) between the responses from each country for each question. As mentioned earlier, questions 5, 7, 10, 11, 12, 13, 14, 15, 19, 20, 21 and 22 all indicated such a significant difference. To further examine these questions, two forms of post-hoc evaluation were performed: a series of non-parametric 'pairwise' (Mann–Whitney U) tests as well as a determination of homogenous subsets as identified using a 'stepwise stepdown' multiple comparison.

It is important to remember when analysing the responses to these questionnaires that a common statistical flaw in many experiments is to test multiple null hypotheses that originate from the results of a single experiment without correcting for the inflated risk of type 1 error (false positives) that results from this. Multiple comparison procedures (MCP) are designed to minimize this risk. The two types of test ('pairwise' and a homogenous subset analysis using a 'stepwise step down' comparison) used in this post-hoc analysis have a Bonferroni correction [Essex, 2011] applied to them to reduce Type I errors. However, it is worth noting that one of the criticisms [Critic, 2011] of the Bonferroni method is that it reduces Type I errors at the expense of increasing Type II errors (false negatives).

The following descriptions provide the results of these analyses. This includes both the unadjusted as well as the adjusted significance (adjusted = Bonferroni corrected). Obviously, a greater weight can be given to the adjusted significance results, but the non-adjusted can also be used in an attempt to determine further, less weighty, conclusions.

Each question discussed below contains tables showing the distribution of data by country and the interpretation of that data. Also the associated figures show the results of the MCP tests. The first figure shows the statistically significant differences (p<0.05, non-significant differences are not shown) for both adjusted and non-adjusted pairwise comparisons., and the second figure shows the homogenous subsets – each subset is significantly different (p<0.05) from the other (each subset column also gives the test results for comparisons within the subgroup).

Whilst always bearing in mind that the small sample size of each country's CAE respondents means that these can only be tentative conclusions, the purpose of applying these multiple tests is to give as much strength to the conclusions drawn from this analysis as possible.

3.6.2.1 QUESTION 5: "TEACHERS / TRAINERS SHOULD ACT AS FRIENDS NOT GURUS"

This question was designed to examine the PDI of each country and to see if the responses given by the students matched the results expected if Hofstede's indices map to educational responses. This is due to the fact that such a high PDI country (see *Table 3.11* above) should disagree with this statement, whilst low PDI countries tend to agree.

Country	Mean	StDev	Median	Interpretation	PDI
Austria (AUT)	2.5	1.049	2.5	Agree	11
China (CHN)	1.714	0.488	2	Agree	80
France (FRA)	3	1.265	2.5	Neither	68
Germany (DEU)	2.167	0.408	2	Agree	35
Greece (GRC)	2	0.894	2	Agree	60
India (IND)	1.917	0.669	2	Agree	77
Ireland (IRL)	2.435	0.843	2	Agree	28
Netherlands (NLD)	2.167	0.983	2	Agree	35
Romania (ROU)	1.838	0.928	2	Agree	82
Saudi Arabia (SAU)	1.2	0.447	1	Strongly Agree	80
United Kingdom (GBR)	2.929	0.858	3	Neither	35

Table 3.34: the median scores and interpretation for Q5

Question 5 investigates the Power Distance Index of Hofstede's dimensions. As can be seen from the above *Table 3.34*, there is a general agreement that "teachers should act as friends not gurus", with students from Saudi Arabia being particularly strident in this position. This is a strange result and the analysis (discussed below) highlights this. To summarize, the grouping of countries that all agree with this statement are generally the high PDI countries that would be expected to disagree (with the minor exception of France). This complete reversal of expected results would imply that whilst the expected PDI grouping does occur, they understand that the teacher as a 'friend' is a desired target, and not reflecting the current reality. It is, however, also possible that the meaning of 'guru' is not a common one across cultures and as such the respondents went with what they knew (friend).

Q5	Austria	China	France	Germany	Greece	India	Ireland	Netherlands	Romania	Saudi Arabia	UK
Austria											
China											
France		Sig									
Germany											
Greece											
India											
Ireland											
Netherlands											
Romania			Sig				Sig				
Saudi Arabia	Sig		Sig				Sig				
UK		Sig			Sig	Sig			Adj Sig	Adj Sig	

Mann-Whitney U Comparison — PDI

Table 3.35: significant differences between countries for Q5, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

From *Table 3.35* there are several significant differences between the subsets described below, but the most important two are those highlighted as still being significant even after adjustment, that the UK (subset 3 below) is significantly different from Romania and Saudi Arabia subset (subset 1 below).

Homogeneous Subsets based on Q5

		Subset		
		1	2	3
Sample[1]	SAU	26.000		
	CHN	50.429	50.429	
	ROU	54.027	54.027	
	IND	59.792	59.792	
	GRC	63.500	63.500	63.500
	NLD	67.583	67.583	67.583
	DEU	71.667	71.667	71.667
	IRL		80.870	80.870
	AUT		82.917	82.917
	FRA		96.167	96.167
	GBR			100.089
Test Statistic		7.302	14.726	10.688
Sig. (2-sided test)		.294	.065	.099
Adjusted Sig. (2-sided test)		.421	.078	.150

Homogeneous subsets are based on asymptotic significances.
The significance level is .05.

[1]Each cell shows the sample average rank of Q5.

Table 3.36: results of the homogenous subset comparison analysis for Q5 (p<0.05)

As can be seen from *Table 3.35* above, the statistically significant groupings occur between those countries that tend to be within the 'Strongly Agree' to 'Agree' responses (Subset 1: China, India, Romania and Saudi Arabia) and those that are more ambivalent in their agreement (Subset 3: Austria, France, Ireland and the UK)(Note: Germany, Greece and the Netherlands have all been omitted due to overlap between the two subsets). According to Hofstede: China, Greece, India, Romania, Saudi Arabia and France all have high PDI scores, and Austria, Germany, Netherlands, Ireland and the UK all have low scores.

The CAE findings however seem to reverse this situation with China, Greece, India, Romania and Saudi Arabia all agreeing to the statement, indicating that they are all *low* PDI countries rather than high. The expected low PDI countries of Austria and the UK are statistically different in the nature of their response from China *et al*, indicating that they neither agree nor disagree.

In Subset 2, the countries tend to 'Agree' (tending towards 'Neither', but not as strongly as in Subset 3) with the statement, the central three countries, Greece, Netherlands, and Germany are present in all three subsets and so little can be said about these (in *Table 3.35* the only significant difference is between Greece and the UK).

Table 3.34 shows that French learners are ambivalent to the statement; despite France's high PDI score (68). This is the only country other than the UK (which has a low PDI score) that is not in agreement with the statement.

This makes the correct interpretation of these results very difficult. The best tentative conclusion from this result is that, for this question, countries in subsets 1 & 2 should be considered to have a low PDI score, whilst countries in subset 3 should tend to be considered with a middling to high PDI score. However it certainly seems that across most of the countries analysed that the majority of them do *not* act as would be expected from their PDI score. Another possible explanation could also

'simply' be the critical attitude of students in higher education, who may not agree with the way their education is being performed. Thus, students in countries where teachers act overly friendly may feel that a little more restraint is necessary, whilst students where teachers take a guru-like position would wish for their education to be performed in a friendlier and open manner.

3.6.2.2   QUESTION 7: "WHEN GIVEN EDUCATIONAL INFORMATION I PREFER IT TO BE PRESENTED IN A TIGHTLY STRUCTURED AND REGULATED MANNER"

This question was designed to examine the PDI of each country and to see if the responses given by the students matched the results expected, thus if Hofstede's indices map to educational responses. As such, a high PDI country (see *Table 3.11* above) should agree with this statement, whilst low PDI countries are expected to disagree.

Table 3.37 shows that the majority of respondents 'Agree' with the statement, thus showing a high PDI score. As can be seen from the table, to only two countries who do not agree with the statement, (the Netherlands and the UK) both have low PDI scores.

Country	Mean	StDev	Median	Interpretation	PDI
Austria (AUT)	2.167	1.472	1.5	Agree	11
China (CHN)	2.571	0.976	2	Agree	80
France (FRA)	1.667	0.516	2	Agree	68
Germany (DEU)	1.667	0.516	2	Agree	35
Greece (GRC)	2	1.095	2	Agree	60
India (IND)	2.417	1.24	2	Agree	77
Ireland (IRL)	2.304	1.146	2	Agree	28
Netherlands (NLD)	2.833	1.169	2.5	Neither	35
Romania (ROU)	1.811	0.967	2	Agree	82
Saudi Arabia (SAU)	2.2	1.643	2	Agree	80
United Kingdom (GBR)	2.69	0.806	3	Neither	35

Table 3.37: median scores and interpretation for Q7

Table 3.38: significant differences between countries for Q7, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

Table 3.38 and *Table 3.39* both bear out this difference, with the only adjusted significance between Romania (high PDI) and the UK (low PDI), but with unadjusted significant results between the Netherlands and Romania (low vs. high), as well as the UK and both France (high PDI) and Germany (low PDI). This last result is not expected and is substantiated with the description of the subsets in *Table 3.39*.

Generally, the respondents agree with this statement, and in the cases of the significant results they also match their PDI score expectations.

Homogeneous Subsets based on Q7

		Subset 1	Subset 2
Sample[1]	DEU	52.833	
	FRA	52.833	
	ROU	55.297	
	GRC	62.917	62.917
	SAU	64.000	64.000
	AUT	64.667	64.667
	IRL	74.478	74.478
	IND	77.167	77.167
	CHN	86.786	86.786
	GBR		93.569
	NLD		95.083
Test Statistic		7.470	6.218
Sig. (2-sided test)		.487	.515
Adjusted Sig. (2-sided test)		.558	.630

Homogeneous subsets are based on asymptotic significances. The significance level is .05.

Table 3.39: results of the homogenous subset comparison analysis for Q7 (p<0.05)

This indicates that for most countries, when it comes to teaching, they prefer a structured rather than a more *laissez faire* attitude. The two countries that come close to disagreeing with this statement (the Netherlands and the UK) are both low PDI countries for which this would be expected.

3.6.2.3 QUESTION 10: "THERE SHOULD BE AS MUCH STRUCTURE AND DIRECTIONS IN A LESSON AS POSSIBLE TO ENSURE THAT THERE IS NO AMBIGUITY"

This question was designed to examine the UAI of each country and to see if the responses given by the students matched the results expected if Hofstede's indices map to educational responses. As such, a high UAI country (see *Table 3.11* above) should agree with this statement, whilst low UAI countries tend to disagree.

Country	Mean	StDev	Median	Interpretation	UAI
Austria (AUT)	2.667	1.211	2.5	Neither	70
China (CHN)	2	0	2	Agree	30
France (FRA)	3.167	0.983	3.5	Neither	86
Germany (DEU)	1.833	0.753	2	Agree	65
Greece (GRC)	1.667	0.816	1.5	Agree	112
India (IND)	2.333	1.073	2	Agree	40
Ireland (IRL)	2.13	1.058	2	Agree	35
Netherlands (NLD)	3.333	1.033	4	Disagree	53
Romania (ROU)	1.4865	0.5588	1	Strongly Agree	69
Saudi Arabia (SAU)	1.4	0.548	1	Strongly Agree	68
United Kingdom (GBR)	2.724	0.882	3	Neither	35

Table 3.40: the median scores and interpretation for Q10

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Once again the CAE results do not bear out the results expected from the UAI rating. Greece has the highest UAI rating (112) and as expected their responses do agree with the statement, on the other hand the next highest UAI scorer is France (86) and they neither agree nor disagree, as would be expected from a low UAI culture.

Only five of the countries examined match the result expected if Hofstede's indices map onto the CAE results (Germany, Greece, Romania, Saudi Arabia and the UK), whilst the remaining six countries do not.

Q10	Austria	China	France	Germany	Greece	India	Ireland	Netherlands	Romania	Saudi Arabia	UK
Mann-Whitney U Comparison											
Austria											
China											
France											
Germany			Sig								UAI
Greece			Sig								
India											
Ireland			Sig								
Netherlands				Sig	Sig		Sig				
Romania	Sig		Adj Sig			Sig	Sig	Adj Sig			
Saudi Arabia	Sig		Sig					Sig			
UK				Sig	Sig		Sig		Adj Sig	Sig	

Table 3.41: significant differences between countries for Q10, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

As can be seen from *Table 3.41* there are three adjusted significant differences, all between Romania (High UAI) and France (high UAI), Netherlands (High UAI and the UK (Low UAI). Other than the UK result, this is not the expected one. Considering the Romanian score is a particularly high one, with a mean of 1.4 and a very small Standard Deviation (0.56) (which is to be expected) it would seem to indicate that in this case the UAI score for France and the Netherlands should be adjusted to be Low.

Homogeneous Subsets based on Q10

Sample[1]	Subset 1	Subset 2	Subset 3	Subset 4
SAU	40.700			
ROU	44.973			
GRC	52.917	52.917		
DEU	61.750	61.750	61.750	
IRL	70.522	70.522	70.522	
CHN	72.500	72.500	72.500	72.500
IND		78.542	78.542	78.542
AUT		90.417	90.417	90.417
GBR			96.483	96.483
FRA				109.167
NLD				112.167
Test Statistic	11.037	3.976	10.274	9.496
Sig. (2-sided test)	.051	.553	.068	.091
Adjusted Sig. (2-sided test)	.091	.771	.121	.160

Homogeneous subsets are based on asymptotic significances. The significance level is .05.

Table 3.42: results of the homogenous subset comparison analysis for Q10 (p<0.05)

Table 3.42 would seem to bear out this conclusion, with both Saudi and Romanian students (both High UAI) being in Subset 1, whilst Austria, France, India, the Netherlands, and the UK are all indicated to be Low UAI (Subset 4, with no overlapping countries). In this case the findings that France and the

Netherlands should be marked as Low UAI countries is backed up, with the addition of Austria (another High UAI) to this group – both India and the UK are originally low UAI cultures and would be expected to be here.

Considering the large number of overlapping subsets, it is dangerous to draw any more conclusions from these results, other than to say that in Subset 1, of the 5 countries that do not overlap with Subset 4, 4 of them are placed in agreement with their Hofstede scores – Saudi Arabia, Romania, Greece and Germany are all High UAI cultures and would be expected to be in (strong) agreement with the statement.

3.6.2.4 QUESTION 11: "I PREFER TO REDUCE COMPLEXITY BY USING SMALLER, LIMITED AMOUNTS OF INFORMATION"

This question was also designed to examine the UAI of each country and to see if the responses given by the students matched the results expected if Hofstede's indices map to educational responses. As such, a high UAI country (see *Table 3.11* above) should agree with this statement, whilst low UAI countries tend to disagree.

Country	Mean	StDev	Median	Interpretation	UAI
Austria (AUT)	2.833	0.983	2.5	Neither	70
China (CHN)	2.571	1.134	2	Agree	30
France (FRA)	3.667	0.816	4	Disagree	86
Germany (DEU)	2.167	0.753	2	Agree	65
Greece (GRC)	2.167	1.329	2	Agree	112
India (IND)	3.5	0.674	4	Disagree	40
Ireland (IRL)	2.522	0.846	2	Agree	35
Netherlands (NLD)	2.167	0.408	2	Agree	53
Romania (ROU)	2.405	0.985	2	Agree	69
Saudi Arabia (SAU)	2.6	0.894	2	Agree	68
United Kingdom (GBR)	3.036	1.036	3	Neither	35

Table 3.43: the median scores and interpretation for Q11

Unlike the results for Q10 above, here many of the responses match the expectations of the country's UAI score. The dissenters are Austria, China, France and Ireland, with China and Ireland both having low UAI scores, but they both 'agree' with the statement, whilst Austria and France are either ambivalent or 'disagree' with the statement (being high UAI countries they would be expected to agree).

Table 3.44: significant differences between countries for Q11, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

The only adjusted significant result is between India (low UAI) and Romania (high UAI); due to their divergent UAI scores such a difference is expected. The two main groupings of significant results lie with India and France, which, as can be seen from *Table 3.45*, are both found in Subset 3 and are the only two countries that are not found in Subset 1.

Homogeneous Subsets based on Q11

		Subset 1	Subset 2	Subset 3
Sample[1]	NLD	51.000		
	DEU	52.250		
	GRC	52.667		
	ROU	59.527		
	IRL	65.130	65.130	
	CHN	66.714	66.714	66.714
	SAU	68.000	68.000	68.000
	AUT	76.833	76.833	76.833
	GBR	84.143	84.143	84.143
	IND		103.708	103.708
	FRA			108.083
Test Statistic		10.353	10.218	7.857
Sig. (2-sided test)		.241	.069	.164
Adjusted Sig. (2-sided test)		.286	.123	.280

Homogeneous subsets are based on asymptotic significances. The significance level is .05.

Table 3.45: results of the homogenous subset comparison analysis for Q11 (p<0.05)

As such, Subset 3 tends towards disagreeing with the statement, whilst Subset 1 tends towards agreement. Whilst many of the results match those expected from Hofstede's UAI scores, France is a distinct exception. With a high UAI of 86, it would be expected to agree or even strongly agree with this question. Obviously, in this case, French students show instead a strong preference towards greater complexity with larger amounts of information given at once.

3.6.2.5 QUESTION 12: "I THINK THAT 'UNDERSTANDING' SHOULD BE THE GOAL OF EDUCATION, NOT THE COMPLETION OF 'LEARNING TASKS' AND 'EXAMS'"

This question was designed to examine the UAI of each country and to see if the responses given by the students matched the results expected, if Hofstede's indices map to educational responses.

Country	Mean	StDev	Median	Interpretation	UAI
Austria (AUT)	1.333	0.516	1	Strongly Agree	70
China (CHN)	1.143	0.378	1	Strongly Agree	30
France (FRA)	2.333	1.366	2	Agree	86
Germany (DEU)	1.167	0.408	1	Strongly Agree	65
Greece (GRC)	1.5	0.837	1	Strongly Agree	112
India (IND)	1.417	0.669	1	Strongly Agree	40
Ireland (IRL)	1.304	0.559	1	Strongly Agree	35
Netherlands (NLD)	1.167	0.408	1	Strongly Agree	53
Romania (ROU)	1.3243	0.5299	1	Strongly Agree	69
Saudi Arabia (SAU)	1.8	0.837	2	Agree	68
United Kingdom (GBR)	1.929	0.858	2	Agree	35

Table 3.46: the median scores and interpretation for Q12

Therefore, a high UAI country (see *Table 3.11* above) should disagree with this statement, whilst low UAI countries tend to agree.

As can be seen from *Table 3.46*, this question brought about some of the most emphatic responses of the entire survey. Whilst this may not be the best approach to investigate differences between the respondents; it does show that all students thought that exams are of secondary importance to understanding a subject.

Q12	Austria	China	France	Germany	Greece	India	Ireland	Netherlands	Romania	Saudi Arabia	UK
						Mann-Whitney U Comparison					
Austria											
China											**UAI**
France		Sig									
Germany			Sig								
Greece											
India											
Ireland			Sig								
Netherlands			Sig								
Romania			Sig								
Saudi Arabia											
UK		Sig		Sig			Sig	Sig	Sig		

Table 3.47: significant differences between countries for Q12, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

There are no adjusted significant results in this question. However, this is a prime example of how the Bonferroni correction can reduce Type I errors at the risk of Type II errors – the K-W analysis indicated that there is a significant difference between the countries' responses to this question, but the subsequent post-hoc analysis has not identified any using the Bonferroni correction. In this case it is necessary to examine the uncorrected significant results, and bear in mind that this will reduce the Type II errors at the cost of increasing the Type I. The 'truth' as ever, lies somewhere in the middle.

Homogeneous Subsets based on Q12

		Subset	
		1	2
Sample[1]	CHN	54.143	
	DEU	55.667	
	NLD	55.667	
	IRL	62.783	
	ROU	64.703	
	AUT	66.333	66.333
	IND	68.417	68.417
	GRC	70.500	70.500
	SAU	88.400	88.400
	GBR		92.643
	FRA		98.333
Test Statistic		4.947	6.575
Sig. (2-sided test)		.763	.254
Adjusted Sig. (2-sided test)		.828	.416

Homogeneous subsets are based on asymptotic significances. The significance level is .05.

Table 3.48: results of the homogenous subset comparison analysis for Q12 (p<0.05)

What is obvious (from *Table 3.47* and *Table 3.48*) is that there are two statistically significant groups present, "France and the UK" (none overlapped countries in Subset 2) vs. "China, Germany, Ireland, Romania and the Netherlands". France in particular has a very large spread of data for this question

(StDev 1.4) when compared to the other countries – this may reflect the fact that it has a high UAI and therefore the respondents vary a great deal when answering this question. However, this is the only real similarity between the Hofstede's UAI scores and the CAE results. There are four countries whose CAE results matches their UAI scores (China, India, Ireland and the UK) but this may be happenstance, as all countries agreed with this statement and these countries happen to match a CAE 'agree' position.

As such, the results for this question generally do not seem to support the idea that Hofstede's indices map to the CAE results.

3.6.2.6 QUESTION 13: "I PREFER LESSONS THAT EMPHASISE PRACTICE AND PRACTICAL VALUES RATHER THAN ABSTRACT THEORIES AND 'TRUTH'"

This question was designed to examine the LTO of each country and to see if the responses given by the students matched the results expected if Hofstede's indices map to educational responses. As such, a high LTO country (see *Table 3.11* above) should agree with this statement, whilst low LTO countries tend to disagree.

Country	Mean	StDev	Median	Interpretation	LTO
Austria (AUT)	2.333	0.816	2.5	Agree	--
China (CHN)	1.714	0.951	1	Strongly Agree	118
France (FRA)	2.5	1.049	2.5	Agree	--
Germany (DEU)	2.833	0.983	2.5	Neither	31
Greece (GRC)	2.833	0.753	3	Neither	--
India (IND)	2.417	0.793	2	Agree	61
Ireland (IRL)	2.304	0.926	2	Agree	--
Netherlands (NLD)	3.667	0.816	4	Disagree	44
Romania (ROU)	1.568	0.835	1	Strongly Agree	35
Saudi Arabia (SAU)	1.4	0.894	1	Strongly Agree	--
United Kingdom (GBR)	2.714	1.182	3	Neither	25

Table 3.49: the median scores and interpretation for Q13

This question has resulted in a reasonably wide range of responses, with China, Romania and the UK all strongly agreeing with the statement that they prefer practice to abstract theories; however the Dutch students would prefer to emphasise these more abstract values.

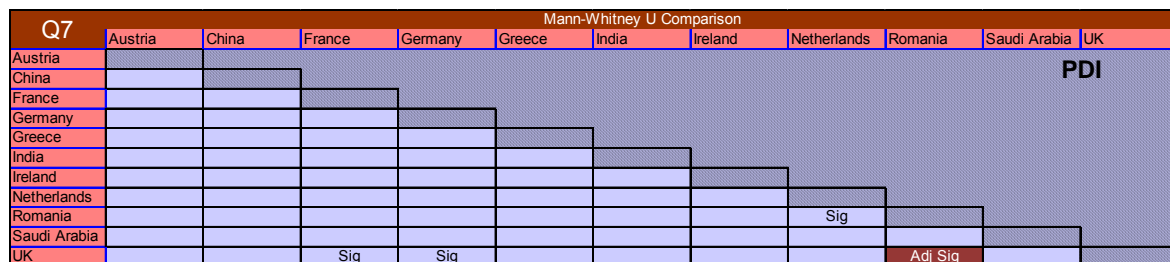| Q13	Mann-Whitney U Comparison									
	Austria	China	France	Germany	Greece	India	Ireland	Netherlands	Romania	Saudi Arabia	UK
Austria											
China											
France											
Germany											
Greece		Sig									
India											
Ireland											
Netherlands		Sig				Sig	Sig				
Romania			Sig	Sig	Sig	Sig	Sig	Adj Sig			
Saudi Arabia				Sig	Sig	Sig		Adj Sig			
UK		Sig							Adj Sig	Sig	

Table 3.50: significant differences between countries for Q13, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

As can be seen in *Table 3.50*, there are three adjusted significant difference results, between the Netherlands (low LTO) and Romania (low LTO) and Saudi Arabia (no LTO score), as well as between the UK (low LTO) and Romania (low LTO). As these countries, for which an LTO score is available, are all low LTO cultures, this difference seems like a strange result. When the significant results are considered along with *Table 3.51*, it can be seen that there are only two subsets, with Saudi, Romania and China being in the 'strongly agreeing' Subset 1 and all other countries (with a single overlap by China) in Subset 2.

As can be seen from *Table 3.49* above, the problem with comparing LTO scores with the CAE results is that not all of the countries have been given an LTO score by Hofstede. Of the six countries that have been given an LTO score, three of them match the CAE result (the Netherlands, India and China), with only Romania not matching (it would be expected to disagree with the statement). Germany and the UK neither agrees nor disagrees, but with a low LTO it would be expected to disagree.

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Homogeneous Subsets based on Q13

		Subset	
		1	**2**
Sample[1]	SAU	38.300	
	ROU	45.203	
	CHN	51.500	51.500
	IRL		74.913
	AUT		77.250
	IND		79.958
	FRA		81.750
	GBR		87.179
	DEU		93.500
	GRC		95.333
	NLD		119.667
Test Statistic		.593	14.181
Sig. (2-sided test)		.743	.077
Adjusted Sig. (2-sided test)		.993	.093

Homogeneous subsets are based on asymptotic significances. The significance level is .05.

Table 3.51: results of the homogenous subset comparison analysis for Q13 (p<0.05)

Therefore, except for Romania, this result matches what would have been expected if the LTO could be mapped onto the CAE results (ignoring both Germany and the UK as their result is inconclusive), which leads to the possibility that perhaps the remaining five country's CAE results could be used to infer the general level of their LTO scores. If this were true then the following could be said for the five countries with no official LTO score:

Austria	High LTO
France	High LTO
Greece	no data
Ireland	High LTO
Saudi Arabia	Very High LTO

These inferences could then be used with a reasonable confidence rate (the CAE results matched 3/4 LTO scores, so 75%) in Chapter 4 to determine the CAE-F instance values for these countries that require an LTO input. See Section 3.7.1.5 for more details. For the case of Romania, it is possible that Hofstede's results have been influenced by evaluating an older, pre-revolution generation, which put much more emphasis on theory, and our evaluation has highlighted the orientation of the younger generation, the students, who, with all their part-time jobs, etc., are of a much more practice-oriented mind-set. This can show cultural changes within a country in time – and a social upheaval such as a revolution might reasonably looked upon to provoking such changes. These kind of time variance is however not the focus of this thesis and thus not further explored, but would make for interesting follow-up research.

3.6.2.7 QUESTION 14: "SEPARATION OF THE GENDERS IN EDUCATION ENABLES MORE EFFECTIVE TEACHING, WITH A TEACHER BETTER ABLE TO TARGET EACH GROUP"

This question was designed to examine the MAS of each country and to see if the responses given by the students matched the results expected if Hofstede's indices map to educational responses. As such, a high MAS country (see *Table 3.11* above) should agree with this statement, whilst low MAS countries tend to disagree.

Country	Mean	StDev	Median	Interpretation	MAS
Austria (AUT)	5	0	5	Strongly Disagree	79
China (CHN)	3.857	0.9	4	Disagree	66
France (FRA)	4.5	0.837	5	Strongly Disagree	43
Germany (DEU)	4	1.265	4.5	Disagree	66
Greece (GRC)	5	0	5	Strongly Disagree	57
India (IND)	3.833	1.115	4	Disagree	56
Ireland (IRL)	3.957	1.022	4	Disagree	68
Netherlands (NLD)	4.333	0.516	4	Disagree	14
Romania (ROU)	3.919	1.01	4	Disagree	45
Saudi Arabia (SAU)	1.6	1.342	1	Strongly Agree	52
United Kingdom (GBR)	3.786	1.134	4	Disagree	66

Table 3.52: the median scores and interpretation for Q14

This question generated some of the strongest and most polarised responses of any of the questions. With Saudi Arabia learners strongly agreeing with the statement, although Saudi only has a MAS rating of 52 (so although it counts as a 'high' rating it only just ranks as this). From this response, Saudi would be expected to have a much higher MAS score.

Q14	Mann-Whitney U Comparison										
	Austria	China	France	Germany	Greece	India	Ireland	Netherlands	Romania	Saudi Arabia	UK
Austria											MAS
China	Sig										
France											
Germany											
Greece		Sig									
India	Sig				Sig						
Ireland	Sig				Sig						
Netherlands											
Romania	Sig				Sig						
Saudi Arabia	Adj Sig	Sig	Sig	Sig	Adj Sig	Sig	Sig	Sig	Sig		
UK	Sig				Sig					Sig	

Table 3.53: significant differences between countries for Q14, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

Saudi Arabia is significantly different from all of the other countries examined and with two adjusted differences with Austria and Greece. It is the only country that agrees with the statement that separation of the genders is a good idea in education. As such it is the only non-overlapping country in Subset 1 of *Table 3.54*, all other countries disagree to varying degrees, with Austria and Greece being particularly strident in their disagreement – they have a standard deviation of 0.0.

However only France, the Netherlands and Saudi Arabia's CAE results match the expect MAS score, with all the other countries examined going against this. This may well be because there are additional overtones involved in this question beyond the mere assignment of 'traditional' roles as would be expected with MAS scores – perhaps general mixed gender schools and gender equality legislation in these countries overrides these more traditional expectations.

Homogeneous Subsets based on Q14

		Subset 1	Subset 2	Subset 3
Sample[1]	SAU	15.000		
	CHN	63.286	63.286	
	GBR	65.464	65.464	
	IND	66.417	66.417	
	ROU	68.257	68.257	
	IRL	70.196	70.196	
	DEU	75.083	75.083	75.083
	NLD	80.333	80.333	80.333
	FRA	92.083	92.083	92.083
	AUT		115.000	115.000
	GRC			115.000
Test Statistic		13.582	11.632	9.047
Sig. (2-sided test)		.093	.168	.060
Adjusted Sig. (2-sided test)		.113	.202	.127

Homogeneous subsets are based on asymptotic significances.
The significance level is .05.

Table 3.54: results of the homogenous subset comparison analysis for Q14 (p<0.05)

As Q6 does seem to indicate that some distinction differences may exist (as would be expected by MAS) that this is not as cut and dried as might appear.

3.6.2.8 QUESTION 15: "I CONCENTRATE ON EACH EDUCATIONAL TASK SEPARATELY AND REQUIRE IMMEDIATE RESULTS TO GAUGE MY SUCCESS"

This question was designed to examine the LTO of each country and to see if the responses given by the students matched the results expected, if Hofstede's indices map to educational responses. As such, a high LTO country (see *Table 3.11* above) should disagree with this statement, whilst low LTO countries tend to agree.

Country	Mean	StDev	Median	Interpretation	LTO
Austria (AUT)	2.667	0.816	2.5	Neither	--
China (CHN)	3.143	0.9	3	Neither	118
France (FRA)	3.5	0.837	4	Disagree	--
Germany (DEU)	2.667	0.816	2.5	Neither	31
Greece (GRC)	3.2	0.447	3	Neither	--
India (IND)	2.417	0.9	2	Agree	61
Ireland (IRL)	2.739	0.864	2	Agree	--
Netherlands (NLD)	3.333	1.033	4	Disagree	44
Romania (ROU)	2.351	0.919	2	Agree	35
Saudi Arabia (SAU)	2.6	1.14	3	Neither	--
United Kingdom (GBR)	3.357	0.951	3	Neither	25

Table 3.55: the median scores and interpretation for Q15

This question does not have as many significantly differences as the previous LTO question Q13. However, one is able to see that, of the six countries for which the LTO data is available, three have inconclusive results (China, Germany and the UK) and will have to be ignored. Of the remaining three, only one matches the expect LTO results (Romania), both India and the Netherlands have results opposite to what was expected.

Q15	Austria	China	France	Germany	Greece	India	Ireland	Netherlands	Romania	Saudi Arabia	UK
										Mann-Whitney U Comparison	
Austria											LTO
China											
France											
Germany											
Greece											
India			Sig								
Ireland											
Netherlands											
Romania		Sig	Sig		Sig			Sig			
Saudi Arabia											
UK						Sig	Sig		Adj Sig		

Table 3.56: significant differences between countries for Q15, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

In examining *Table 3.56* one can see that Romania (low LTO) has the only adjusted significant results (against the UK, low LTO), which is a similar result to that found in Q13. In addition to this, one of the unadjusted significant results also matches one of the adjusted results in Q13, that of Romania against the Netherlands.

Homogeneous Subsets based on Q15

		Subset	
		1	2
Sample[1]	ROU	52.595	
	IND	54.833	54.833
	SAU	64.600	64.600
	AUT	65.167	65.167
	DEU	65.167	65.167
	IRL	67.652	67.652
	CHN	84.714	84.714
	GRC	89.400	89.400
	NLD	91.333	91.333
	GBR		91.571
	FRA		99.000
Test Statistic		12.350	15.288
Sig. (2-sided test)		.136	.083
Adjusted Sig. (2-sided test)		.164	.083

Homogeneous subsets are based on asymptotic significances. The significance level is .05.

Table 3.57: results of the homogenous subset comparison analysis for Q15 (p<0.05)

Table 3.57 identifies two subset groups, with Romania in Subset 1 being the only none overlapping country, indicating a clear agreement with the statement. In subset 2, both the UK and France (with the Netherlands being very closely linked, but with no significant results other than with Romania) are tending to disagree with the statement.

Once again it is possible to use this information and attempt to infer the approximate LTO value for the five countries that have no LTO scores:

Austria	no data
France	High LTO
Greece	no data
Ireland	Low LTO
Saudi Arabia	no data

These inferences could then be used with a low confidence rate (the CAE results matched 1/3 LTO scores, so 33%) in Chapter 4 to determine the CAE-F instance values for these countries that require an LTO input. See Section 3.7.1.5 for more details.

3.6.2.9 QUESTION 19: "I WOULD PREFER TO BE EDUCATED IN MY OWN LANGUAGE"

Question 19 focuses upon the issue of language and determines if there is a cultural preference that creates a barrier to learning for different countries.

In *Table 3.58* below a "CEI score" is assigned, based on the response compared with Hypothesis 2, which states that a learner desires to be taught in the manner they are used to. Hence a high CEI score indicates a lack of willingness or desire to be exposed to other cultures. In the case of this question responses that agree with the statement should be assigned a high CEI score:

Strongly Agree	100 points
Agree	75 points
Neither	50 points
Disagree	25 points
Strongly Disagree	0 points

Country	Mean	StDev	Median	Interpretation	CEI score
Austria (AUT)	2.667	0.516	3	Neither	50
China (CHN)	3.143	0.69	3	Neither	50
France (FRA)	3	0.894	3	Neither	50
Germany (DEU)	2.5	1.225	3	Neither	50
Greece (GRC)	2.833	1.329	2	Agree	75
India (IND)	2.917	1.24	3	Neither	50
Ireland (IRL)	1.391	0.499	1	Strongly Agree	100
Netherlands (NLD)	3.833	0.408	4	Disagree	25
Romania (ROU)	3.622	0.794	4	Disagree	25
Saudi Arabia (SAU)	2.8	1.304	3	Neither	50
United Kingdom (GBR)	1.552	0.736	1	Strongly Agree	100

Table 3.58: median scores and interpretation for Q19

As can be seen from *Table 3.58*, the data for the UK and Ireland tend towards strongly agreeing to the statement "I would prefer to be educated in my own language". With all other countries either being ambivalent or disagreeing with this.

Q19	Austria	China	France	Germany	Greece	India	Ireland	Netherlands	Romania	Saudi Arabia	UK
Austria											
China											
France											
Germany											
Greece											
India											
Ireland	Sig	Adj Sig	Sig	Sig	Sig	Adj Sig					
Netherlands							Adj Sig				
Romania			Sig				Adj Sig	Sig			
Saudi Arabia							Sig				
UK	Sig	Sig	Sig		Sig	Sig		Adj Sig	Adj Sig	Sig	

(Mann-Whitney U Comparison — CEI)

Table 3.59: significant differences between countries for Q19, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

Table 3.59 shows that these two countries (Ireland and the UK) countries are highly significantly different to all of the other countries in the study. This question has the greatest number of adjusted significance results of the entire survey, indicating that even with the Bonferroni correction applied, this is statistically a major issue for these two countries. The only small exception to this is that Germany is not significantly different from the UK.

At the opposite end of the spectrum, students from the Netherlands tend to disagree with the statement, with two adjusted significant results between the Netherlands and both Ireland and the UK.

Homogeneous Subsets based on Q19

Sample[1]		Subset			
		1	2	3	4
	IRL	31.804			
	GBR	37.241			
	DEU	69.250	69.250		
	AUT		74.833	74.833	
	GRC		78.500	78.500	78.500
	SAU		79.600	79.600	79.600
	IND		82.333	82.333	82.333
	FRA		86.333	86.333	86.333
	CHN		91.071	91.071	91.071
	ROU			105.919	105.919
	NLD				114.750
Test Statistic		5.218	1.629	12.280	10.536
Sig. (2-sided test)		.074	.950	.056	.104
Adjusted Sig. (2-sided test)		.245	.991	.087	.158

Homogeneous subsets are based on asymptotic significances. The significance level is .05.

Table 3.60: results of the homogenous subset comparison analysis for Q19 (p<0.05)

Hence it seems safe to conclude (even with our small sample size) that UK and Irish students do not wish to learn new languages to study abroad (in fact they are actively against this), whilst students from the Netherlands would wish to be taught in another language rather than their own (they are the only non-overlapping country in subset 4), although students from Romania are a close second in this regard. For the remaining countries, the language of choice for teaching is a more fluid choice. The Dutch situation is confirmed by the fact that in many universities in the Netherlands, Dutch students ask to be taught in English, even if the main teaching language is Dutch, and that they often write their thesis in English.

3.6.2.10 QUESTION 20: "GIVEN THE CHANCE, I WOULD PREFER TO BE EDUCATED IN ANOTHER COUNTRY"

Question 20 was designed to determine if there is a difference between cultures in their desire to be taught outside of the 'comfort zone' of their own surroundings. It should be noted that respondents to the CAE questionnaire consist of students who are already studying abroad (n=65) but are also (and always have been) studying from their home countries (n=114). An additional Kruskal-Wallis test was performed between those students that responded to the CAE questionnaire and have studied

abroad, and those students who have stayed at home, there is no statistical difference between the two groups (p=0.199), the details are shown in *Table 3.61*.

Home vs. abroad	n	Mean	StDev	Interpretation
Abroad	65	2.262	1.004	Agree
Home	114	2.456	1.040	Agree

Table 3.61: scores and interpretation for home students vs. those who have studied in more than one country, for Q20

A further study of home vs. abroad students for specific cultures will be shown in Chapter 8.

In *Table 3.62* below, a "CEI score" is assigned, established by the response of the students and the fact that a high CEI score should indicate a lack of willingness or desire to be exposed to other cultures. In the case of this question responses that disagree with the statement should be assigned a high CEI score:

Strongly Agree   0 points

Agree   25 points

Neither   50 points

Disagree   75 points

Strongly Disagree   100 points

Country	Mean	StDev	Median	Interpretation	CEI score
Austria (AUT)	2.333	0.816	2	Agree	25
China (CHN)	2.429	0.976	2	Agree	25
France (FRA)	2.333	0.816	2	Agree	25
Germany (DEU)	2.333	1.033	2	Agree	25
Greece (GRC)	2.333	1.506	2	Agree	25
India (IND)	2	0.603	2	Agree	25
Ireland (IRL)	2.783	0.902	3	Neither	50
Netherlands (NLD)	2.333	1.033	2	Agree	25
Romania (ROU)	1.919	0.924	2	Agree	25
Saudi Arabia (SAU)	2	0	2	Agree	25
United Kingdom (GBR)	3.724	0.591	4	Disagree	75

Table 3.62: median scores and interpretation for Q20

Table 3.62 shows that of the eleven countries studied, only the British are against being educated in another country to their home. The Irish are neither for nor against it, whilst all of the remaining countries agree with the statement and would prefer to be educated in another country.

Table 3.63: significant differences between countries for Q20, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

These differences are highly significant (*Table 3.63*) in the case of the UK and shows they are significantly (including three adjusted significant differences) more likely to consider language an issue when choosing a university. Indeed, the UK students are significantly different from all other countries, including the Irish. *Table 3.64* is the only homogenous subset comparison that has no overlap between the countries in any subset. In responding to this question, the UK students differ from everyone else.

Homogeneous Subsets based on Q20

		Subset	
		1	2
Sample[1]	ROU	47.541	
	SAU	51.000	
	IND	51.917	
	GRC	60.250	
	AUT	63.417	
	FRA	63.417	
	DEU	64.333	
	NLD	64.333	
	CHN	68.929	
	IRL	82.674	
	GBR		116.569
Test Statistic		16.405	.[2]
Sig. (2-sided test)		.059	.
Adjusted Sig. (2-sided test)		.059	.

Homogeneous subsets are based on asymptotic significances. The significance level is .05.

Table 3.64: results of the homogenous subset comparison analysis for Q20 (p<0.05)

At the bottom of Subset 1, the Irish are significantly different to learners from India (non-adjusted) and Romania (adjusted), backing up the results in *Table 3.62* that they are clearly neither in agreement of disagreement with this statement.

All of the remaining countries all have a median of 2 (i.e. they agree with the statement), showing that there are more open and desiring for an education in another country.

3.6.2.11 QUESTION 21: "IN CHOOSING A UNIVERSITY, THE ABILITY TO PRACTICE LANGUAGES OTHER THAN MY OWN IS IMPORTANT"

Question 19 was used to determine if language was a barrier to learning for different cultures and question 20 concerned the preference for either studying in another country to a learner's home country. Here question 21 investigates similar issues but from a more positive attitude – that of the student actively selecting to go to another culture with the intent of learning a new language (and by implication, culture).

In *Table 3.65* below a "CEI score" is assigned, based in the response based on the fact that a high CEI score should indicate a lack of willingness or desire to be exposed to other cultures. In the case of this question responses that disagree with the statement should be assigned a high CEI score:

Strongly Agree   0 points
Agree   25 points
Neither   50 points
Disagree   75 points
Strongly Disagree   100 points

Country	Mean	StDev	Median	Interpretation	CEI score
Austria (AUT)	1.833	0.753	2	Agree	25
China (CHN)	2.857	1.069	3	Neither	50
France (FRA)	1.667	0.816	1.5	Agree	25

Germany (DEU)	2.333	1.751	1.5	Agree	25
Greece (GRC)	2.667	1.506	2	Agree	25
India (IND)	2.667	1.073	2	Agree	25
Ireland (IRL)	3.217	1.166	4	Disagree	75
Netherlands (NLD)	1.833	0.408	2	Agree	25
Romania (ROU)	1.784	0.854	2	Agree	25
Saudi Arabia (SAU)	2.2	1.095	2	Agree	25
United Kingdom (GBR)	3.724	0.996	4	Disagree	75

Table 3.65: median scores and interpretation for Q21

Table 3.65 shows the distribution of data within the sample sets of the eleven countries under investigation. Rather surprisingly there is good spread of responses to this question, much more so than for either of the previous two questions.

Q21	Mann-Whitney U Comparison										
	Austria	China	France	Germany	Greece	India	Ireland	Netherlands	Romania	Saudi Arabia	UK
Austria											CEI
China											
France											
Germany											
Greece											
India											
Ireland	Sig		Sig								
Netherlands								Sig			
Romania		Sig				Sig	Adj Sig				
Saudi Arabia											
UK	Sig		Adj Sig	Sig		Sig			Sig	Adj Sig	Sig

Table 3.66: significant differences between countries for Q21, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

Table 3.66 and *Table 3.67* identify the significant different groups, with three adjusted significant results emphasising them. In this case the UK (disagree) is statistically different from France and Romania (agree); in addition Ireland is also significantly different to Romania. The three subsets identified also agree with these findings, with the UK, Ireland and to a lesser degree China generally disagreeing, whilst all of the remaining countries agree with the question.

Homogeneous Subsets based on Q21

		Subset		
		1	2	3
Sample[1]	FRA	41.417		
	ROU	45.324		
	AUT	47.917	47.917	
	NLD	48.500	48.500	
	DEU	59.583	59.583	
	SAU	59.600	59.600	
	GRC	72.583	72.583	
	IND	75.375	75.375	
	CHN	82.357	82.357	82.357
	IRL		91.913	91.913
	GBR			107.103
Test Statistic		13.029[2]	12.199	3.981
Sig. (2-sided test)		.111	.094	.137
Adjusted Sig. (2-sided test)		.134	.127	.416

Homogeneous subsets are based on asymptotic significances. The significance level is .05.

Table 3.67: results of the homogenous subset comparison analysis for Q21 (p<0.05)

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As would be expected from Questions 19 and 20, both the British and the Irish disagree with the statement, they are not concerned with practising languages other than their own. The Chinese respondents show no preference one way of the other; this issue seems of little importance to them. Whilst the remaining countries all agree with the statement, they would prefer to practice another language when at their university. The most powerful assertion comes from the French students who agree with the statement, with a median of 1.5 and a relatively small StDev of 0.816.

3.6.2.12 QUESTION 22: "I RESPECT THE MANNER IN WHICH MY TEACHERS HAVE TAUGHT ME"

Question 22 aimed to examine the learners and determine if they were content with the style of education they had already received. It makes no distinction between 'home' or 'away' education, but is used to elicit a 'happy with the status quo' response. Students who are content with their education may be less likely to desire a change of approaches, whilst those who are unhappy may well push themselves beyond their traditional educational systems and expose themselves to other cultures.

In *Table 3.68* below a "CEI score" is assigned, based in the response based on the fact that a high CEI score should indicate a lack of willingness or desire to be exposed to other cultures. In the case of this question responses that agree with the statement should be assigned a high CEI score (i.e., they are less likely to want to change their educational culture):

Strongly Agree   100 points

Agree   75 points

Neither   50 points

Disagree   25 points

Strongly Disagree   0 points

Country	Mean	StDev	Median	Interpretation	CEI score
Austria (AUT)	2.333	0.816	2	Agree	75
China (CHN)	2	0.577	2	Agree	75
France (FRA)	2	0.894	2	Agree	75
Germany (DEU)	2	0.632	2	Agree	75
Greece (GRC)	2.333	1.033	2	Agree	75
India (IND)	1.917	1.165	2	Agree	75
Ireland (IRL)	2.174	0.65	2	Agree	75
Netherlands (NLD)	2.167	0.753	2	Agree	75
Romania (ROU)	2.973	1.067	3	Neither	50
Saudi Arabia (SAU)	2.8	1.095	2	Agree	75
United Kingdom (GBR)	2.172	0.658	2	Agree	75

Table 3.68: median scores and interpretation for Q22

The only difference in the results presented in *Table 3.68* lies with the Romanian response, all other countries 'agree' with this statement, indicating that Romanian students do not appear to be content with the educational methods used in teaching them – having said that they are not noticeably discontent either.

Q22	Mann-Whitney U Comparison										
	Austria	China	France	Germany	Greece	India	Ireland	Netherlands	Romania	Saudi Arabia	UK
Austria											CEI
China											
France											
Germany											
Greece											
India											
Ireland											
Netherlands											
Romania		Sig	Sig	Sig		Adj Sig	Sig				
Saudi Arabia											
UK									Sig		

Table 3.69: significant differences between countries for Q22, as determined by a Mann-Whitney U pairwise comparison (p<0.05){Sig = non-adjusted values, Adj Sig = Bonferroni corrected)

Table 3.69 backs up this finding and shows that there are significant differences between Romania and India (adjusted), China, France, Germany, Ireland and the UK (all un-adjusted).

Homogeneous Subsets based on Q22

		Subset 1	Subset 2
Sample[1]	IND	48.500	
	CHN	57.857	
	DEU	58.000	
	FRA	59.000	
	IRL	65.478	
	GBR	65.793	
	NLD	67.000	67.000
	AUT	69.500	69.500
	GRC	70.500	70.500
	SAU	87.000	87.000
	ROU		95.027
Test Statistic		5.954	5.610[2]
Sig. (2-sided test)		.745	.230
Adjusted Sig. (2-sided test)		.745	.438

Homogeneous subsets are based on asymptotic significances. The significance level is .05.

Table 3.70: results of the homogenous subset comparison analysis for Q22 (p<0.05)

These results more clearly displayed by the homogenous subset comparison (*Table 3.70*), with Romania being the only non-overlapping country in Subset 2, against those countries previously mentioned. This question thus shows the general acceptance of most countries' (except for Romania) educational methods by their students.

3.6.3 RESULTS: FURTHER ANALYSES

The majority of this chapter investigates the differences and similarities between the eleven selected cultures for questions Q1-Q32. Further on, this next section is used to study the effect that Gender and Age has upon the responses to the questions determining a learner's attitude to culture and adaptive hypermedia (the CEI and AEI indices respectively). The questions sourced in the Hofstede study are not investigated in this way as there are already additional studies surrounding them. If Hypothesis 1 is accepted, then these studies could and should be examined to see how they may be affected by gender and age before continuing further with the data presented here (which would be of lesser value in the current study, due to limited respondents).

3.6.3.1 GENDER DIFFERENCES

A Kruskal-Wallis test was performed for each of the questions Q19 to Q32 to determine if the respondents' gender has any affect upon their response.

Gender	n
Male	117
Female	58

Table 3.71: gender groups (and 'n' values) used when examining Q19-32

Question 26: " I think the idea of an Adaptive Education System is a good one"
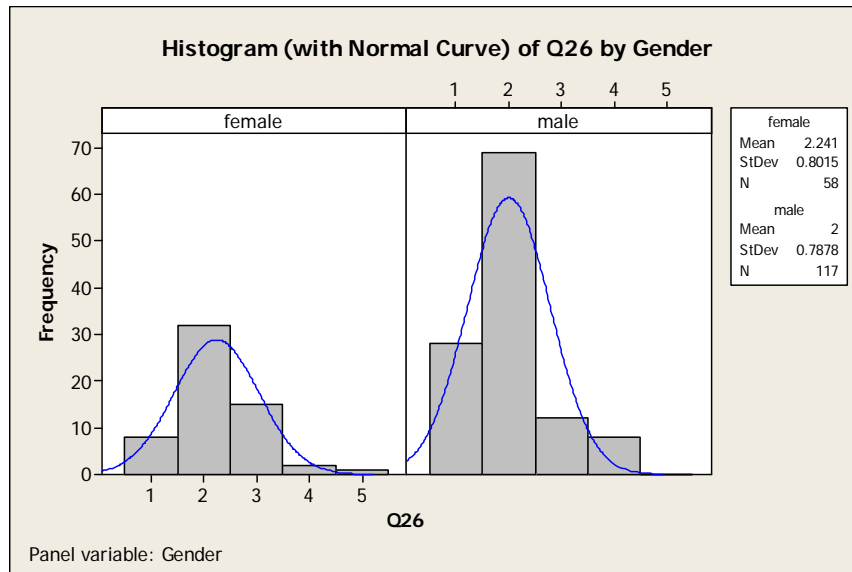
Figure 3.1: histogram of data for Q26, when examining the effect gender has on the CAE response

Only one question had a significant difference (p=0.031), and that was Q26. *Figure 3.1* shows the two histograms for male and female responses to Q26. As can be seen, the responses to the question are significantly more positive for male students (mean 2, StDev 0.8) when compared to those from female students (mean 2.241, StDev 0.8).

The reason for this may be linked to the belief that men are often more technophilic than women and as such may not only be more accepting of technological solutions but actively happier with such scenarios.

3.6.3.2   AGE DIFFERENCES

Another series of Kruskal-Wallis tests were performed to study what affect (if any) the age of the respondent had upon their answers. To do this the data was gathered into the groups shown in *Table 3.72*.

Age group	N
18-22	55
23-27	71
28-32	33
33-37	7
38+	12

Table 3.72: age groups (and 'n' values) used when examining Q19-32

This examination revealed that three of the questions had age related differences within them, Q22, Q25 and Q29. The details of these studies are given below.

Question 22: "I do not have concerns about the type of the personal data that is gathered"

Age Group	Mean	StDev	Median	Range	Interpretation
18-22	2.673	1.055	2	4	Agree
23-27	2.028	0.792	2	4	Agree
28-32	2.303	0.728	2	3	Agree
33-37	2.571	0.787	2	2	Agree
38+	2.000	0.739	2	2	Agree

Table 3.73: median scores and interpretation for the effect of age in answering Q22

At first glance *Table 3.73* does not indicate any large difference between the responses to this question, with all age groups agreeing with the statement. Also in examining *Figure 3.2*, one can see that there is no obvious trend in the data.

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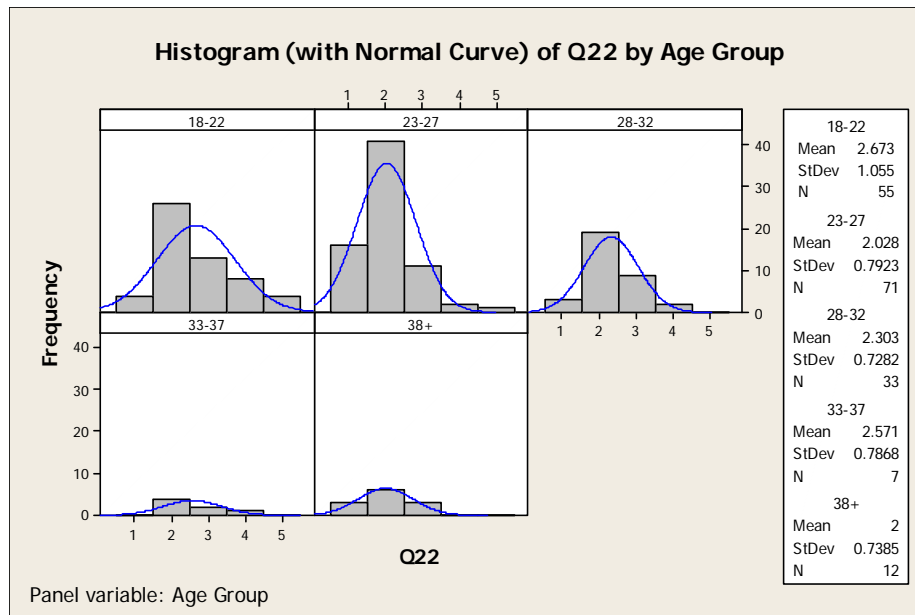
Figure 3.2: histogram of data for Q22, when examining the effect gender has on the CAE response

The post-hoc analyses (Mann-Whitney U) identified three significant difference (at $p<=0.05$), they are '18-22 vs. 23-27', '18-22 vs. 38+' and '23-27 vs. 28-32'. It would seem that these difference are all focused in the lower age groups (two dealing with '18-22' and one '23-27') and their elders, there are no significant differences between the elder age groups. It is only a tentative conclusion (especially considering the means displayed in *Figure 3.2*), but it may be that younger students are slightly more apprehensive and cynical than older students when it comes to being concerned about the type of data stored in these online systems.

Question 25: "I enjoy experiencing other cultures"

Age Group	Mean	StDev	Median	Range	Interpretation
18-22	1.836	0.811	2	4	Agree
23-27	1.578	0.602	2	2	Agree
28-32	1.303	0.467	1	1	Strongly Agree
33-37	1.571	0.535	2	1	Agree
38+	1.833	0.389	2	1	Agree

Table 3.74: median scores and interpretation for the effect of age in answering Q25

Q25 would seem to be much easier to interpret than Q22: there is an obvious difference between the '28-32' age group ('strongly agree') and the others (all of whom 'agree' with the statement). The post-hoc evaluation bears this out with a series of Mann-Whitney U tests performed, indicating that there are significant differences (at $p<=0.05$) between: 18-22 vs. 28-32; 23-27-28-32 and 28-32 vs. 38+.

As can be seen from *Figure 3.3* and *Figure 3.4*, the trend for this question appears to be an initial increase in agreement (with a mean from 1.836 to 1.303) followed by a decrease (with means from 1.303 to 1.833). The Mann-Whitney U tests back this up with the strongly agreeing age group of '28-32' being significantly different from all other groups except '33-37'.

The reasons for this trend are less obvious, if this trend is valid and not an artefact, then for some reason this age group has fewer concerns about the type of personal data being gather by software such as AEH systems. Perhaps it may be due to the fact that the older students have all had time to become somewhat more cynical than this mid group, whilst the youngest groups are more aware and au-fait with these personalised systems and are somewhat more careful. Perhaps this mid group are somewhere in between these bounds of cynicism and youth awareness? Ideally, a new experiement would be required to examine this issue further, but at the very least more CAE data would be needed to ensure that this is a valid finding.

Histogram (with Normal Curve) of Q25 by Age Group

18-22	
Mean	1.836
StDev	0.8111
N	55
23-27	
Mean	1.577
StDev	0.6015
N	71
28-32	
Mean	1.303
StDev	0.4667
N	33
33-37	
Mean	1.571
StDev	0.5345
N	7
38+	
Mean	1.833
StDev	0.3892
N	12

Panel variable: Age Group
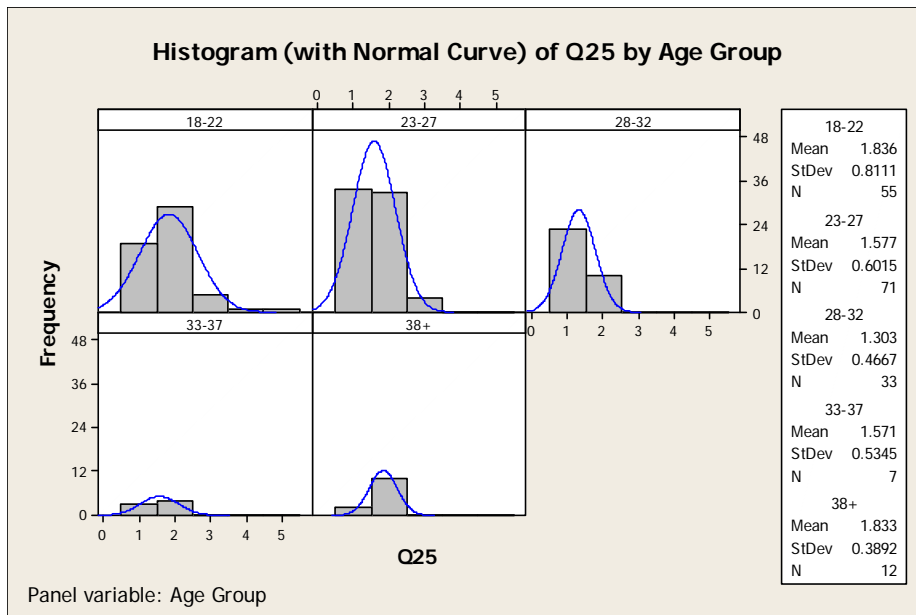
Figure 3.3: histogram of data for Q25, when examining the effect gender has on the CAE response
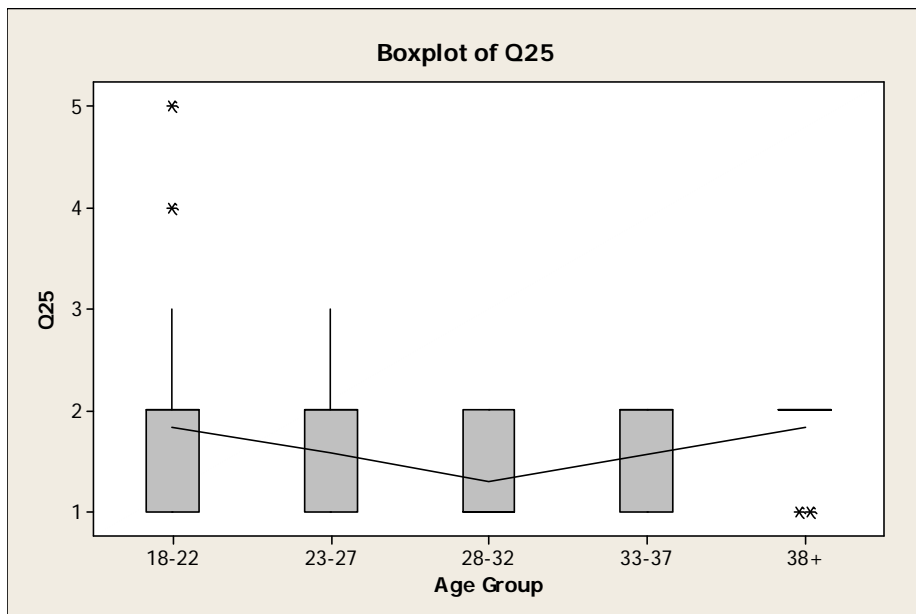
Figure 3.4: distribution of data (boxplot) for Q25, when examining the effect age has on CAE response

Question 29: "I would rather that the lesson the teacher has written is not altered in any way"

Age Group	Mean	StDev	Median	Range	Interpretation
18-22	2.836	1.032	3	4	Neither
23-27	3.014	0.933	3	3	Neither
28-32	3.323	0.832	3	3	Neither
33-37	4.000	0.816	4	2	Disagree
38+	3.583	0.515	4	1	Disagree

Table 3.75: median scores and interpretation for the effect of age in answering Q29

Here in Q29 there seems to be a trend for the younger groups to be ambivalent with the statement and the older groups to move from this position towards disagreement. This trend is confirmed by the significant differences discovered in the post-hoc Mann Whitney U analyses: 18-22 vs 28-32; 18-22 vs 33-37; 18-22 vs 38+ and 23-27 vs 33-37.
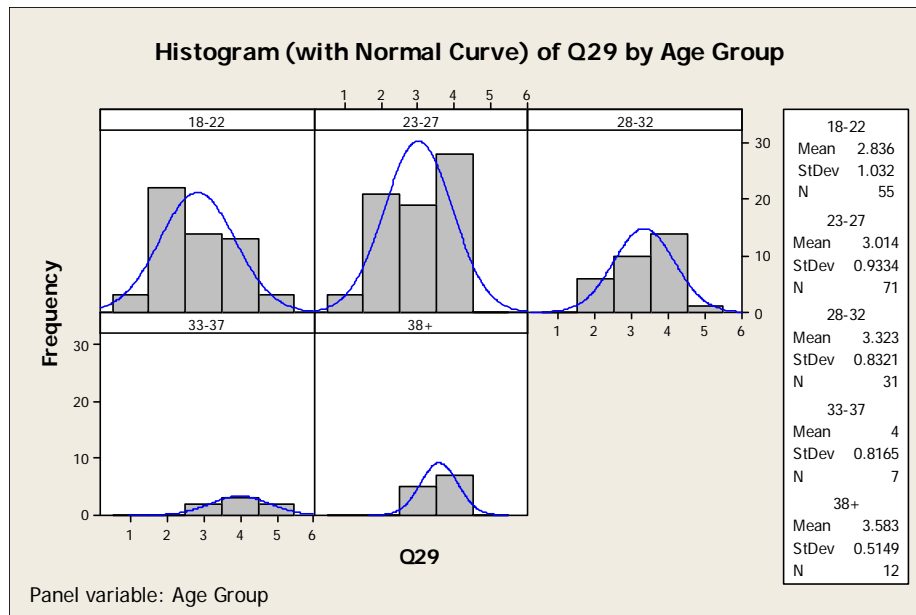
Figure 3.5: histogram of data for Q29, when examining the effect gender has on the CAE response
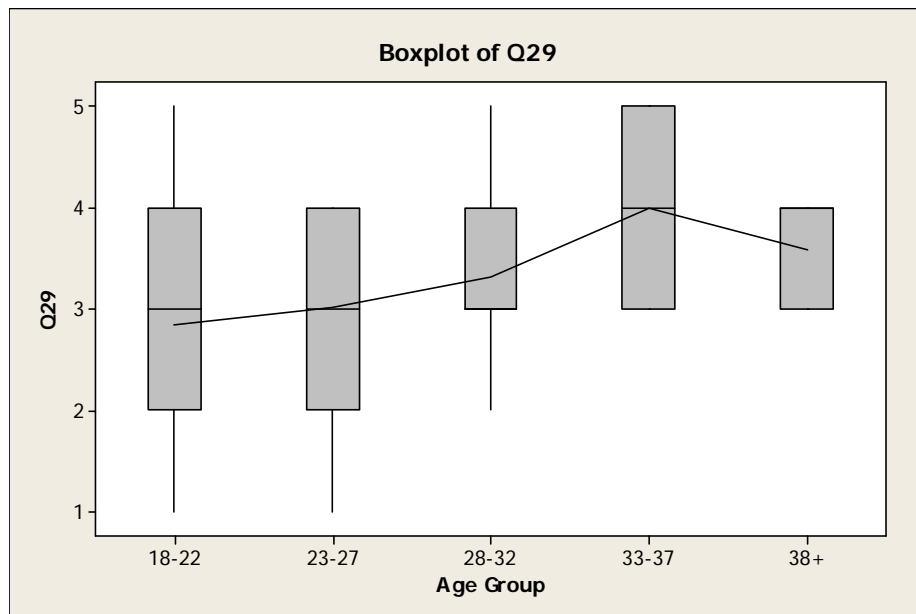
Figure 3.6: distribution of data (boxplot) for Q29, when examining the effect age has on CAE response

The data presented in *Figure 3.5* and *Figure 3.6* shows that older students (with a slight drop in the 38+ students) are much more likely to desire a lesson to be changed from the teacher's original materials; whilst younger students neither disagree or agree with statement that the teachers original materials should not be modified. This is perhaps due to the more technical savvy younger students being more open to (perhaps even expecting) AEH system personalisation mechanism being used. Once again, ideally another experiment would be needed here to determine the truth behind this finding (although of the three questions discussed in this section it certainly has the clearest trend).

3.6.4 CAE RESULTS VS HOFSTEDE'S INDICES

The results discussed so far have all focused on individual questions and the differences (if any) in responses between the various cultures under investigation. The following section groups the questions by the Hofstede index that they were created to investigate and attempts to determine if the Null Hypothesis (that there is *no* difference between the CAE investigation's results and the original indices findings) is to be accepted or rejected.

3.6.4.1 CAE RESULTS: HOFSTEDE INDICES

Questions Q1, Q5, Q7 and Q9 have all been designed to investigate the connection between Hofstede's PDI scores (as interpreted for web interfaces through the findings of Marcus and Gould). As can be seen from *Table 3.14*, *Table 3.20*, *Table 3.34* and *Table 3.37*, the findings for these questions (the interpretation of the Likert Scale used in each question) are given below in *Table 3.76*.

The Key for reading the following tables is:

SA   Likert Scale result: Strongly Agree

A   Likert Scale result: Agree

N   Likert Scale result: Neither

D   Likert Scale result: Disagree

SD   Likert Scale result: Strongly Disagree

H-D   Cultures with a HIGH PDI score should tend to DISAGREE with this question

H-A   Cultures with a HIGH PDI score should tend to AGREE with this question

As has been previously described, the Hofstede scores are based on a 0-100 scale (with a few more modern exceptions which will be discussed later). As a Likert scale was used to gather the answers to the CAE questions, it is possible to apply a 'score' to each of the Likert responses. Of course, the score given depends on the manner in which the question was designed, the key for the *Table 3.76* mentions this:

Question type 'H-A'   *Cultures with a HIGH PDI score should tend to AGREE with this question*

Question type 'H-D'   *Cultures with a HIGH PDI score should tend to DISAGREE with this question*

Following this interpretation, 'H-A' questions will be scored as follows:

Strongly Agree	100
Agree	75
Neither	50
Disagree	25
Strongly Disagree	0

Whilst 'H-D' questions will be scored as follows:

Strongly Agree	0
Agree	25
Neither	50
Disagree	75
Strongly Disagree	100

This allows a numeric score to be assigned to each question. The distribution of these scores can then be analysed using a *Hypothesis test* (a single sample, *Wilcoxon-signed rank* [Choudhury, 2009][Wilcoxon, 2011] where a sample is tested against a given median, in this case the Hofstede score). This test is used to compare the median score of a sample (in this case the numerical Likert scale responses for the questions examining a given Hofstede index) to a known value (in this case the Hofstede score for a country for that index). The Null Hypothesis is that there is no significant difference between the sample and the known value – that the CAE result matches the original Hofstede score. If the Null Hypothesis is rejected (in this case if the result of the test has a 'p' value of less than 0.1 – this value was used from the desire to err on the side of caution and only accept the Null Hypothesis when sure; also, as the Wilcoxon test uses medians it is not as accurate as a Student t-test which uses means and so a slightly wider range is being considered) then there is a statistically significant difference between the sample and the known value.

UAI	Q2	Q10	Q11	Q12
Country	H-D	H-A	H-A	H-D
Austria	A	N	N	SA
China	A	A	A	SA
France	A	N	D	A
Germany	N	A	A	SA
Greece	A	A	A	SA
India	A	A	D	SA
Ireland	A	A	A	SA
Netherlands	A	D	A	SA
Romania	SA	SA	A	SA
Saudi Arabia	A	SA	A	A
UK	A	N	N	A

LTO	Q13	Q15	Q17
Country	H-A	H-D	H-A
Austria	A	N	N
China	SA	N	A
France	A	D	A
Germany	N	N	N
Greece	N	N	N
India	A	A	A
Ireland	A	A	A
Netherlands	D	D	A
Romania	SA	A	A
Saudi Arabia	SA	N	A
UK	N	N	A

IDV	Q3	Q16	Q18
Country	H-A	H-D	H-A
Austria	N	A	A
China	D	A	N
France	D	A	N
Germany	D	A	A
Greece	D	A	A
India	N	A	A
Ireland	N	A	A
Netherlands	D	A	SA
Romania	D	A	A
Saudi Arabia	N	A	A
UK	D	A	A

MAS	Q4	Q6	Q8	Q14
Country	H-A	H-A	H-D	H-A
Austria	A	N	D	SD
China	A	D	D	D
France	A	D	A	SD
Germany	A	A	D	D
Greece	A	D	D	SD
India	A	D	D	D
Ireland	A	D	D	D
Netherlands	N	D	D	D
Romania	A	A	N	D
Saudi Arabia	A	A	D	SA
UK	A	D	D	D

PDI	Q1	Q5	Q7	Q9
Country	H-D	H-D	H-A	H-A
Austria	N	A	A	N
China	D	A	A	D
France	D	N	A	N
Germany	D	A	A	D
Greece	D	A	A	N
India	N	A	A	N
Ireland	D	A	A	N
Netherlands	D	A	N	D
Romania	SD	A	A	D
Saudi Arabia	A	SA	A	N
UK	D	N	N	N

Table 3.76: the collective question results interpretations for the CAE results investigating the PDI, UAI, IDV, MAS and LTO indices

Table 3.77 to *Table 3.81* below give the results of these analyses, significant differences are highlighted in shaded cells.

Question:	Q1	Q5	Q7	Q9	Average	*PDI*	Wilcoxon
Austria	50	25	75	50	50	11	0.066
China	75	25	75	25	50	80	0.063
France	75	50	75	50	63	68	0.458
Germany	75	25	75	25	50	35	0.458
Greece	75	25	75	50	56	60	1.000
India	50	25	75	50	50	77	0.066
Ireland	75	25	75	50	56	28	0.141
Netherlands	75	25	50	25	44	35	0.461
Romania	100	25	75	25	56	82	0.269
Saudi Arabia	25	0	75	50	38	80	0.068
UK	75	50	50	50	56	35	0.059

Table 3.77: showing the CAE question scores and the p-value ('Wilcoxon' column) result from comparing these with the PDI score

As can be seen in *Table 3.77*, there are five countries (Austria, China, India, Saudi Arabia and the UK) that significantly differ from the original PDI score as determined by Hofstede.

The CAE scores for three of the five (China, India, Saudi Arabia) are lower than would be expected from the Hofstede scores and as such it would seem that these countries are expecting greater equality than would normally be expected in their culture during their educational years. The country of note here is Saudi Arabia, as it has by far the largest difference between the Hofstede and CAE scores, far more than either China or India. These students in particular seem to expect equality in the classroom, even if they are willing to accept greater inequality outside of it.

The other two countries with a significant difference are Austria and UK. Both of these countries seem to accept, even expect greater inequality between the roles in the classroom. Austria with a very low Hofstede score seems to be far more rigid in its expectations of education. This is in conformity with the observations in the field for the education in Austria, where the roles of the teachers and students are well defined and delimited.

All of the remaining countries accept the Null Hypothesis, which indicates that (until more data is gathered) there is no difference between the original PDI scores and the CAE findings.

Question:	Q2	Q10	Q11	Q12	Average	*UAI*	Wilcoxon
Austria	25	50	50	0	31	70	0.066
China	25	75	75	0	44	30	0.461
France	25	50	25	25	31	86	0.059
Germany	50	75	75	0	50	65	0.461
Greece	25	75	75	0	44	112*	0.066
India	25	75	25	0	31	40	0.461
Ireland	25	75	75	0	44	35	0.461
Netherlands	25	25	75	0	31	53	0.141
Romania	0	100	75	0	44	69	0.461
Saudi Arabia	25	100	75	25	56	68	0.461
UK	25	50	50	25	38	35	0.458

Table 3.78: showing the CAE question scores and the p-value ('Wilcoxon' column) result from comparing these with the UAI score

Table 3.78 identifies three countries (Austria, France and Greece) whose CAE results significantly differ from the original UAI scores.

* It should be noted that Greece's UAI score is 112 and due to the method used in calculating the CAE scores (converting the Likert scale values into a numerical, 0-100, scale) it is of course impossible for Greece's CAE score to ever reach this value. Therefore a second test was performed with the CAE results examined against a modified UAI score of 100 for Greece (the highest comparable value on the CAE result scale), the result of which was a 'p' value of greater than 0.1 – which is not significant.

Therefore, if the second analysis for Greece is accepted, this leaves Austria and France as the only countries in the UAI that reject the Null Hypothesis, indicating that in the domain of education they both have a relatively low UAI figure and that greater degrees of uncertainty are acceptable for Austrian and French students than would be normally expected given their high Hofstede UAI score.

Question:	Q3	Q16	Q18	Average	IDV	Wilcoxon
Austria	50	25	75	50	55	0.593
China	25	25	50	33	20	0.102
France	25	25	50	33	71	0.102
Germany	25	25	75	42	67	0.276
Greece	25	25	75	42	35	1.000
India	50	25	75	50	48	0.593
Ireland	50	25	75	50	70	0.285
Netherlands	25	25	100	50	80	0.276
Romania	25	25	75	42	32	1.000
Saudi Arabia	50	25	75	50	38	0.593
UK	25	25	75	42	89	0.102

Table 3.79: showing the CAE question scores and the p-value ('Wilcoxon' column) result from comparing these with the IDV score

When examining the IDV index, *Table 3.79* shows that there are no significant differences between the IDV index for the Hofstede and CAE scores. It should however be noted that whilst not statistically significant, the 'p' value for China, France and the UK is very close to the 0.1 threshold. With more data it may be that these results would differ from the original IDV scores – at the very least the results tend to lean towards this conclusion.

Question:	Q4	Q6	Q8	Q14	Average	MAS	Wilcoxon
Austria	75	50	75	0	50	79	0.066
China	75	25	75	25	50	66	0.458
France	75	25	25	0	31	43	0.461
Germany	75	75	75	25	63	66	0.705
Greece	75	25	75	0	44	57	0.461
India	75	25	75	25	50	56	0.458
Ireland	75	25	75	25	50	68	0.458
Netherlands	50	25	75	25	44	14	0.066
Romania	75	75	50	25	56	45	0.269
Saudi Arabia	75	75	75	100	81	52	0.059
UK	75	25	75	25	50	66	0.458

*Table 3.80: showing the CAE question scores and the p-value (*Wilcoxon' column) result from comparing these with the MAS score*

All bar three of the countries shown in *Table 3.80* accept the Null Hypothesis, with Austria, the Netherlands and Saudi Arabia being the only countries to reject it. For these countries there is a significant difference between the CAE results and the original MAS score. For the Dutch and Saudi students the CAE score is significantly higher than the Hofstede score, indicating that they expect more traditional gender and age distinctions, and more importantly that they are far more personally competitive than their very low MAS score suggests. In the case of Austria, the opposite is true, their CAE score is lower than the Hofstede score, seemingly indicating that traditional gender and age distinctions are less important in education than in the rest of their culture.

Question:	Q13	Q15	Q17	Average	LTO	Wilcoxon
Austria	75	50	50	58	--	--
China	100	50	75	75	118*	0.109
France	75	75	75	75	--	--
Germany	50	50	50	50	31	0.083
Greece	50	50	50	50	--	--

India	75	25	75	58	61	1.000
Ireland	75	25	75	58	--	--
Netherlands	25	75	75	58	44	0.276
Romania	100	25	75	67	35	0.285
Saudi Arabia	100	50	75	75	--	--
UK	50	50	75	58	25	0.102

Table 3.81: showing the CAE question scores and the p-value ('Wilcoxon' *column) result from comparing these with the LTO score*

Table 3.81 identifies one country (Germany) whose CAE results significantly differ from the original LTO scores.

* Note that China's LTO score is 118 and, as in the exception described for Greece's UAI score above, that the best way to compare this score to the CAE score above is to reduce this to 100. Therefore a second test was performed with the CAE results examined against a modified LTO score of 100 for China, the result of which was a 'p' value of 0.181 – which remains not significant.

The German students (and with a p value of 0.102, very nearly to the UK value) is the only country in the LTO that rejects the Null Hypothesis. As such, it seems that German students would prefer to focus on practical problems and are possibly more patient than expected in achieving their goals.

It should also be noted that the Wilcoxon test can only be performed on the six countries that have a Hofstede LTO value. Although the remaining five countries cannot be used in examining Hypothesis 1.5, they will be used in the next chapter, as the CAE results for this index will be used for all eleven countries in determining a culture's profile (see Section 3.7.1.5).

3.6.5 CAE RESULTS: THE CEI AND AEI

Unlike the previous section that compares the CAE results against the original Hofstede findings, the creation of the CEI and AEI scores is novel to the CAE questionnaire examination. The creation of these scores uses the same method used in above sections. *Table 3.82* shows the summarised responses for the CEI and AEI questions.

CEI	**Q19**	**Q20**	**Q21**	**Q22**	**Q23**	**Q24**	**Q25**
Country	H-A	H-D	H-D	H-A	H-D	H-D	H-D
Austria	N	A	A	A	N	SA	A
China	N	A	N	A	N	SA	SA
France	N	A	A	A	N	A	SA
Germany	N	A	A	A	N	SA	SA
Greece	A	A	A	A	N	A	A
India	N	A	A	A	N	A	A
Ireland	SA	N	D	A	N	SA	A
Netherlands	D	A	A	A	N	A	A
Romania	D	A	A	N	N	A	A
Saudi Arabia	N	A	A	A	A	A	SA
UK	SA	D	D	A	N	A	A

AEI	**Q26**	**Q27**	**Q28**	**Q29**	**Q30**	**Q31**	**Q32**
Country	H-A	H-A	H-D	H-D	H-D	H-A	H-A
Austria	A	D	SA	N	A	N	A
China	A	N	SA	D	A	A	A
France	A	D	A	N	A	N	N
Germany	A	N	A	N	A	A	N
Greece	A	N	SA	N	A	A	A
India	A	N	A	N	A	N	N

Ireland	A	N	SA	N	A	A	A
Netherlands	A	D	A	D	A	A	A
Romania	A	D	SA	D	A	A	N
Saudi Arabia	A	N	A	N	A	A	A
UK	A	D	A	N	A	A	N

Table 3.82: the collective question results interpretations for the CAE results for the CEI and AEI indices

Again using the Likert scale results it is possible to apply a 'score' to each of the Likert responses. As stated previously, this score given depends on the manner in which the question was designed, the key for the *Table 3.82* is:

Question type 'H-A'   *Cultures with a HIGH CAE or AEI score should tend to AGREE with this question*

Question type 'H-D'   *Cultures with a HIGH CAE or AEI score should tend to DISAGREE with this question*

Hence for 'H-A' questions: and for 'H-D' questions:

Strongly Agree	100		Strongly Agree	0
Agree	75		Agree	25
Neither	50		Neither	50
Disagree	25		Disagree	75
Strongly Disagree	0		Strongly Disagree	100

This allows a numeric score to be assigned to each question; these results are given in *Table 3.83*.

Question:	Q19	Q20	Q21	Q22	Q23	Q24	Q25	*CEI result*
Austria	50	25	25	75	50	0	25	36
China	50	25	50	75	50	0	0	36
France	50	25	25	75	50	25	0	36
Germany	50	25	25	75	50	0	0	32
Greece	75	25	25	75	50	25	25	43
India	50	25	25	75	50	25	25	39
Ireland	100	50	75	75	50	0	25	54
Netherlands	25	25	25	75	50	25	25	36
Romania	25	25	25	50	50	25	25	32
Saudi Arabia	50	25	25	75	25	25	0	32
UK	100	75	75	75	50	25	25	61

Table 3.83: showing the CAE question scores and the final CEI score

As can be seen from *Table 3.83*, the CEI scores range from a 'low' 32 to a 'high' 61 (a range of 29 and a mode of 36). From these results it is possible to draw the following general conclusion – that Ireland and the UK are the only two countries with respectively high CEI scores, with the remaining countries having relatively low CEI scores.

Question:	Q26	Q27	Q28	Q29	Q30	Q31	Q32	*AEI result*
Austria	75	25	0	50	25	50	75	43
China	75	50	0	75	25	75	75	54
France	75	25	25	50	25	50	50	43
Germany	75	50	25	50	25	75	50	50
Greece	75	50	0	50	25	75	75	50
India	75	50	25	50	25	50	50	46
Ireland	75	50	0	50	25	75	75	50
Netherlands	75	25	25	75	25	75	75	54
Romania	75	25	0	75	25	75	50	46
Saudi Arabia	75	50	25	50	25	75	75	54
UK	75	25	25	50	25	75	50	46

Table 3.84: showing the CAE question scores and the final AEI score

As can be seen from *Table 3.84*, the AEI scores range from a 'low' 43 to a 'high' 54 (a range of 11 and a mode of 46, 50, 54). Unlike the CEI scores above, there is not as useful a spread of scores across the countries. Indeed three of the eleven countries have an AEI score of 50 (with five in the 40s and three in the 50s). Therefore it seems that many of the countries investigated have no strong feelings concerning the AEI questions.

3.7 SUMMARY

After examining and comparing (using the nonparametric Wilcoxon test) the Hofstede and CAE scores for each country by index, the results are summarised (significant differences between the two are marked with an 'N') in *Table 3.85* below.

Country	PDI	UAI	IDV	MAS	LTO
Austria	N	N	Y	N	
China	N	Y	Y	Y	Y
France	Y	N	Y	Y	
Germany	Y	Y	Y	Y	N
Greece	Y	Y	Y	Y	
India	N	Y	Y	Y	Y
Ireland	Y	Y	Y	Y	
Netherlands	Y	Y	Y	N	Y
Romania	Y	Y	Y	Y	Y
Saudi Arabia	N	Y	Y	N	
UK	N	Y	Y	Y	Y

Table 3.85: summarises the results of the Hofstede vs. CAE results comparison. 'Y' indicates that the two results agree and 'N' that there is a significant difference between the two.

3.7.1 HYPOTHESIS 1

"Hofstede's cultural dimensions apply to the educational domain. (Hofstede's cultural dimensions were extracted from data from the corporate world; can they be mapped from this domain to the educational domain?)"

Table 3.85 above summarises the overall results for the investigation of the CAE results and determining their match (or lack thereof) with the original Hofstede indices. As can be seen, in general the CAE results match the Hofstede findings, with only 11 significant differences out of 50 comparisons in total (22% not matching, and 78% matching).

Before it is possible to determine if Hypothesis 1 has been accepted or rejected, however, an examination of sub-hypotheses 1.1 to 1.5 is necessary.

3.7.1.1 HYPOTHESIS 1.1

"Hofstede's Power Distance Index (PDI) applies to the educational domain."

Out of eleven potential matches, six of the countries under examination had no significant difference between the CAE results and the Hofstede findings (54.5% match), indicating that there is no majority of countries accepting Hypothesis 1.1, that Hofstede's PDI index applies to the educational domain.

This is a very interesting result, as it indicates that in the domain of education students are not driven by their culture's attitudes to authority and (un-)equal power ranks. This is not unexpected, as the majority of Hofstede's findings are based on adults in employment and as such it may be these attitudes change once they are out of an educational environment.

Of course, the five countries (Austria, China, India, Saudi Arabia and the UK) that did not accept this hypothesis now require special focus when their cultural template for adaptive educational systems is created.

3.7.1.2   HYPOTHESIS 1.2

"Hofstede's Collectivism vs. individualism Index (IDV) applies to the educational domain."

Out of eleven potential matches, all eleven of the countries under examination had no significant difference between the CAE results and the Hofstede findings (100% match), hence all of the countries accept Hypothesis 1.2, that Hofstede's IDV index applies to the educational domain.

3.7.1.3   HYPOTHESIS 1.3

"Hofstede's Femininity vs. masculinity Index (MAS) applies to the educational domain."

Out of eleven potential matches, eight of the countries under examination had no significant difference between the CAE results and the Hofstede findings (72.7% match), indicating that the majority of the countries accept Hypothesis 1.3, and that Hofstede's MAS index applies to the educational domain. Only Austria, the Netherlands and Saudi Arabia did not accept the hypothesis.

3.7.1.4   HYPOTHESIS 1.4

"Hofstede's Uncertainty avoidance Index (UAI) applies to the educational domain."

Out of eleven potential matches, nine of the countries under examination had no significant difference between the CAE results and the Hofstede findings (81.8% match), indicating that the majority of the countries accept Hypothesis 1.4, that Hofstede's UAI index applies to the educational domain. Only Austria and France did not accept the hypothesis.

3.7.1.5   HYPOTHESIS 1.5

"Hofstede's Long vs. short term orientation Index (LTO) applies to the educational domain."

Out of six potential matches, five of the countries under examination had no significant difference between the CAE results and the Hofstede findings (83.3% match), indicating that the majority of the countries accept Hypothesis 1.5, that Hofstede's LTO index applies to the educational domain. Only Germany did not accept the hypothesis.

As such a high match rate was discovered in the analysis of this dimension, the rest of the CAE investigation will attempt to assign an 'estimated' (that is, not Hofstede approved) LTO value to the five countries in this study that do not have one (Austria, France, Greece, Ireland and Saudi Arabia).

To this end the results of Questions 13, 15 and 17 are considered, when given an average score (see *Table 3.81*). These match those results extrapolated from Question 13 (this being the most accurate of the three LTO questions, which was also able to identify differences between the respondents' cultures).

Hence the LTO values in *Table 3.81* will be used in the next chapter to determine the CAE ontology values.

Overall, *Hypothesis 1 can be said to have been accepted* (78% acceptance rate), with sub-hypotheses 1.2, 1.3 and 1.4 all having extremely high acceptance rates (72-100%, average 84.5%).

3.7.2   HYPOTHESIS 2

"Students desire to be taught in the manner that they have been brought up with."

As can be seen from *Table 3.83*, it seems that the majority of countries respond to the CEI questions in a generally negative manner (considering the inversion of meaning required depending upon if the question is a 'H-A' or 'H-D' question, see *Table 3.82*), with a mean response of 36% (median and mode of 36). Only two countries have what could be considered to have a high CEI score, the UK (61) and Ireland (54). This has been discussed previously in the detailed analysis of the CEI questions, but bears out these individual analyses – that both of these countries are less open to being taught in different

languages or in different cultures/countries, compared to the remaining countries that are much more open to differing perspectives and cultures.

The countries grouped in the 30s range (eight of the eleven countries analysed) all seem to reject Hypothesis 2 that they do not desire only to be taught in the manner that they have been brought up in, with only the UK and Ireland accepting Hypothesis 2. Hence, overall, *Hypothesis 2 can be rejected*.

3.7.3 HYPOTHESIS 3

"There is a cultural bias in the acceptance of openly acknowledged Adaptive Educational systems."

As can be seen from *Table 3.84* there is little strong feeling concerning the answers to the AEI questions, with a mean response of 48.7% (median 50 and mode of 46,50,54). The countries with the strongest agreement with the AEI questions are China, the Netherlands and Saudi Arabia with an AEI score of 54.

Overall there seems to be little difference between the countries investigated in their response to the AEI questions, as indicated by a small range (11). This result seems to *reject Hypothesis 3*, in that there appears to be little or no cultural bias in a countries acceptance of educational AH. AEH seems to be accepted, generally speaking, but the questions have highlighted several concerns students have regarding the mechanism of personalisation, as was detailed in this chapter.

Considering the potentially sensitive nature of the data gathered, and the issues surrounding each student being given a personal lesson (for example a student may not want to be identified as a 'slow' learner) it does not come as a great surprise that students opinions are ambivalent on the subject of AEH acceptance.

3.8 NEXT

In this chapter the CAE questionnaire was created to examine three major hypotheses. The analyses of the responses to this questionnaire have also been detailed, and as a result Hypothesis 1 has been accepted and Hypotheses 2 and 3 have been rejected.

Using these results, the next major stage in this work is to create a cultural stereotype model and create instances of this model for each country (see Chapter 4).

It should also be noted that further tests using the CAE questionnaire remain to be performed:

a) One of the assumptions of this study was that, as the CAE questionnaire was written and delivered in English, that there is no significant difference between students who could read English and those who could not. For example an Indian student's responses would be the same if the questionnaire is written in English or Hindi. This assumption will be tested in Chapter 8.

b) Given the highly tentative nature of the conclusions that can be drawn from the CAE questionnaire study (due to the small sample size) it was decided to perform another experiment to support or refute these findings. To this end, a small scale experiment involving structured interviews with a group of students was performed. This study is presented in Section 7.3.

CHAPTER 4:

THE CAE FRAMEWORK

4 CAE FRAMEWORK

4.1 1. INTRODUCTION

Following on from the work of Chapter 3, the results of the CAE questionnaire analysis were used to devise a semantic framework around which educational materials could be personalised for a learner from a specific culture (which as has been previously stated equates in this case to 'country').

The adoption of Semantic Web Technologies into education gave rise to educational ontologies: these are ontologies that encapsulate 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 [Apple and Horace, 2007]. A number of ontology names can be found in numerous research works and several systems or tools are developed to fulfil a particular education purpose.

This chapter presents the research performed in describing the CAE ontologies to represent the cultural artefacts (based on the analysis of CAE questionnaire), the **CAE-F (Full scale)** (*Figure 4.2*) and the slimmed down, easier to implement **CAE-L (Lightweight)** (*Figure 4.3*) ontology frameworks. The main purpose of mapping these questions onto ontologies is to have an easy to use and flexible tool to describe, analyse and extend adaptive educational systems, and in particular, user/ learner models.

4.2 THE CAE ONTOLOGIES

By analyzing the CAE questionnaire results and linking this to the Hofstede indices, the **CAE-F** and **CAE-L** User Model Ontologies have been developed. Section 2.5.2 gives further details on this analysis and how Hofstede's indices have been used to create the series of web appropriate cultural concepts used in the CAE ontologies. The CAE-F model represents the entire framework as derived from Hofstede's indices, whilst the CAE-L model is a smaller subset of CAE-F. The CAE-L subset was extracted as a simpler approach to creating a feasible software implementation; this implementation will be discussed further in Chapter 5.

This was done by examining the three Hypotheses introduced in the previous chapter, and using these as a basis for grouping the attributes detailed in *Table 2.2* to *Table 2.6* (the expected likes and dislikes of web users with respect to Hofstede's indices as extrapolated from [Marcus and Gould, 2000a]) as well as the attitudes to a cultural education and use of AEH systems. To this end, all of the concepts resulting from the questionnaire and the analysis of the results in Chapter 3 were examined by looking into the semantics, patterns, commonalities and links between concepts, the result of this study was a mind map, the structure of which directly informed the creation of the ontology described below.

As a result of this analysis, a compact structure was obtained, and five sub-ontologies could be identified: (1) *Authority*, (2) *Group*, (3) *Language*, (4) *Lesson* and (5) *Data*. This covers all of the aspects from [Marcus and Gould, 2000a] as well as those novel aspects analysed in questions 19 to 32 of the CAE questionnaire. Beside of these sub-ontologies, a top level concept was identified, namely the 'AEH' concept (which is used to recognise if a student is accepting of the use of personalisation techniques, such as those used in AEH systems). This new top level concept was added, as none of the other sub-ontologies and their concepts would be required, if this marked a student as being unwilling to accept receiving a personalised lesson.

As for the five sub-ontologies, *Figure 4.1* details them for CAE-F and *Figure 4.3* for CAE-L, along with their associated concepts (and concept values (attributes)). For example, the CAE-L 'Data' ontology is described by the '*hasData*' relationship with the concept '*Security*' whose possible values are 'present' or 'absent'.

The concepts for these sub-ontologies were created from the grouping of attributes and attitudes, as mentioned previously. Hence the 'Authority' sub-ontology contains all concepts dealing with issues of authority in an online lesson, such as navigation hierarchies, authority figures – such as who is considered an 'authority' and what services could be offered.

Obviously, each sub-ontology contains concepts generally linked to the Hofstede and CAE indices (such as many PDI concepts in 'Authority and AEI concepts in 'Data'), but they also contain concepts

not obviously linked – such as an AEI concept 'AEH Approval' in 'Authority' (dealing with who should be considered an authority in the approval of a lesson).
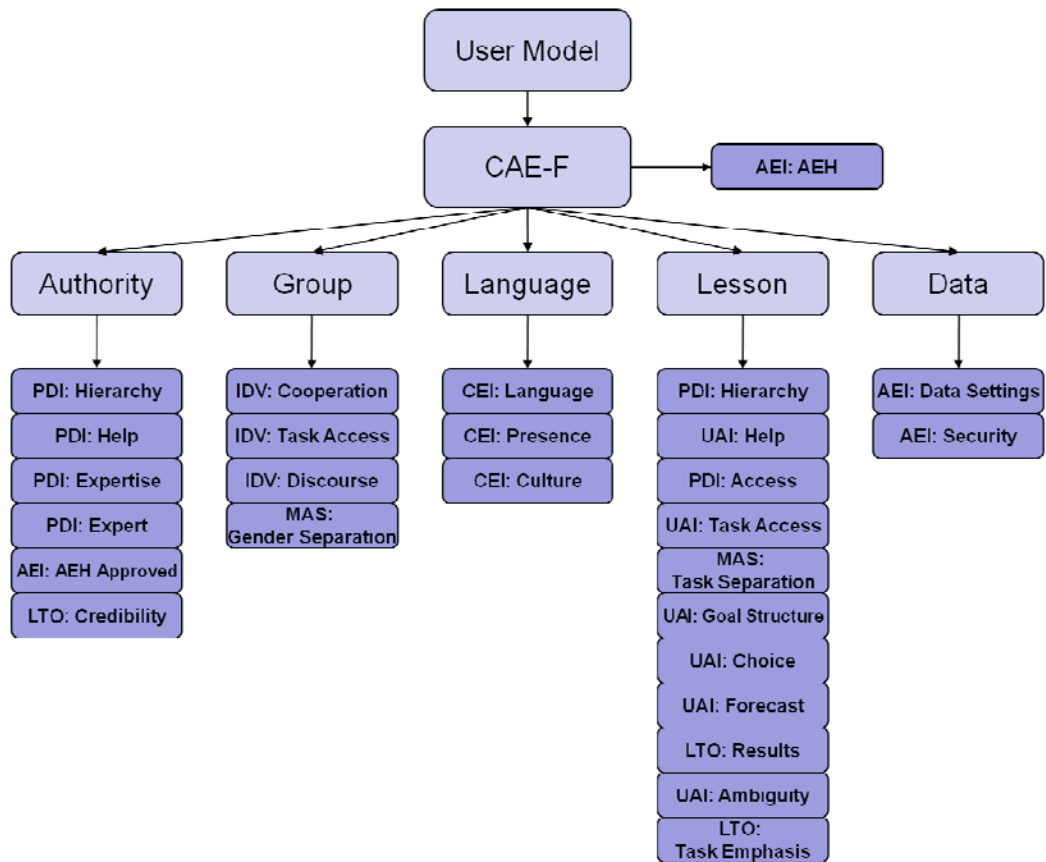
Figure 4.1: The CAE-F ontology outlining the relationship between the concepts and Hofstede's indices.

Once this analysis of the Hofstede and CAE indices as well as the [Marcus and Gould, 2000a] interpretation and the associated attitudes was complete, the CAE ontology was created.

Figure 4.1 shows this ontology and the relationships between the CAE concepts and Hofstede's indices (PDI: Power distance Index, UAI: Uncertainty Avoidance Index, MAS: Masculinity index, IDV: Individuality index, LTO: Long Term Orientation index) as well as the AEI (Adaptive Education Index) and CEI (Cultural Education Index) devised as part of the CAE analysis requirements.

Once the entire ontology was created, each concept was given one of two attributes, each linked to a 'high' or 'low' value for the given index. This bipolar representation of the leaves of the ontology is based on the range of values in Marcus & Gould's modelling style for web design.

An overview of the conceptual model for both the CAE-F and CAE-L ontologies is presented in *Figure 4.2* and *Figure 4.3* respectively (with the key given in *Figure 4.4*).
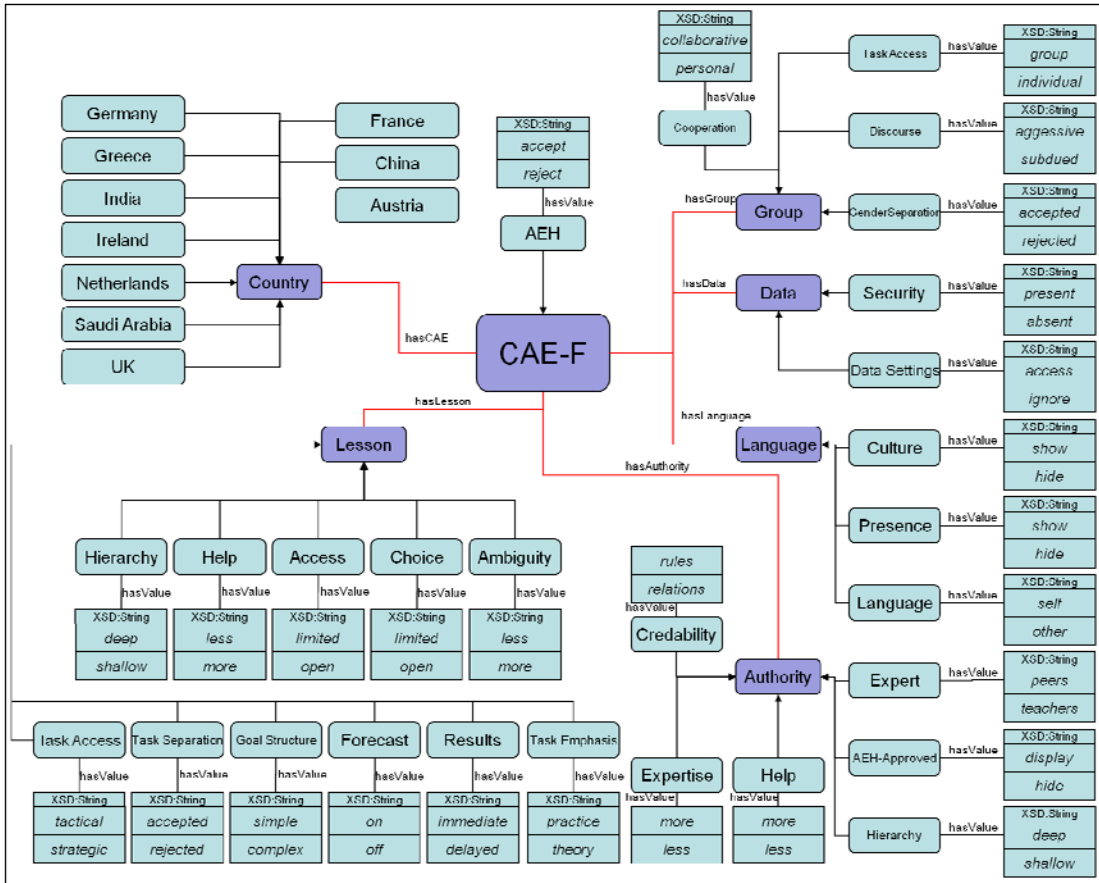
Figure 4.2: Model of CAE-F Ontology Framework
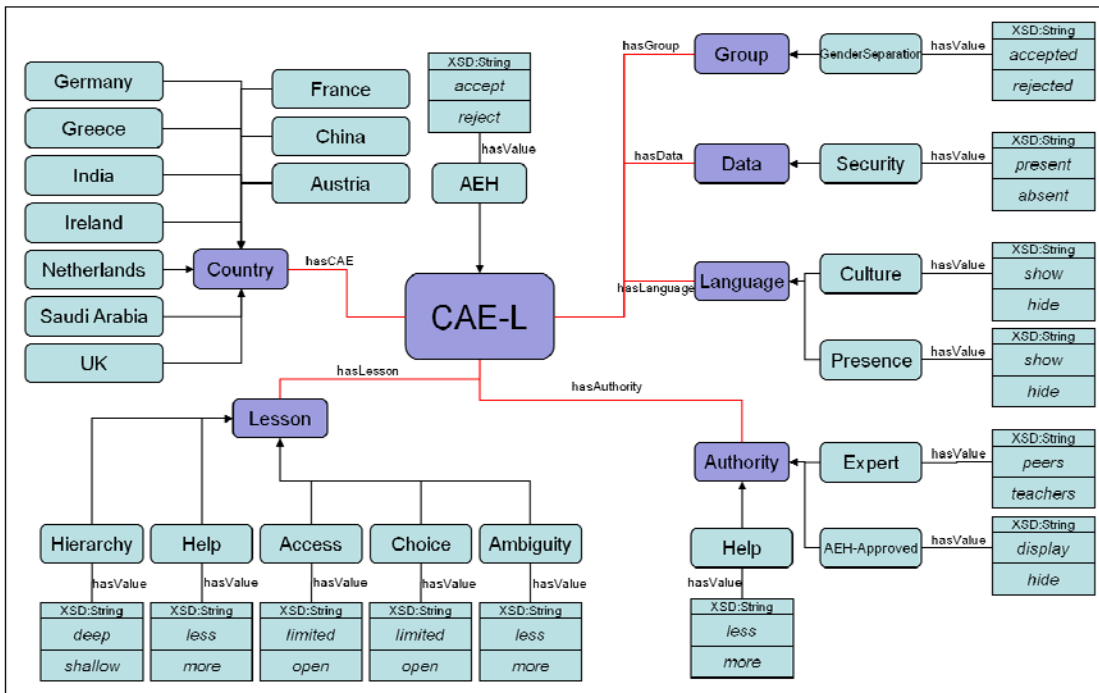
Figure 4.3: Model of CAE-L Ontology Framework

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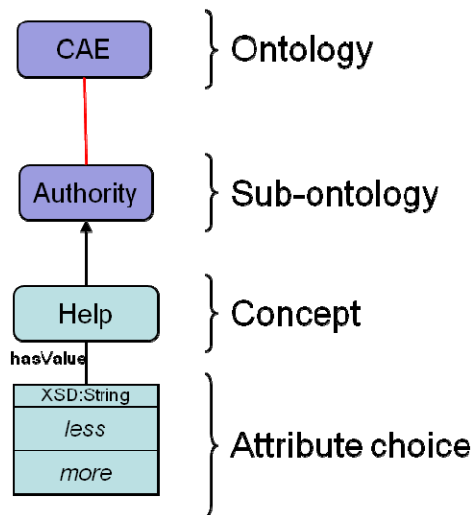
Figure 4.4: key for CAE Ontology for Figure 4.2 and Figure 4.3

4.3   ONTOLOGY CONCEPT DESCRIPTION

The CAE-F ontology contains five sub-ontologies and one concept directly linked to the upper level

CAE-F ontology. These are described below.

CAE-F ontology:

- **AEH**

  values: { accept | reject }

  Index values: high AEI = accept   low AEI = reject

  description: some learners may be content (*accept*) to have their lesson adapted for their

  specific needs, whilst others may not be (*reject*). Of course, this applies only to obvious or

  labelled adaptation. It may well be that hidden adaptation (where the lesson is adapted but

  the user is not informed) would actually be advisable in some cases.

Authority Ontology: This ontology describes concepts related to how learners from different cultures

differ in their perception and relationship with 'authority'. The ontology recognizes that authority can

come in many forms, and thus the concepts identified through the analysis of the CAE questionnaire

are:

- **Hierarchy**

  values: { deep | shallow }

  Index values: high PDI = deep   low PDI = shallow

  description: the learner may have strong feelings concerning the *degree* of authority used in

  an AEH system. Those who have the value of '*deep*' for this concept are more accepting of

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many layered hierarchies and would expect to interact with different layers for different purposes (i.e., it may be unacceptable for a Teaching Assistant to set and mark a lesson or task for learners with this concept set to *deep*, but quite acceptable for those set to *shallow*)

- **Help**

  values: { more | less }

  Index values: high PDI = more   low PDI = less

  description: lessons for some cultures should ensure that any help offered to the students should emphasise *more* of the official nature of that help. Whilst other cultures need *less* emphasis. This concept could for example reflect on the amount of peer support that a student is willing to accept (in social/collaborative systems).

- **Expertise**

  values: { less | more }

  Index values: high PDI = more   low PDI = less

  description: some learners require a strong focus on the expertise being offered by the AEH system; *more* signs of authoritative approval would be required in these cases - compared to learners who require *less* or fewer indications of such approval.

- **Expert**

  values: { peers | teachers }

  Index values: high PDI = teachers   low PDI = peers

  description: do the learners accept any other authority than the teachers? A learner may consider their *peers* and other sources outside of those established by the educational hierarchy as an expert (in addition to their teachers) On the contrary, other learners may only recognise their *teachers* and other officially designated authorities as experts.

- **AEH-Approved**

  values: { display | hide }

  Index values: high AEI = display   low AEI = hide

  description: this concept is concerned with the acceptance (or lack thereof) for an adapted lesson. The 'authority' at issue is that of the teacher; if a culture will only accept an AEH

lesson if a teacher has pre-approved it then *display* this fact. Otherwise *hide* this mark of approval. Such a mark could be an icon indicating teacher approval of the lesson.

- **Credibility**

  values: { rules | relations }

  Index values: high LTO = relations low LTO = rules

  description: the credibility of the authority is always important, even if the lesson is teacher approved – how credible is that teacher for this lesson? This concept determines the nature of the approved sources of authority: *rules* such as "This teacher has been approved by the University", or "This student has been approved by the teacher" are one approach. The other, *relations*, would include approvals such as "the class knows student X is an expert at subject Y", or "This teacher is known by all students to be excellent at teaching".

Group Ontology: This ontology provides description for the social behaviour, interaction and work of learners.

- **Cooperation**

  values: { collaborative | personal }

  Index values: high IDV = personal low IDV = collaborative

  description: the nature of group interactions can depend on the learner's desire for either a group (or *collaborative*) outcome versus their desire for a more *personal* outcome. I.e., a student's efforts are better directed towards helping the group (e.g. class, workgroup, university) succeed, in some cases, and helping their own personal goals (even if working as part of a group), in others.

- **Task Access**

  values: { group | individual }

  Index values: high IDV = individual low IDV = group

  description: the learner prefers to either work as part of a *group* or on their own (*individual*). This selection obviously does not mean that all AEH learning structures must be delivered in one form or the other, but indicates the preference, where available.

- **Discourse**

  values: { aggressive | subdued }

Index values: high IDV = aggressive | low IDV = subdued

description: some learners thrive in environments where outspoken, argumentative and even *aggressive* views can be aired, whilst others prefer a more *subdued* and peaceful discourse to be held.

- ***Gender Separation***

  values: { accepted | rejected }

  Index values: high MAS = accepted | low MAS= rejected

  description: this concept concerns whether or not the separation of the genders for teaching is *accepted* or *rejected*.

Language Ontology: The language ontology provides concept description for language and cultural modelling while presenting the education content.

- ***Language***

  values: { self | other }

  Index values: high CEI = self | low CEI = other

  description: would the learner prefer to be taught in their own (*self*) language or would they prefer/embrace another (*other*) language to be taught in? This is an active choice by the learner in most cases, but the CAE analysis shows that in some cases it may be possible to automatically set this (as in the case of the Netherlands students being taught in English).

- ***Presence***

  values: { show | hide }

  Index values: high CEI = hide | low CEI = show

  description: does a learner's culture accept/embrace the presence of languages other than their own in their educational materials (i.e. the materials are not core but peripheral, compared to the 'language' concept above where the materials would be considered core)? If so, then an AEH system may *show* such languages, otherwise it should endeavour (where possible) to *hide* them.

- ***Culture***

  values: { show | hide }

  Index values: high CEI = hide | low CEI = show

description: does a learner's culture accept being exposed to cultures other than their own? If so, then an AEH system may *show* such cultural aspects, otherwise it should endeavour (where possible) to *hide* them.

Lesson Ontology: This ontology describes the presentation of a lesson, module or series of tasks.

- ***Hierarchy***

  values: { deep | shallow }
  Index values: high PDI = deep low PDI = shallow
  description: as some cultures are more accepting of strong hierarchies than others, so too do learners from those cultures expect hierarchies that are either *deep* or *shallow* in nature. This has obvious implications to the presentation of a lesson's content navigation hierarchy.

- ***Help***

  values: { less | more }
  Index values: high UAI = more low UAI = less
  description: how much help should initially be made available to a student? Some cultures are accepting of being left to look after themselves and as such need *less* up front help. Whilst cultures that are less accepting of being left unaided need *more* help.

- ***Access***

  values: { limited | open }
  Index values: high PDI = limited low PDI = open
  description: this concept deals with a cultures desire for barriers to access learning materials. Those that require *open* access should be allowed to roam the learning space (as dictated by other pedagogies). Compare this to those that require more *limited* access – where the learning space should be partitioned with frequent barriers to access – such as achieving a sufficient score or multiple course prerequisites.

- ***Task Access***

  values: { tactical | strategic }
  Index values: high UAI = tactical low UAI = strategic
  description: the tasks in a lesson can be displayed with either a *tactical* (intra-task) focus or a *strategic* (inter-task) focus. In the first case, the focus of the AEH system should be to

encourage the learner to master a given task (or small series of related tasks). Conversely, in the second case, the system should encourage the learner to master the entire lesson (or lessons), even if this means directing the student away from the current task.

- **Task Separation**

  values: { accepted | rejected }

  Index values: high MAS = accepted   low MAS = rejected

  description: there are often various distinctions within a group (or class): some learners prefer these traditional distinctions (such as teams, gender and age) to be respected, whilst others prefer them to be removed. This applies also to how a lesson's tasks can be arranged, in some cases the learner prefers to be with like minded people (*accepted*) but others prefer to be mixed with others (*rejected*).

- **Goal Structure**

  values: { simple | complex }

  Index values: high UAI = simple   low UAI = complex

  description: some learners would prefer a *simple*, concise and restricted path described for them to achieve their desired goals, restricted data access is also preferred in these cases. Otherwise the students may prefer a more open and *complex* set of achievement paths and data access.

- **Choice**

  values: { limited | open }

  Index values: high UAI = limited   low UAI = open

  description: this concept deals with a culture's acceptance for the choices made available to them. Should they be free and *open* choices, allowing for maximum complexity in data presentation? Or should they be *limited* choices always directing them down a safer path, with simplicity in data presentation?

- **Forecast**

  values: { on | off }

  Index values: high UAI = on   low UAI = off

description: result and achievement forecasting is desired in cases where the student desires more information (*on*) to help them make the correct choice in progressing through the lesson – i.e., they would like to know the likely outcome of an action before progressing with it. In other cases the unknown is preferable, with students quite willing to forge their own way through the lesson without any forecast data (*off*).

- **Results**

  values: { immediate | delayed }
  Index values: high LTO = delayed   low LTO = immediate
  description: a leaner may desire to be given *immediate* feedback whilst they work through a given lesson or task and any delay will reduce the efficiency of the AEH itself. One the other hand, some learners would prefer that the feedback is *delayed*, as repeated, immediate feedback could be intrusive when they do not feel that they need it.

- **Ambiguity**

  values: { less | more }
  Index values: high UAI = less   low UAI = more
  description: how much ambiguity in the presentation of learning materials will a culture accept? Those wishing for *less* ambiguity will need multiple, redundant cues to aid them in their use of the learning system, whilst those desiring *more* ambiguity will need fewer of such cues.

- **Task Emphasis**

  values: { practice | theory }
  Index values: high LTO = practice   low LTO = theory
  description: some learners fare better when presented with the *theory* and abstract fundamentals to a given set of learning materials, before moving onto applying these in *practice*, whilst others prefer the opposite.

Data Ontology: This ontology is related to the security of data for the learners.

- **Data Settings**

  values: { access | ignore }
  Index values: high AEI = access   low AEI = ignore

description: AEH systems gather information about a learner to enable them to make choices concerning educational personalisation. Some learners would prefer up front and easy *access* to their User Profile's data settings, so that they can examine and change them as required. Other students are more likely to trust that the AEH system will handle their data correctly and so *ignore* these data settings. In the case of the former the user profile's settings should be accessible through a simple link/button option in the main user interface, in the latter option this link should still be available but does not need to be always present in the main interface.

- **Security**

  values: { present | absent }

  Index values: high AEI = present   low AEI = absent

  description: whilst all user data stored in an AEH system should be secure, some cultures need to see and identify such security. As such a security indicator should be *present*. Whilst in those cultures that are less concerned such indicators may be *absent*.

Figure 4.1 also shows the relationship between the instances of each 'Country' and the generic CAE-F model, through the 'hasCAE' relationship. The CAE-F ontology was described using the OWL DL language. The *Figure 4.2* CAE-F Ontology Model provides the formal description of the TBox (terminological box) model, whilst *Figure 4.5* provides the ABox (assertional box) instances [DL-model, 2011]. In the TBox model, the conceptualisation of Cultural behaviour is modelled using concept relations. While, in the ABox instances of particular scenarios are created (such as those for the eleven countries under consideration). The data collected from the user study was analysed to determine differences in the responses between countries (see previous chapter). The results are given in *Table 4.1*.

Country	PDI	UAI	IDV	MAS	LTO	CEI	AEI
Austria (AUT)	high	low	high	low	high	low	low
China (CHN)	low	low	low	high	high	low	high
France (FRA)	high	low	high	low	high	low	low
Germany (DEU)	low	high	high	high	high	low	incon
Greece (GRC)	high	high	low	high	incon	low	incon
India (IND)	low	low	low	high	high	low	low
Ireland (IRL)	low	low	high	high	high	high	incon
Netherlands (NLD)	low	high	high	high	low	low	high
Romania (ROU)	high	high	low	low	low	low	low
Saudi Arabia (SAU)	low	high	low	low	high	low	high
UK (GBR)	high	low	high	high	low	high	low

Table 4.1: summary of the CAE results for the eleven countries under investigation. incon = inconclusive value. This data is derived from the findings of Chapter 3.

By applying the results described in *Table 4.1* within the CAE-F ontology, it is possible to describe a stereotypical series of values for each learner from the eleven countries under study. For example the value derived for "Chinese" students for the 'Authority' concept of 'Help' (a PDI concept), is 'less' (as the PDI value is 'low') illustrating that Chinese students prefer less help from authority figures. Similarly, Chinese learners consider teachers and peers to be an 'authority' whilst Austrian students consider only teachers to be an authority. Also, cultural stereotypes can be noted in the usage of "Language" between students from these countries. Chinese students are open to receiving learning materials in a language other than their own and are happy to be exposed to other cultures whilst the Irish and British students prefer not to be exposed to other languages. A discussion of the results is presented in previous work [Stewart *et al*, 2008].

Compared to the work presented in [Blanchard and Frasson, 2005], the CAE-F ontology presented in this chapter provides a formalisation of the culturally sensitive metadata and is described using semantic web language (OWL).

4.4   CAE-F USER MODEL INSTANCES

By applying the results described in *Table 4.1* within the CAE-F ontology, it is possible to describe a stereotypical series of values for each learner in the eleven countries under study. These ontology instances are show in *Figure 4.5* to *Figure 4.15*. The relationships of the CAE-F ontology for a given country (such as *China*) and the concepts as described in *Figure 4.2*. For example, the value for the 'Authority' sub-ontology concept of 'Help', is shown through the relationship China CAE-F "*hasAuthorityHelp*" set as 'less' (in *Figure 4.2* one can see that the 'Help' concept has two potential values: 'less' and 'more', illustrating that Chinese students want less help from authority figures).

Before applying the results from *Table 4.1*, the CAE questions in Chapter 3 that displayed a significant difference between the eleven culture's responses should be examined to check if there are any specific instances where the question responses override the generic results.

For example, the results for The Netherlands show that generally Dutch students have a 'high' UAI score (the CAE score of 31 was not found to be significantly different from the Hofstede score of 53, hence the 'high' value of the Hofstede score has been retained), however in response to Q10 of the CAE questionnaire (*Table 3.41*) it can be seen that the Netherlands significantly differ from other 'high' UAI countries such as Germany, Greece, Romania and Saudi Arabia. In examining Q10 it has been found that this refers to the issue of ambiguity, as addressed by the 'ambiguity' concept of the 'Lesson' ontology (as described above). Therefore, a special modification may be inserted into the CAE-F instance for the 'Lesson::ambiguity' concept – instead of the expected high UAI value of 'less' the value of '*more'* will be used, as this seems to reflect the specific, significant results of Q10 for the Netherlands learners.

Other special circumstances exist for the following:

- Q7 (PDI): the UK and Netherlands both stand as significantly different from the other countries, specifically the UK is statistically significantly different (adjusted) from Romania. As such, whilst the UK's PDI score indicates a 'high' value (as opposed to the Hofstede 'low' value), it seems that with respect to Q7 and the nature of access to resources (it should not be structured and regulated) the UK acts as a 'low' PDI culture. Hence the 'Lesson::access' concept should be set to 'open' rather than 'limited'.

- Q11 (UAI): both China and Ireland have been determined to be 'low' UAI cultures; however, the results for this question imply that in the case of reducing complexity in lessons they both act contrary to this (i.e., as 'high' UAI cultures). The results from this question also highlight the difference between China & Ireland and India, another 'low' UAI culture whose CAE result matches the Hofstede score. The findings of this question affect two concepts 'Lesson::task access' and 'Lesson::choice', where in both cases the 'high' UAI value should be used rather than the anticipated 'low' value.

- Q13 (LTO): Romania (a 'low' LTO culture) strongly agrees that the emphasis should be on practice and practical values rather than abstract theories, which is a 'high' LTO culture response. Considering that it is significantly different (adjusted) from both the UK and the Netherlands (both 'low' LTO cultures that do not agree with the statement – therefore

acting as would be expected) it seems that in this case Romania should be treated as a 'high' LTO country. Therefore 'Lesson::task emphasis' should be set to 'practice' for Romania.

- Q14 (MAS): there is a great difference between Saudi Arabia and all of the other countries, therefore the 'Group::gender separation' concept should be set to '*rejected*' for all of the countries that are not Saudi Arabia, which should be set to 'accepted'.

- Q15 (LTO): the UK and Netherlands stand as the only countries which significantly differs (adjusted in the case of the UK) to another 'low' LTO country (Romania) in not agreeing with this statement. As such they should have the 'Lesson::results' concept set to the 'high' LTO value.

- Q20 (CEI): due to the significant difference between Ireland and the UK in response to this question, the 'Language::Culture' concept should be set to '*show*' for Ireland rather than the standard high CEI value of 'hide'.

Using these modifications the new results can be used to create CAE-F country instance diagrams, as seen in *Figure 4.5* to *Figure 4.15*.

4.4.1 AUSTRIA
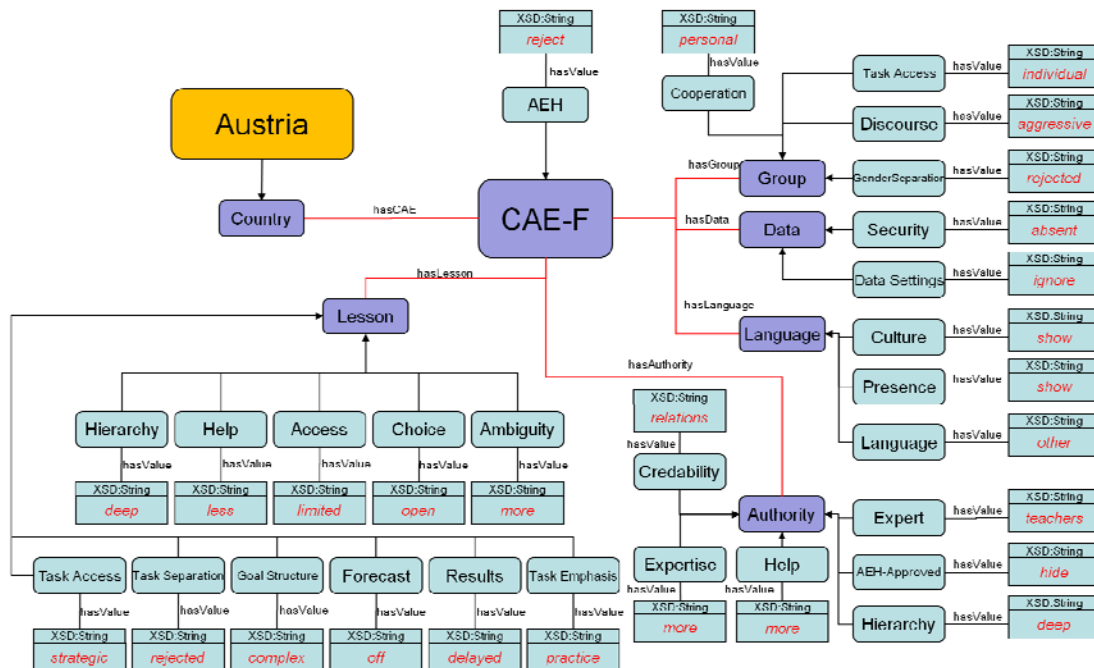
Figure 4.5: Instance Diagram of the CAE-F Ontology for Austria (AUT)

The Austrian student stereotype above describes a learner that prefers to focus on their own individual goals (ideally with potential goal results and outcomes not being forecast) when involved in group work, this will allow for a more vocal and outspoken exchange of views (and groups ideally should more homogeneous in their composition). Whilst they have a more individualistic mind set, it seems that overall they do not wish to use an AEH system to give them a personalized lesson. This possibly links to their views on the nature of the student::teacher interaction – they prefer a strict boundary between teachers and learners. However, they will tend to listen to their colleagues when it comes to recommendations. An AEH system blurs that distinction and as such may not be welcome, although it may be that with 'officially approved' lessons this distinction can be reinforced. This however conflicts with the 'AEH-Approved' concept value of 'hide', more research would be needed to investigate this issue.

With respect to the Austrian learners' views on the personal data storage and modelling, here it seems that they either accept and trust that the system will be secure (therefore not requiring the presence of 'security' or 'data settings' information or reassurance), or that they just do not care. Considering their acceptance of the 'teacher knows best' attitude it seems that any lesson delivered

in class may, in part, explain this lack of concern. The 'language' sub-ontology, identifies (as with many of the countries investigated) a learner that is open to being taught in secondary languages and in differing cultures.

Finally, it seems that with respect to lesson delivery, the students prefer a more open learning path, with potentially more ambiguity and less help being available – that is, they are not put off by the possibility of making mistakes and therefore learning from them. To this end they do not need their results forecast and these results do not need to be immediately delivered. As would be expected, the nature of their task emphasis is practical rather than theoretical and they consider the 'big picture' when it comes to accessing and addressing tasks (task access = strategic).

4.4.2 CHINA

Chinese students prefer to focus on the overall group effort. These groups (such as a small team dedicated to a particular task or the entire class) prefer to work towards their overall group goals and handle conflict in a less outspoken and individualistic manner – respect for your group peers is expected, even if you disagree with them. Working with their peers is preferred and in addition the accepted authority figures are teachers and peers, although it seems that the credibility for the teacher comes mainly from the relations that the teacher has (bottom up), rather than from any university edict (top down). There is no need to display the credentials of the person who is doing the teaching.
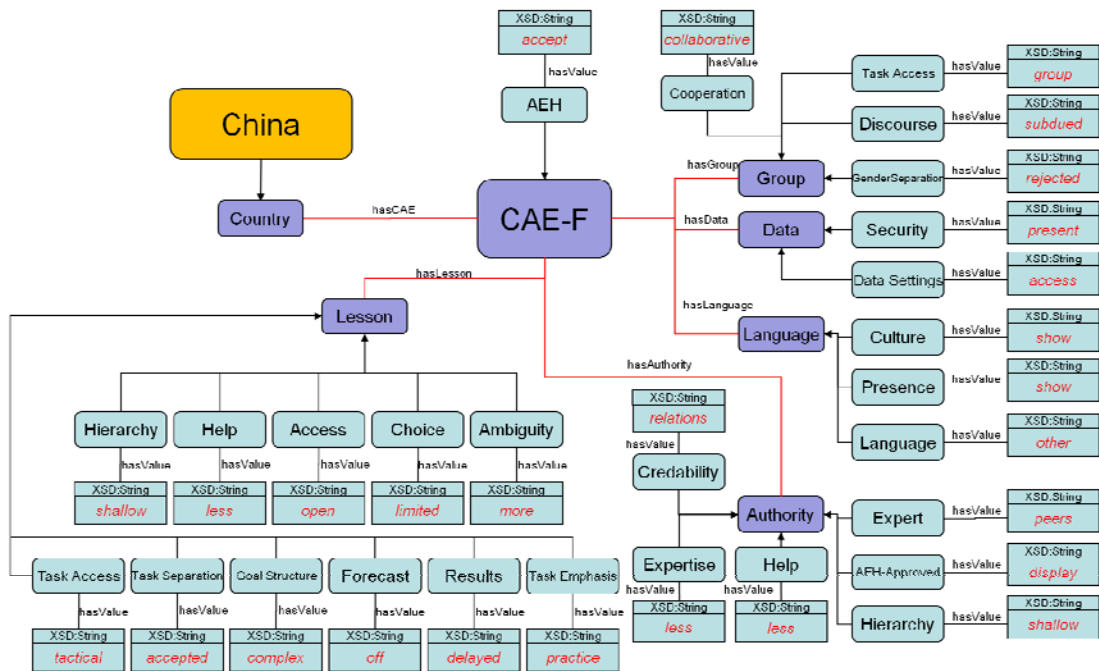
Figure 4.6: Instance Diagram of the CAE-F Ontology for China (CHN)

Content and lessons delivered in AEH systems are accepted, but the personalized lessons need to be marked as being approved for use by the teacher (or other experts). The personal data stored must be clearly marked as being secure (ideally by acknowledged experts, rather than an anonymous company) with the students been given easy access to these settings. Like many of the other countries under investigation, Chinese students are accepting of being taught in languages other than their mother tongue and of the presence of differing cultures to their own.

When it comes to lesson structure, Chinese students are accepting of greater degrees of ambiguity and uncertainty in their lessons, but at the same time prefer to have limited access to specific tasks for their given goals (which may be complex in nature). Hence they focus on a smaller series of tasks, but may have more links and information leading them to related information (it must be closely related to the task at hand however). As for achieving these goals, these learners have patience in achieving them and do not need immediate feedback as they progress.

4.4.3 FRANCE
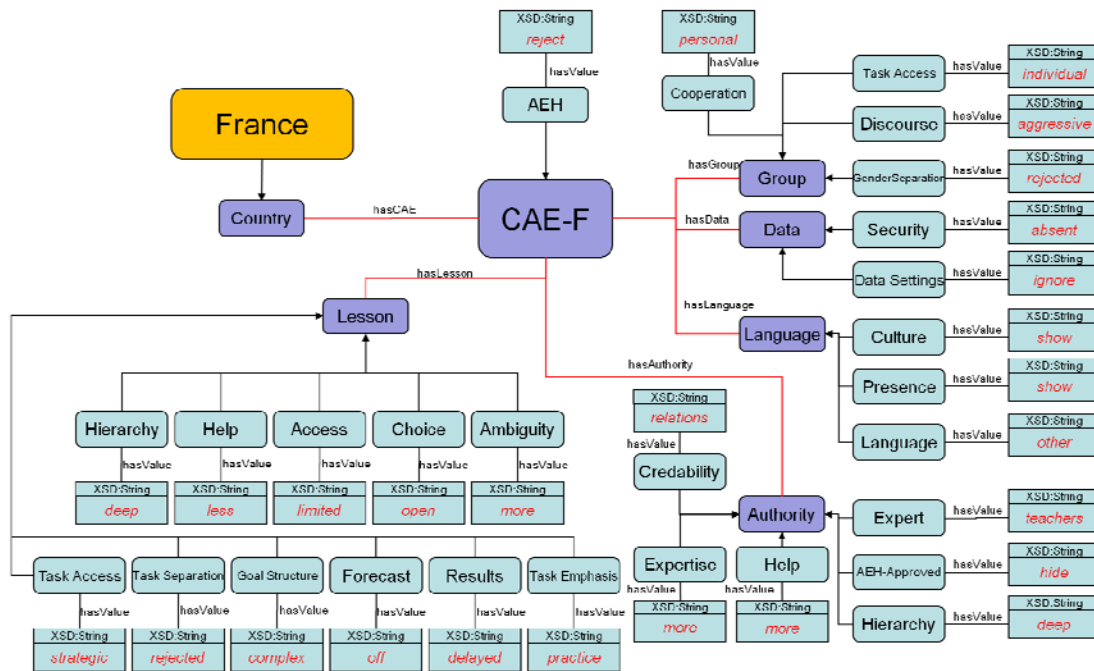
Figure 4.7: Instance Diagram of the CAE-F Ontology for France (FRA)

The French students are similar to Austrian students in many respects – they are both cultures that prefer to focus on the individual - its goals, tasks and achievements, with a focus on a more aggressive dialogue between contending members. Teachers of these students are held in esteem, with their expertise being more accepted and valued than the student's peers. Unlike the Chinese, the French have no need for the 'officially' approved nature of the personalized lesson to be displayed; nor do they require the presence of data security information to be clearly labelled, and access to this data does not have to be as readily available.

These learners have no obvious desire to use AEH systems to receive a personalized lesson, which, considering their focus on the individual rather than the group, seems strange. In some cases it may be better for these students to have no initial personalization of the lesson – at least for the content (so that all members of the group receive the same content) whilst adapting the user interface using the other aspects of the CAE-F ontology. However, it may be that it is the lack of exposure to such systems that causes them concern and the fact that the teachers are held in high regard – an online system may not be considered an 'expert' - and as such, its automatic decisions are to be suspected. More research would be required to investigate this issue, but, in such cases, delivering an adaptive lesson may be better than a non-adaptive one, but the adaptation should be hidden.

Education in languages other than French is accepted, as is exposure to other cultures. Within the lesson structure, French students prefer limited access to tasks, but open access to information surrounding those tasks (with less direct help and a willingness to experience more ambiguity within the lesson), with delayed feedback on the results.

4.4.4 GERMANY

German learners are individuals in nature when it comes to achieving their goals and tasks. Even when working in a group, they prefer to focus on their own aims (resulting in a more outspoken discussion style), with readily available forecasting/feedback (although final results may be delayed) for the results of their actions where possible.

German students focus less on the divisions between teachers and their peers, and accept that their peers may well be considered experts in a topic in addition to their teachers (such credibility is governed by relations – so the opinion of their peers is closely listened to). The nature of AEH systems and the delivery of personalized lessons are neither rejected nor accepted, but with additional focus on the personal gains to be made from such systems, this indifference could probably be overcome.
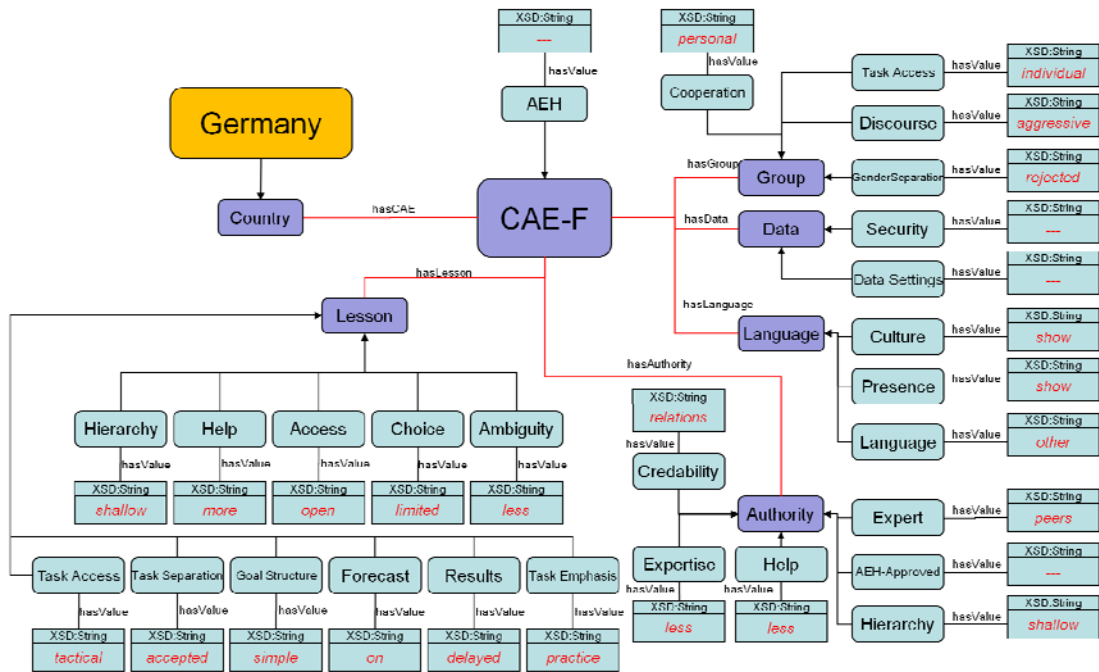
Figure 4.8: Instance Diagram of the CAE-F Ontology for Germany (DEU)

When it comes to addressing other languages and cultures, the Germans are open to both. Attitudes to control and access to their data is currently unknown, however it is probably advisable to ensure that obvious security features are available.

The lessons that are presented to German students should be unambiguous, with clearly defined and simply presented goals and tasks that give an idea of the possible outcomes however delayed feedback on the results is acceptable (forecasting should be available). The lesson's tasks may be completed in any order (as long as they follow the rules set above: i.e. clearly defined) with more help easily available.

4.4.5 GREECE

Greek students, like the Chinese students, prefer to work in cooperative groups that use subdued, less individually focused, hyperbole in their discussions. There is no clearly identified way to identify expertise and credibility within the lessons. However, considering that teachers are considered the 'experts', then it is probably best that they are also considered to be more authoritative than their peers and emphasis should be placed on this expert nature of the teachers, content and help given in the lesson (until more data is available to accurately decide on this issue).

The CAE study has not been able to determine the Greek students values for several concepts in *Figure 4.9*, such as 'AEH-Approved', 'Credibility', 'Expertise', 'AEH', 'Security' and 'Data settings'; more information is needed before any conclusions can be drawn for these concepts.

Like the previous countries, the Greek learners are open to be taught in a language other than Greek and being exposed to differing cultures than their own.

As for the manner in which a lesson should be presented, these students prefer a directed lesson structure that minimizes uncertainty, offering more help, directed task access for limited lesson goals, with fewer links to additional materials (beyond the basic lesson) and results should ideally be forecast.

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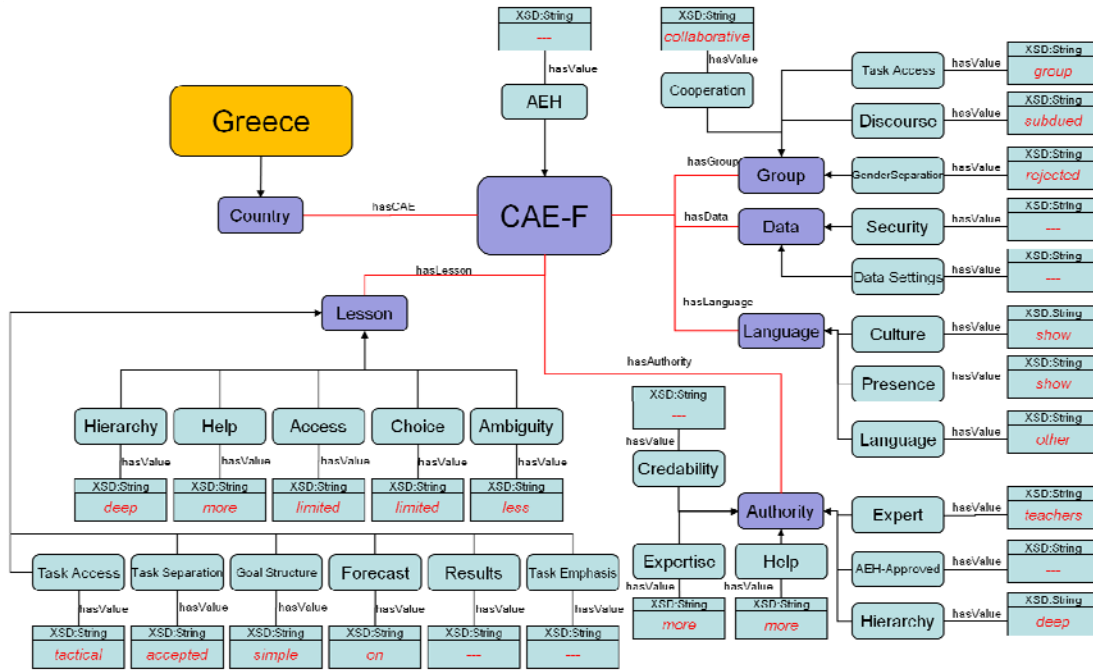
Figure 4.9: Instance Diagram of the CAE-F Ontology for Greece (GRC)

4.4.6   INDIA

Indian students reject the need for AEH based lessons, but if they are to be used, then they do not need to be reassured that the lesson has been approved by their teachers, nor do they need clearly presented security details or ready access to their user model and other lesson data.

Like several other countries they use relations to determine which of their teachers or peers can be considered experts, and this distinction does not need to be clearly marked in the lessons and any help that is given. Their group structure is a cooperative one, with learner focus on working together for all members to achieve their goals.
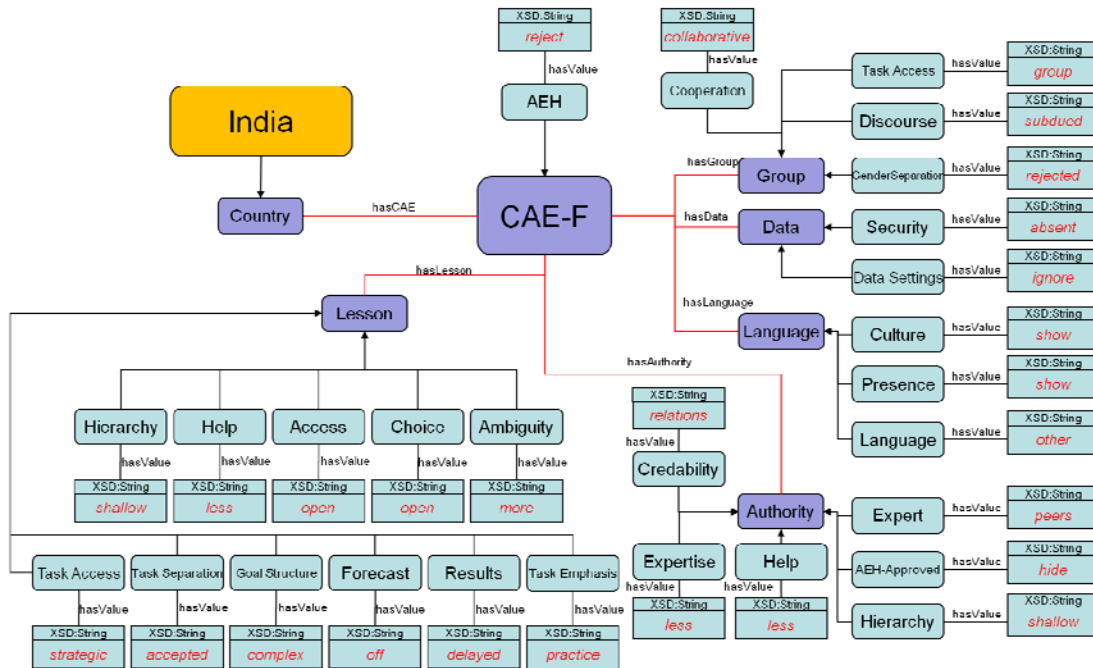
Figure 4.10: Instance Diagram of the CAE-F Ontology for India (IND)

The lesson structure reflects the desire for clearly defined but shallow hierarchies, with an uncertainty being an accepted part of the teaching process – as such they need less access to help systems than

some other countries under investigation, also links to additional materials that are related to the current task should be given. The path to achieve each goal may be complex, and the access to the tasks involved in these paths should be open. Forecasting is not necessarily required and feedback on actions may be delayed rather than immediately given.

4.4.7 IRELAND

Ireland is the first of the countries studied whose students have a limited desire to be exposed to other languages. These students would rather be taught in their own mother tongue (presumably this might be English, but this was not investigated), and they would prefer that their teaching materials restricted the presence of other languages to a bare minimum. However, they are content to be exposed to other cultures. Hence an Irish student studying abroad would prefer that their learning materials were presented in English, but would be accepting of local cultures and mores being visible/available within the AEH system.
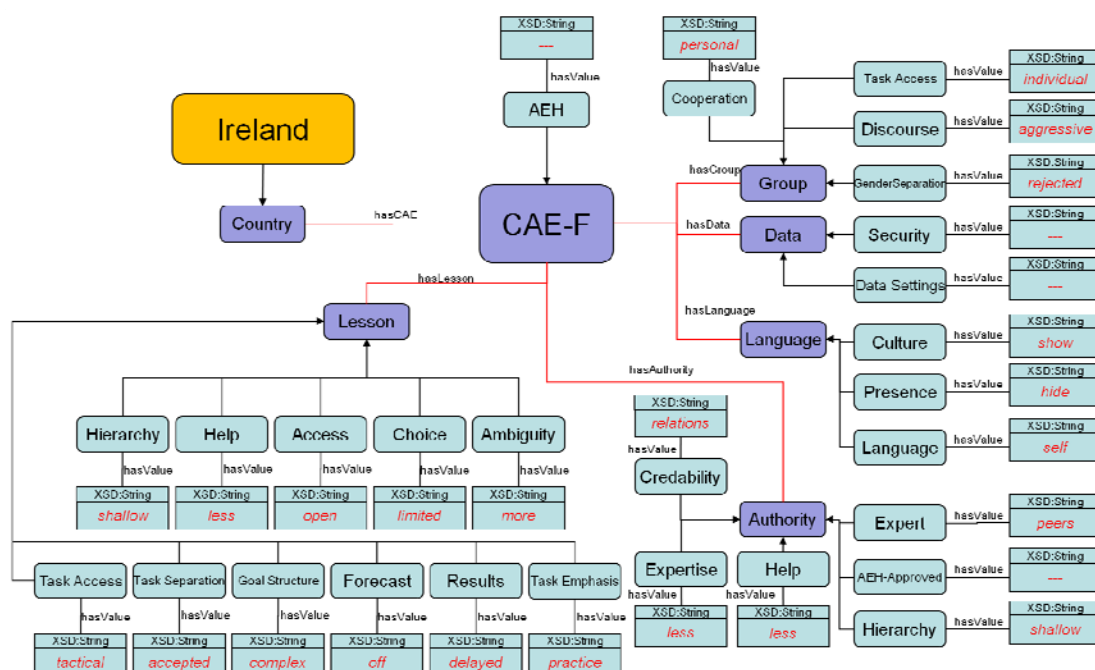
Figure 4.11: Instance Diagram of the CAE-F Ontology for Ireland (IRL)

Beyond this, Ireland is the second country that the CAE study has not been able to determine the student values for the concepts of: 'AEH-Approved'; 'AEH'; 'Security' and 'Data settings', as students showed no clear preferences for these features. More information is needed before any conclusions can be drawn for these concepts.

The Irish preference for group structure is to focus on individual goals and attitudes (ideally in homogenous groups). Word of mouth (relations) is used to determine who the best experts are, and these can be teachers as well as peers.

The lesson should allow for greater ambiguity (less help) and access to additional materials, and the access to tasks should be directed (although with fewer barriers to access, such as tests and prerequisite tasks), with no need for either forecasting the results or immediate feedback on progress.

4.4.8 NETHERLANDS

The Dutch students are accepting of the use of AEH systems, but these lessons should be clearly marked as having been approved by the appropriate authority, with a clearly defined data security plan and access to these settings.

The Dutch stereotype shows that these students are very individualistic, with personal gains being the focus of any group activities, with tasks being separated between like-minded members and

discussion between these members being forceful and insistent in getting across their personal view point.
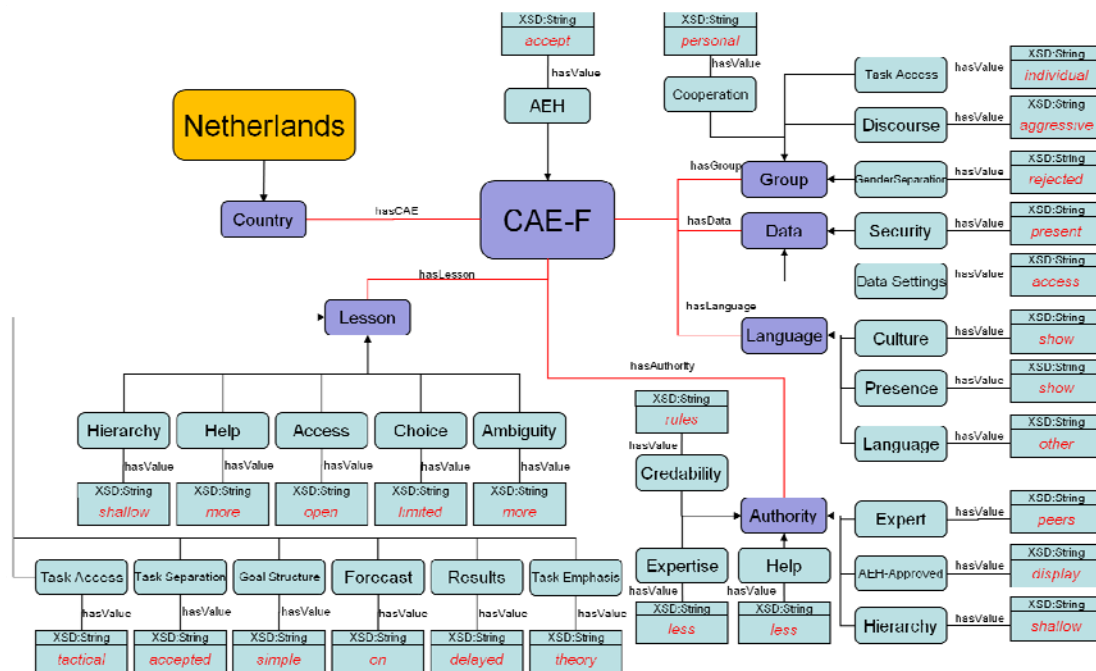
Figure 4.12: Instance Diagram of the CAE-F Ontology for Netherlands (NLD)

The students' peers as well as their teachers are considered experts, but the source of this credibility should be established from above (e.g., by the teachers). Therefore, the official nature of any help given does not have to be highlighted and the difference between teachers and students as 'experts' is less than in most other countries ('hierarchy' = 'shallow').

A lesson presented in an adaptive system for Dutch students should allow for open access to tasks and lesson contents. The students are then able to direct their own learning, rather than being explicitly directed by the system. Thus, the support that these learners receive, including access to additional help materials and goal structures, should be kept simple. Whilst ambiguity and uncertainty are more acceptable for Dutch students, they should have ready access to forecasts (highlighting what the results of a given choice will be) and feedback.

It should also be noted that whilst the CAE-F ontology does not make a distinction concerning the respondent's language of choice, the Dutch students were the only ones whose response to the 'Language' sub-ontology indicated that they prefer to be taught in a language *other* than their own (rather than being indifferent).

4.4.9 ROMANIA

Romanian students reject the idea for a personalised learning environment, but if one was to be used (for example in manipulating the AEH interface style rather than the core content) then there is no need for teacher approval of the lesson to be present, nor is there need for the data security plan and setting to be made available. The appropriate authority for a Romanian student is the teacher with rules enforced from above (e.g., the university) clearly defining who is allowed to be 'in charge'.

When group structures are involved, Romanian students prefer to work collaboratively in the group towards a common purpose rather than focussing on the individual. Like many of the other countries under investigation, they are open to being taught in other languages and experiencing cultures other than their own.

Within the AEH lesson, Romanians prefer a more directed level of guidance, with more help, less ambiguity, limited and focused choice of tasks with frequent barriers to access (e.g., tests). The results for a given task should be forecast where possible and results should be given immediately.
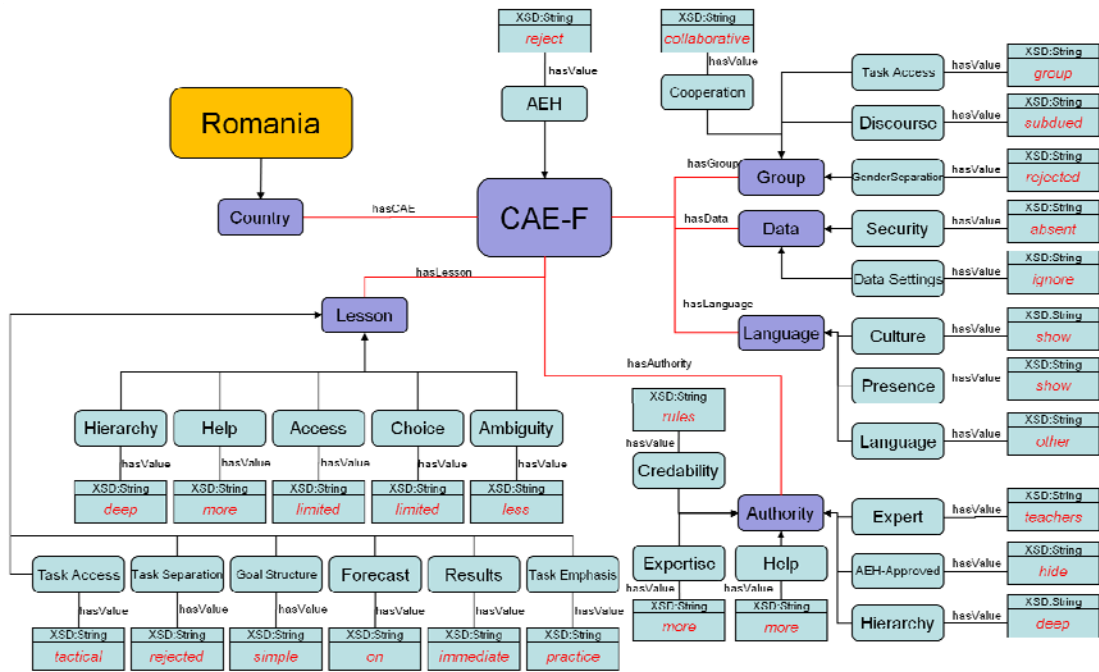
Figure 4.13: Instance Diagram of the CAE-F Ontology for Romania (ROU)

4.4.10 SAUDI ARABIA
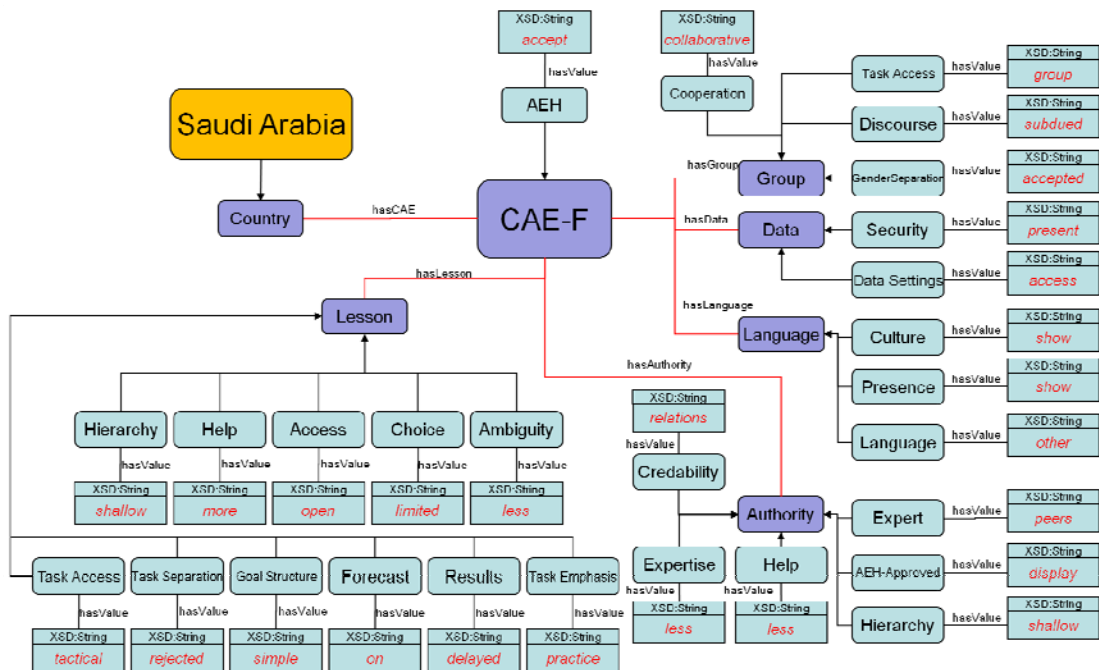
Figure 4.14: Instance Diagram of the CAE-F Ontology for Saudi Arabia (SAU)

Saudi students are focused on collaborative group work, with preference for working with homogeneous groups – to the extent that Saudi respondents were the only ones that indicated that they accepted the need for separation of the genders in teaching. This has obvious implications for group formation, but also for the discussion fora and media presentation in the lesson.

These students are positively inclined with respect to the need for an AEH learning system. However, they need to see such a system's lessons clearly marked as 'teacher approved'. In addition, the user model needs to be easily accessed and the data security settings to be clearly indicated.

Experts are both their teachers and peers. Which teachers (or peers) are considered to be experts is decided upon by the student and teacher relations, rather than by the university or the teachers themselves.

A Saudi student lesson focuses on a simple goal structure and using a directed task access (e.g., as established by various prerequisites). Choices beyond this should be kept open, but with readily available help, thereby reducing uncertainty. Also to help with this, the forecasting of outcomes should be available (e.g., "if you choose task A, you will be allowed to access task B, followed by the exam"), although feedback can be delayed rather than immediate.

4.4.11 UNITED KINGDOM

The UK students reject the use of AEH systems, but if used, then these lessons do not need to be clearly marked as having been approved by the appropriate authority, nor do they need a clearly defined data security plan and access to these settings.

UK students consider their own individual focus when it comes to working in groups (ideally they would prefer to work alone at their own pace), and will be forthright in putting their own opinion forwards. Teachers are considered experts (directed by rules and regulations applied by the institution) and help/lesson materials should be clearly marked as being from them.

The lesson structure should allow for greater uncertainty and open choice of materials, and an open series of complex task structures (i.e., multiple learning paths are appropriate and the student should have few barriers to accessing whatever path they chose). Results do not need to be forecast, and any feedback may be delayed.

The main distinction of the UK stereotype is within the 'Language' sub-ontology: these students do *not* wish to be taught in any language other than their own, nor do they wish exposure to other cultures or languages within their lesson material (obviously this might not always be possible, especially for language students). This makes the UK students the most insular of all the countries investigated. This it is an important aspect for any AEH lesson materials presented (otherwise there is the risk of alienating the students and reducing the learning efficiency).
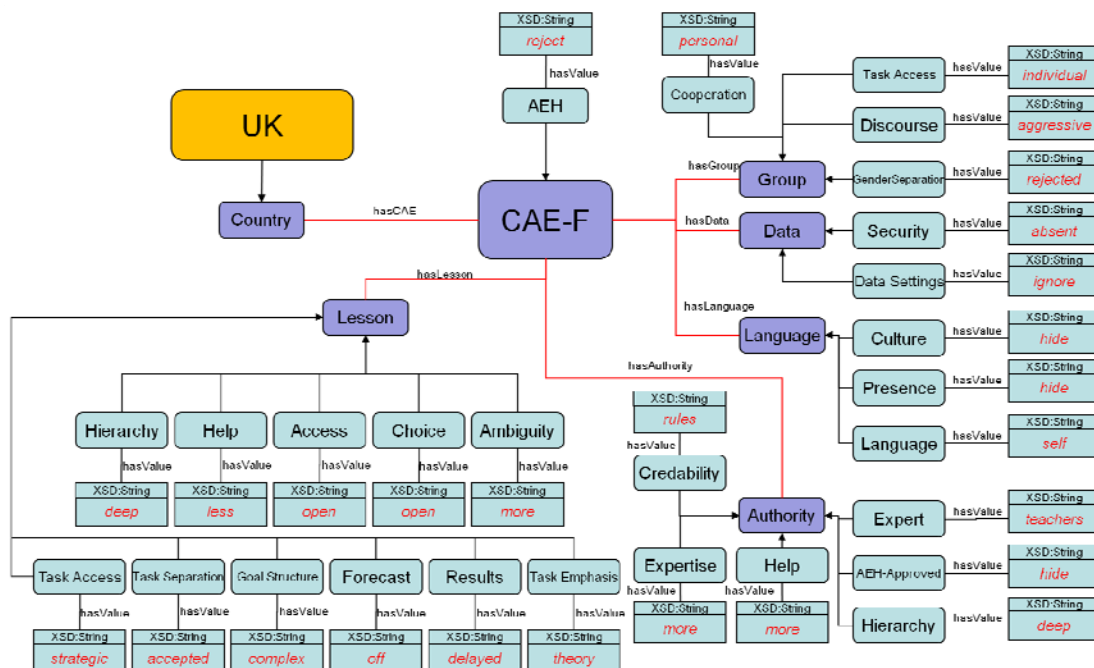
Figure 4.15: Instance Diagram of the CAE-F Ontology for United Kingdom (GBR)

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4.5.1   CAE-L ONTOLOGY:

The CAE-F instances described above are the ideal use case examples. However, as previously discussed, the CAE-L subset was extracted as a simpler approach to creating a feasible software implementation (the choice was made for each concept as to how easily it could be implemented within the time scale in an AEH systems such as ADE, see Chapter 2 and Chapter 5 for more information on this implementation). For example Lesson::hierarchy was chosen to be included as implementing this in an AEH system as part of the navigation bar was considered a straightforward matter. Compare this with Lesson::results which ideally should present the learner with feedback (or not as the case may be), which would have required a great deal of time to implement in our proposed test system (using ADE – see Chapter 7). As such, the concepts chosen to be included will be used to create an AEH system that will be able to adapt to those concept values as they are considered to represent a balanced enough set of features for the total features space.

The CAE-L instance values can be seen in *Table 4.2*, followed by a short description concerning the type of adaptation that could be used in the AEH implementation (this is a more application-oriented description, rather than the generic one given earlier).

Ontology: *Concept*	Austria	China	France	Germany	Greece	India	Ireland	Netherlands	Romania	Saudi Arabia	UK
AEH	reject	accept	reject	null	null	reject	null	accept	reject	accept	reject
Authority:											
Expert	teachers	peers	teachers	peers	teachers	peers	peers	peers	teachers	peers	teachers
Help	more	less	more	less	more	less	less	less	more	less	more
AEH Approved	hide	display	hide	null	null	hide	null	display	hide	display	hide
Group:											
Gender Separation	rejected	rejected	rejected	rejected	rejected	rejected	rejected	rejected	rejected	accepted	rejected
Language:											
Presence	show	show	show	show	show	show	hide	show	show	show	hide
Culture	show	show	show	show	show	show	show	show	show	show	hide
Lesson:											
Hierarchy	deep	shallow	deep	shallow	deep	shallow	shallow	shallow	deep	shallow	deep
Help	less	less	less	more	more	less	less	more	more	more	less
Access	limited	open	limited	open	limited	open	open	open	limited	open	open
Choice	open	limited	open	limited	limited	open	limited	limited	limited	limited	open
Ambiguity	more	more	more	less	less	more	more	more	less	less	more
Data:											
Security	absent	present	absent	null	null	absent	null	present	absent	present	absent

Table 4.2: The CAE-L instance descriptions for the eleven countries under investigation.

The CAE-L ontology top level concept:

- *AEH*

   Adaptation value: accept – the system should clearly indentify that this lesson has been

   personalised for the learner.

Adaptation values: reject – the system should hide the fact that the system has been personalised. (the decision was made not to drop adaptation, but to still perform a version of it, albeit a very light-touch one)

Adaptation values: null – the system should hide the fact that the system has been personalised. (null values result from unknown states or data; the decision was made to treat nulls as 'reject', in order to minimize the potential negative impact of adaptation on the student users; please note that this method is used throughout the defining elements of the CAE-L ontology)

Authority Ontology concepts:

- *Expert*

  Adaptation value: peers – learners will readily accept expert teaching from their peers; chat fora could be used to this end.

  Adaptation value: teachers – with this concept value, the learners only consider the expertise of their superiors (such as teachers) as being valid – any teaching given in a lesson should reflect this.

- *Help*

  Adaptation value: more – online help should be offered through officially moderated avenues ("email the teacher!")

  Adaptation value: less – peer support is acceptable, "email your group!"

- *AEH-Approved*

  Adaptation value: display – a notice stating that the teacher has approved this lesson should be included.

  Adaptation value: hide – there is no need for any such notice to be included.

  Adaptation values: null – there is no need for any such notice to be included.

Group Ontology concepts:

- *Gender Separation*

Adaptation value: accepted – ideally, all references to the opposite gender should be removed, where feasible. This includes images, examples and coursework.

Adaptation value: rejected – there is no special need to separate the genders in coursework, groups, or in social venues (chat fora).

Language Ontology concepts:

- ***Presence***

  Adaptation value: show – educational materials in non-mother tongue languages are allowed (and may even be encouraged) to be displayed (this may be important in Open Hypermedia Systems, where additional materials from the web can be imported).

  Adaptation value: hide – ideally, all educational materials should be presented in the mother tongue. Where this is not possible (for example an Italian student studying in France, where the materials are all in French), then exposure to additional languages should be minimised.

- ***Culture***

  Adaptation value: show – the learner is accepting of exposure to different cultures. When adapting to this concept, the adaptive system could display local information (be it of a educational nature or not).

  Adaptation value: hide – the learner should be minimally exposed to cultures other than their own. In fact, the system could even display news items from their home country, no matter where they are situated.

Lesson Ontology concepts:

- ***Hierarchy***

  Adaptation value: deep – adaptation to this concept value is straightforward to perform, as it has been implemented in many AEH systems already (in a limited manner as a method to apply different learning styles, specifically 'Global vs. Analytical' [Whitefield, 1995], or 'Field Dependence vs. Independence' [Witkin and Goodenough, 1981]). This implementation would take the form of concepts being arranged in a 'deep' manner, with topics being presented in a top down fashion (topics as children).

Adaptation value: shallow – with this concept value topics should be presented in a breadth first approach, content trees should be shallow in presentation, which would result in more topics being presented at the same time (topics as siblings).

- *Help*

Adaptation value: less – within any given presentation of lesson materials, whilst Help should always be available, there is no need for learners with this concept value to have any additional recourse to other Help functionalities (materials or structures).

Adaptation value: more – learners with this concept value are more likely to desire the presence of additional support functions. This is not to say that they need this 'Help', but that they would feel more comfortable with it available – such as 'Help' links within the educational materials.

- *Access*

Adaptation value: limited – these learners are more comfortable with limited access to learning materials, with new materials only becoming available (visible) as they progress through a lesson (as defined by their lesson score or lesson prerequisites).

Adaptation value: open – whereas learners with the concept value of 'open' would have access to all of the learning materials (under the auspices of the lesson designer) and are encouraged to work through them in any way they wish.

- *Choice*

Adaptation value: limited – the complexity of lesson presentation should be kept to a minimum, with fewer unnecessary choices for the student. This is a much more highly structured educational methodology, with a less cluttered user interface.

Adaptation value: open – similar to the 'open' concept value for '**Access**' above, this concept value describes the complexity of the materials and learning interface beyond mere access to educational resources. Learners with this concept value should be allowed to make their own choices as to the manner of their learning allowing for maximum complexity in data presentation.

- *Ambiguity*

    Adaptation value: less – learners with this concept value should be presented with multiple redundant cues within each lesson and the AEH interface should give them several ways in which to complete their tasks.

    Adaptation value: more – these learners do not need the multiple cues that those with the concept value of 'less' do.

Data Ontology concepts:

- *Security*

    Adaptation value: present – Security indicators, such as security procedures and information, should be plainly visible.

    Adaptation value: absent – here such security indicators do not need to be as visible; they still need to be in place, but the students do not always need to see that they are in place.

    Adaptation values: null – again, such security indicators do not need to be as visible; they still need to be in place, but the students do not always need to see that they are in place.

4.5.2 CAE-L XML

Following through on the CAE-L ontology presented in *Figure 4.3*, the CAE-L structure was described as an XML node tree in *Figure 4.16*. Each sub-ontology is defined as an XML element, with the concepts as XML attributes. Attributes were used in preference to elements for the concepts, as to better control the values that may be contained within them. An XML element value may reasonably be expected to be any valid text string, on the other hand attributes are expected to have a limited set of choices. This is more in keeping with the CAE-L ontology instances.

```
<?xml version="1.0"?>

<cael version="1.0" aeh="">
      <countryCode name="" threela="" twola="" numeric=""/>

      <authority help="" expert="" aehApproved=""/>

      <group genderseparation=""/>

      <language presence="" culture=""/>

      <lesson hierarchy="" help="" access="" choice="" ambiguity=""/>

      <data security=""/>

      <comment></comment>

</cael>
```

Figure 4.16: the CAE-L XML structure (cael.xml).

The country stereotype values described in *Table 4.2* can then be applied to this XML structure and each country has its own XML instance, see *Figure 4.17* for Austria's example.

```xml
<?xml version="1.0"?><!DOCTYPE cael []>

<cael version="1.0" aeh="reject"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation="caels.xsd">

      <countryCode name="Austria" threela="AUT" twola="AT"
                numeric="040"/>
      <authority help="more" expert="teachers" aehApproved="hide"/>
      <group genderseparation="rejected"/>
      <language presence="show" culture="show"/>
      <lesson hierarchy="deep" help="more" access="limited"
                choice="limited" ambiguity="less"/>
      <data security="absent"/>
      <comment>Comment text for Austria's CAE-L description</comment>
</cael>
```

Figure 4.17: the CAE-L XML instance for Austria (cael-aut.xml).

For the rest of the XML instances of all the eleven countries under investigation see Appendix B.

4.5.3   XML SCHEMA FOR CAE-L

As can be seen from *Figure 4.17*, the CAE-L XML files contain a reference to the CAE-L XSchema:

```
        xsi:noNamespaceSchemaLocation="caels.xsd">
```

The CAE-L XML Schema is used to validate each of the CAE-L XML files to ensure that each one is correct in its structure and concept values. The overall Schema structure is shown in *Figure 4.18*.

As can be seen from *Figure 4.18* the structure of the XML Schema file matches that of the CAE-L XML file, with each XML element identified using a reference, such as:

```xml
<xs:element ref="authority" minOccurs="1" maxOccurs="1"/>
```

The element reference also sets the limits on how many of such elements are to be allowed in each XML file, in this case '1' (minimum = 1 and maximum = 1) for each of the sub-ontology elements (authority, group, language, lesson and data). Also the country specific data element (countryCode) may only be included once; this 'countryCode' reference is required for the identification of which country instance belongs to which of the several country identifiers available for use (see *Table 5.1* in Chapter 6 for more details). Whereas the 'comment' element has been included so that additional textual information may be added if required; to this end the element description is:

```xml
<xs:element ref="comment" maxOccurs="1" minOccurs="0"/>
```

Hence this element is optional but may only be included a maximum of one time. Please note that any length of text can be added via this element, though.

Following each element reference the attributes of each element are described, for the 'authority' element, for example:

```xml
<xs:element name="authority">
      <xs:complexType>
            <xs:attribute name="aehApproved" use="required"
                  type="c-aehApproved"/>
            <xs:attribute name="expert" use="required" type="c-expert"/>
            <xs:attribute  name="help"  use="required"  type="c-authority-
help"/>
      </xs:complexType>
</xs:element>
```
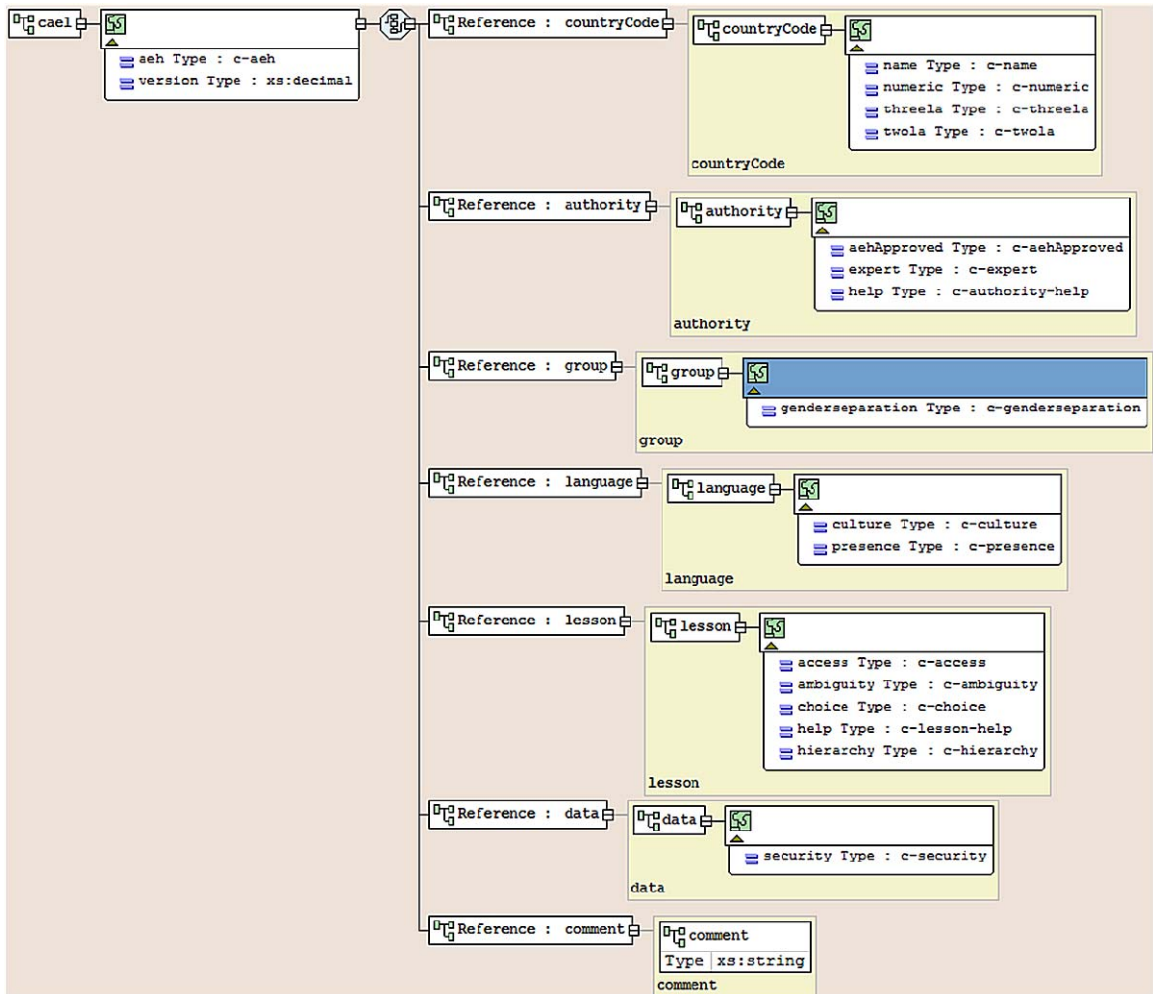
Figure 4.18: the CAE-L XSchema structure (caels.xsd), the full XSD file is given in Appendix D.

Here the 'authority' element has three attributes, 'aehApproved', 'expert' and 'help'. Each of the attributes has a set name (matching the XML instance files), a 'use' which defines if there are to be any restrictions used for this attribute value (and if these restrictions are required or optional) and a 'type' (this links to the type description for the attribute's restriction values). So for the 'expert' attribute of the 'authority' element, the type description is:

```
<xs:simpleType name="c-expert">
       <xs:restriction base="xs:string">
              <xs:enumeration value="peers"/>
              <xs:enumeration value="teachers"/>
       </xs:restriction>
</xs:simpleType>
```

Note that the <xs:attribute> 'type' links to the 'name' of the <xs:simpleType>. The 'simpleType' goes on to describe the possible accepted values for this attribute – this is done as a 'restriction'. This means that only an attribute value of 'peers' or 'teachers' is acceptable when completing the XML instance XML files. Any other value will mean that the XML file is invalid.

Another use of this type description is for the 'countryCode' element, hence the 'name' of the country is described as:

```
<xs:simpleType name="c-name">
       <xs:restriction base="xs:string">
              <xs:pattern value="([a-zA-Z])+"/>
       </xs:restriction>
</xs:simpleType>
```

Here there is no set country that must be specified but the value of this attribute must be a text string using the letters a to z (and or A to Z), no other text characters are allowed.

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The 'numeric' attribute is described as:

```
<xs:simpleType name="c-numeric">
      <xs:restriction base="xs:positiveInteger">
            <xs:maxInclusive value="999"/>
            <xs:totalDigits value="3"/>
      </xs:restriction>
</xs:simpleType>
```

The nature of the numeric country identifier means that each country is given a three digit code, this is described here with the 'maxInclusive' descriptor, meaning that the highest value numeric country code allowed is 999, and that this attribute must contain three digits (hence '1' is invalid, but '001' is valid).

Finally the 'threela' and 'twola' attributes are described using the following approach:

```
<xs:simpleType name="c-threela">
      <xs:restriction base="xs:string">
            <xs:pattern value="[a-zA-Z][a-zA-Z][a-zA-Z]"/>
      </xs:restriction>
</xs:simpleType>
```

The regEx [regEx, 2011] pattern here describes the three letter abbreviation allowed for the 'threela' attribute (the 'twola' uses: [a-zA-Z][a-zA-Z]), which means that three letters have to be used, and each letter has to be within the a to z range, but may be either lower or upper case.

It should be noted that of the four attributes used to describe a country only the 'name' attribute is mandatory, the remaining three are optional, although their use should be strongly recommended, as these are a ISO standards[5] - based approach to identifying each country, which will make implementation much simpler and efficient.

4.6   SUMMARY

In this chapter, the results of the CAE questionnaire consolidated into two ontologies (the CAE-F and CAE-L ontologies) guided by the Marcus and Gould examination of the Hofstede indices on the Web. The CAE-F ontologies have been presented and the possible meaning behind each country's ontology instance has been presented and discussed.

Following this, the CAE-L ontology has been described. Thus, this work goes beyond mirroring that of Hofstede, which would mean building only a set of indexes for the educational domain. Instead, this work delivers cultural ontologies for the educational domain. By building ontologies, the connections between the cultural concepts are also represented, and can be used in building learner models for adaptive educational systems. The two versions of the ontologies leave it to the developer to decide on the complexity of the implementation, thus allowing a quick and simple solution for integrating cultural diversity in the personalisation process.

Moreover, for the CAE-L ontology, the implementation of this ontology for each country in XML format has been given. Finally, the XML Schema that sets the validation boundaries for this ontology has been created and discussed.

4.7   NEXT

The findings from this chapter will be used in Chapter 5 to guide us towards the implementation of a CAE-L aware AEH system.

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[5] As detailed at the beginning of chapter 5.

CHAPTER 5:

THE CAE SOFTWARE

5 CAE SOFTWARE

5.1 INTRODUCTION

As stated in Chapter 4, the CAE-L ontology was extracted from the CAE-F ontology as a simpler approach to creating a feasible software implementation. In this chapter, the software implementations/modifications required to allow an extant AEH system to access and use the CAE-L ontology are discussed. This chapter focuses on the process involved in establishing the link between any AEH system and the CAE-L ontology repository. Suggestions are then made as to how an AEH could use this information, focussing on interface adaptation, as this is one of the most interesting and unused types of adaptation and as such should not interfere with current adaptive behaviours (some overlap is unavoidable, it would be up to the AEH designer how to handle these instances). The actual implementation within an AEH environment will be discussed later, in Chapter 7.

5.2 CAE-L PROCESS

Any AEH designer who wishes to make use of the CAE-L ontology can do so. What follows is an example how this could be managed. This is a multi-stage process with the following steps:

1. The learner creates an account in the AEH system (for example Moodle or ADE); as part of this process the learner's nationality is recorded by the AEH's user model.

2. The AEH system sends a request to the CAE-L web service. The parameter of this request is the learner's nationality as represented through one of the following (see *Table 5.1* for these details for the eleven CAE countries discussed so far):

   a. A three letter country code (ISO 3166-1 alpha-3 [3166-a3, 2011])

   b. A two letter country code (ISO 3166-1 alpha-2 [3166-a2, 2011])

   c. A three digit country code numeric (ISO 3166-1 numeric [3166-n, 2011])

   d. The country's name

Country	3 letter	2 letter	Numeric
Austria	AUT	AT	040
China	CHN	CN	156
France	FRA	FR	250
Germany	DEU	DE	276
Greece	GRC	GR	300
India	IND	IN	356
Ireland	IRL	IE	372
Netherlands	NLD	NL	528
Romania	ROU	RO	642
Saudi Arabia	SAU	SA	682
UK	GBR	GB	826

Table 5.1: detailing the country identification information for each of the CAE countries

3. The web service transfers this request to the web service application, which interrogates the database (e.g., the Sesame database), which then returns the required country data. The web service then sends this information back to the AEH system as an XML node tree (as described in the previous chapter).

4. The AEH system uses this country stereotype data in any manner it requires to personalize the lesson for the user.

Note that the above scenario is not prescriptive in that the CAE-L web service aims to present the cultural stereotype to any system (be it an AEH system or not) upon request, but how that system uses the information is not controlled or even directed by the web service. This approach gives the maximum amount of flexibility and ideally future proofs the web service. This approach is based on previous work on interfacing between AEH systems [Stewart *et al*, 2005], where it was considered most appropriate to build a light-weight interface, and thus 'weak connections' between the systems, when interchanging adaptation data, instead of attempting a full-scale integration of the system. This

was in order for the approach to be reusable for other AEH systems, thus reproducible and system-independent.

In examining the scenario described above, it was determined that the following implementations would be required:

- **An AEH**: modified, so that a request for the CAE data can be sent and used

    1. Request string forwarded to web service;
    2. XML node tree accepted and imported into user model, therefore:
    3. The system's user model needs to be expanded to accept the new cultural stereotype data;
    4. UI changes need to be implemented depending on the new user model;
    5. Educational content presentation scenarios need to be changed to reflect the user model.

- **A web service:** created, this service will need to:

    1. Accept request parameter and forward this to the service application;
    2. Accept the response data from the application and forward this back to the AEH system;

- **A service application:** created, this application will process the request by creating a SPARQL query to interrogate the CAE-L ontology instances.

- **CAE-L ontology instances:** created, this database will hold and maintain the actual instances of the CAE-L ontology.

The rest of this chapter details the implementation of these four requirements.

5.2.1   PROTÉGÉ AND OWL

Initially presented in Chapter 2, Protégé was used to create the CAE-L ontology. *Figure 5.1* shows the Protégé interface for creating the initial ontology, with *Figure 5.2* detailing the interface of the Class editor, with *Figure 5.3* finally showing the properties editor. It is through the use of these various interfaces that the CAE-L ontology has been created.
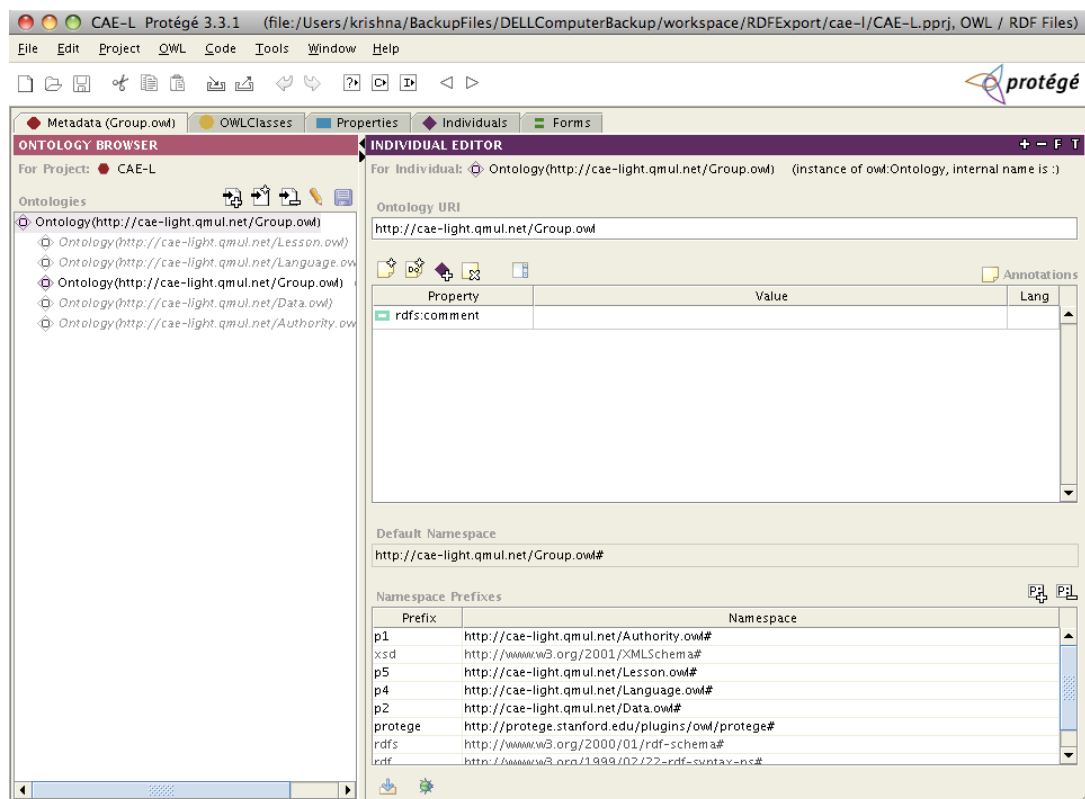
Figure 5.1: CAE-Light Ontology editor

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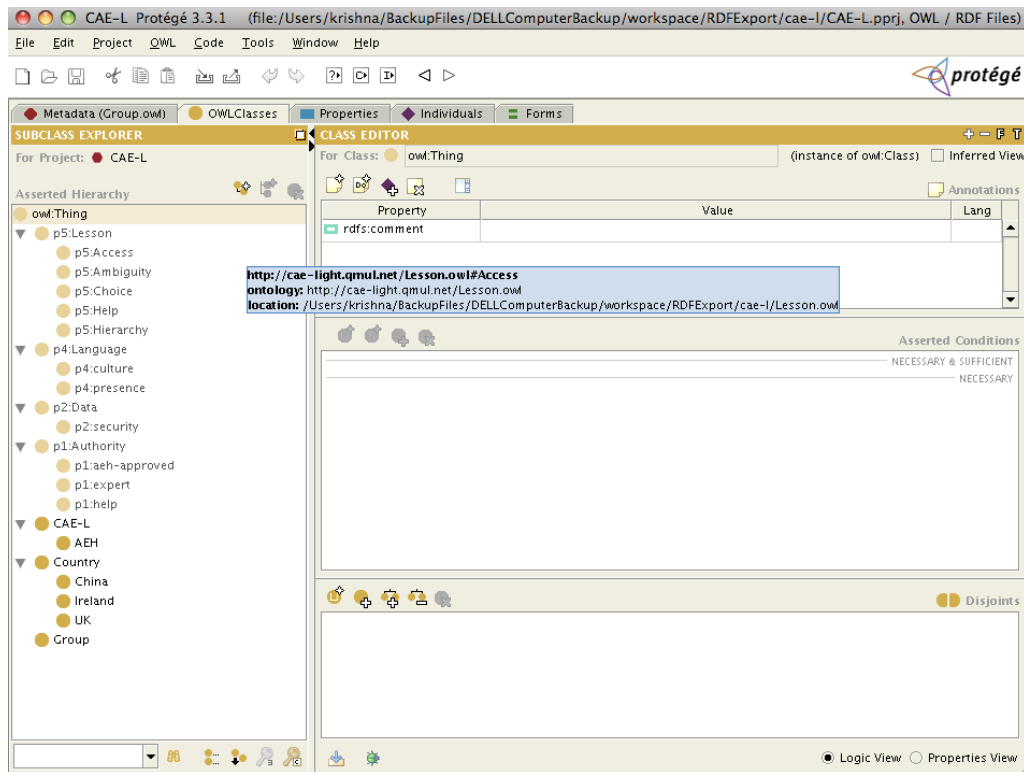
Figure 5.2: Screenshot for "Classes" definition
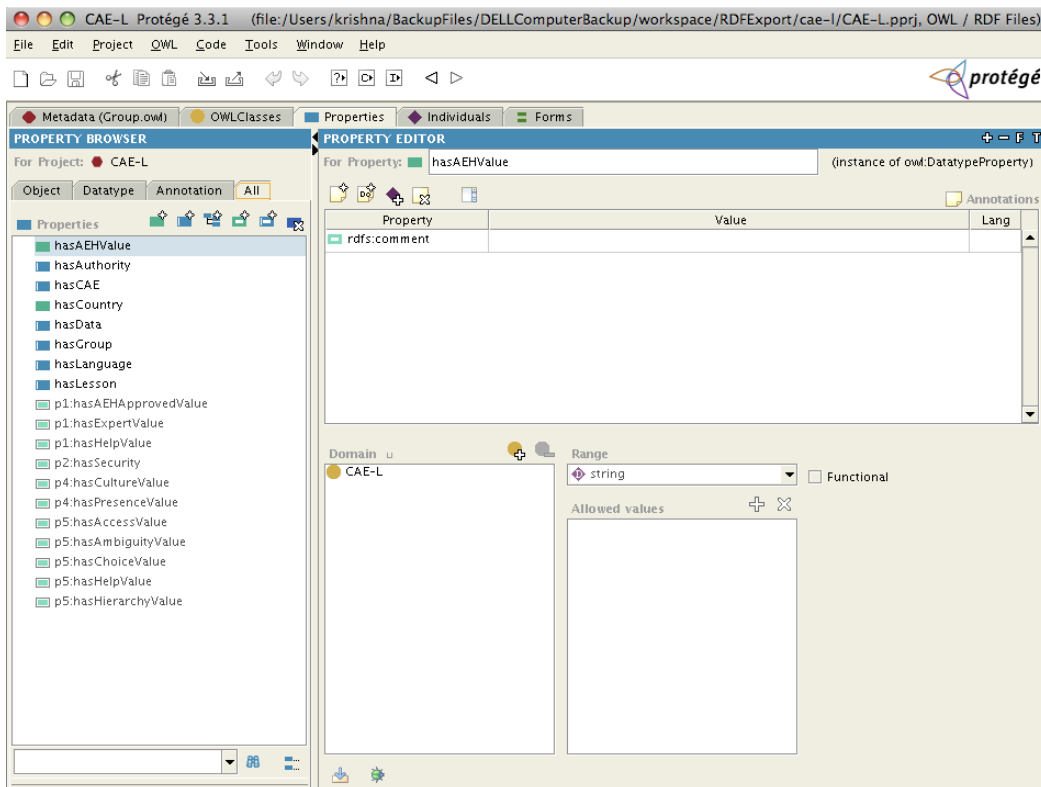
Figure 5.3: Screenshot for the "Property" definition

As detailed in Chapter 2, OWL was chosen to describe the "CAE-L" class definition for the CAE-L Ontology which is defined as follows:

```
<owl:Class rdf:ID="CAE-L">

  <rdfs:subClassOf>

    <owl:Restriction>
```

```
      <owl:cardinality rdf:datatype="http://www.w3.org/2001/XMLSchema#int"
        >1</owl:cardinality>
      <owl:onProperty>
        <owl:ObjectProperty rdf:ID="hasAuthority"/>
      </owl:onProperty>
    </owl:Restriction>
</rdfs:subClassOf>
<rdfs:subClassOf>
  <owl:Restriction>
    <owl:cardinality rdf:datatype="http://www.w3.org/2001/XMLSchema#int"
    >1</owl:cardinality>
    <owl:onProperty>
      <owl:ObjectProperty rdf:ID="hasLesson"/>
    </owl:onProperty>
  </owl:Restriction>
</rdfs:subClassOf>
<rdfs:subClassOf>
  <owl:Restriction>
    <owl:cardinality rdf:datatype="http://www.w3.org/2001/XMLSchema#int"
    >1</owl:cardinality>
    <owl:onProperty>
      <owl:ObjectProperty rdf:ID="hasLanguage"/>
    </owl:onProperty>
  </owl:Restriction>
</rdfs:subClassOf>
<rdfs:subClassOf>
  <owl:Restriction>
    <owl:cardinality rdf:datatype="http://www.w3.org/2001/XMLSchema#int"
    >1</owl:cardinality>
    <owl:onProperty>
      <owl:ObjectProperty rdf:ID="hasGroup"/>
    </owl:onProperty>
  </owl:Restriction>
</rdfs:subClassOf>
<rdfs:subClassOf>
  <owl:Restriction>
    <owl:cardinality rdf:datatype="http://www.w3.org/2001/XMLSchema#int"
    >1</owl:cardinality>
    <owl:onProperty>
      <owl:ObjectProperty rdf:ID="hasData"/>
    </owl:onProperty>
  </owl:Restriction>
</rdfs:subClassOf>
```

```
    <rdfs:subClassOf rdf:resource="http://www.w3.org/2002/07/owl#Thing"/>

  </owl:Class>
```

As can be seen from this, the owl:Class element of the CAE-L ontology defines several properties that identify the additional structures, such as the sub-groups: Authority; Lesson; Language; Group and Data.

5.2.2   SESAME INTERFACE

Whilst Protégé is ideal for the creation and visualisation of the CAE-L ontology, Sesame is used as another link in the chain to deliver the CAE-L ontology to a requesting AEH system.

As detailed in Chapter 2 Sesame was used to create the CAE-L repository.
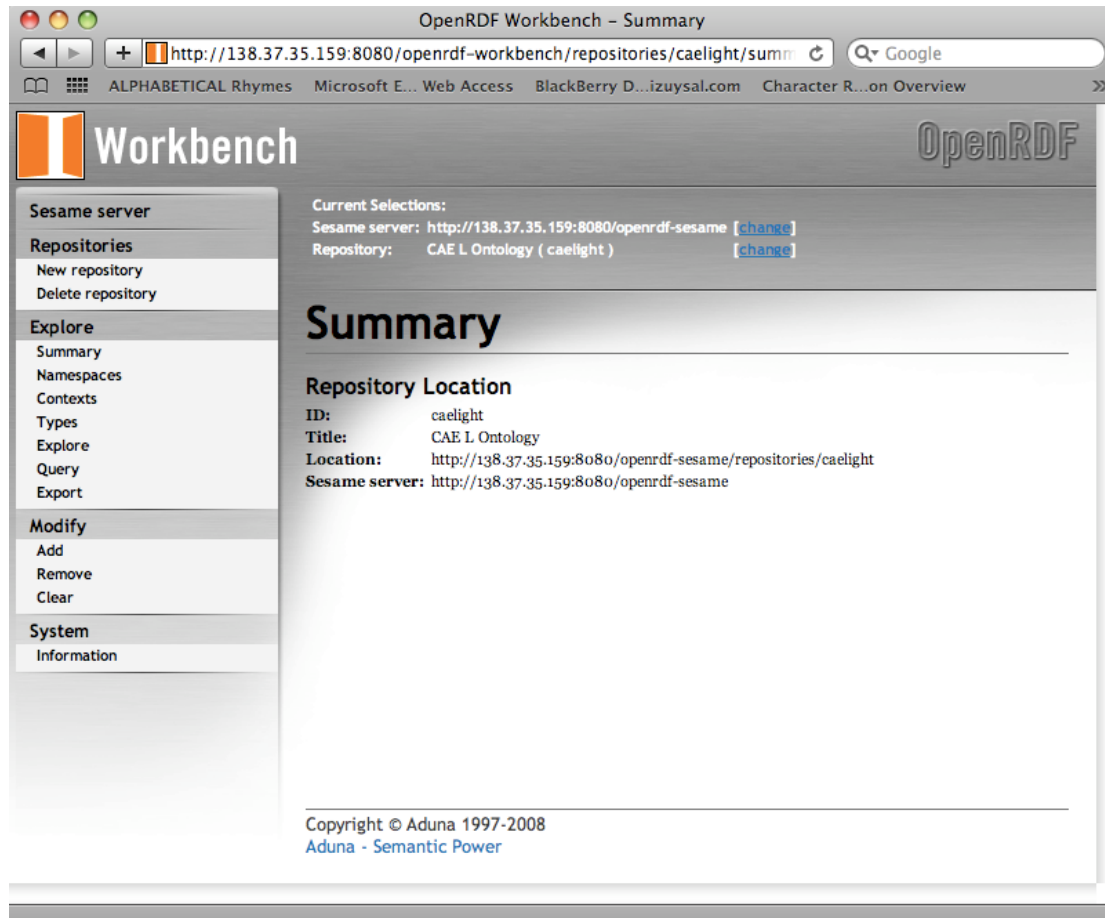
Figure 5.4: The Sesame repository for CAE-Light Ontology

Figure 5.4 above shows a screenshot from the web interface for the Sesame repository. This screenshot details the summary information for the CAE-L ontology and shows that this ontology can be connected to using the address:

http://138.37.35.159:8080/openrdf-sesame/repositories/caelight

To examine this data Sesame also provides the Workbench that allows a viewer to explore and interact with the data, including querying the repository. *Figure 5.5* shows the Workbench interface displaying the results from exploring the CAE-L.owl repository.

Figure 5.6 shows how Sesame can be used to execute a query, in this case the SPARQL query that follows in *Figure 5.5*.
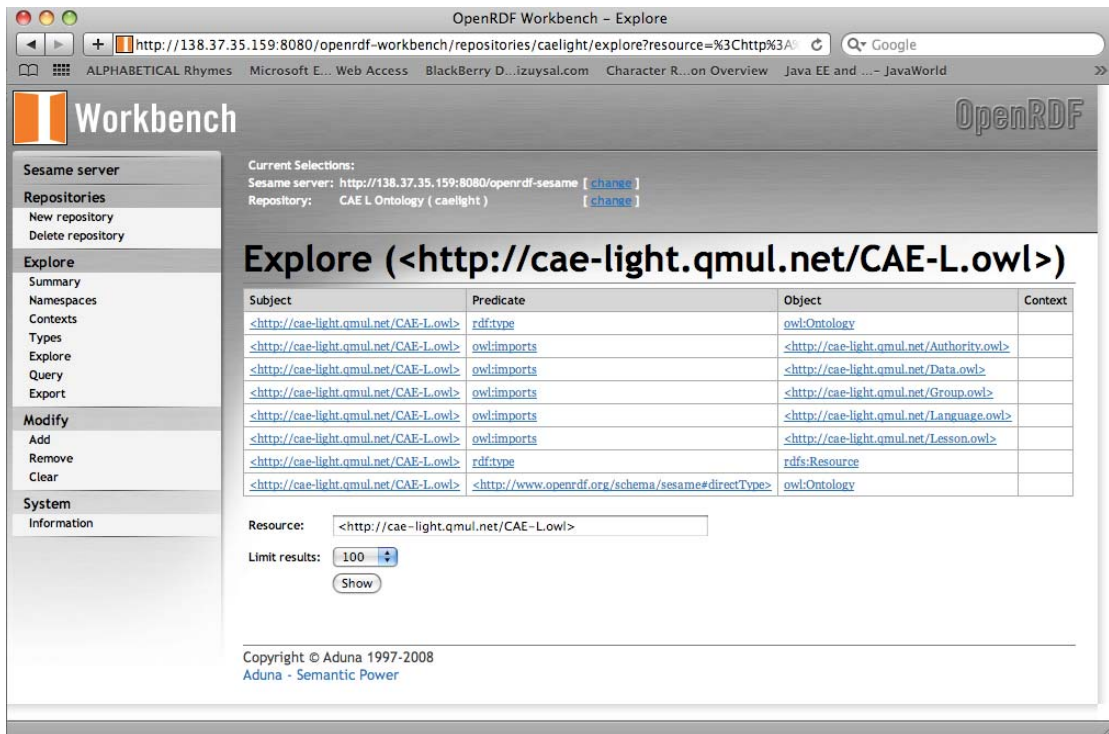
Figure 5.5: Instantiation of CAE-L Class from CAE-L Ontology

```
select ?caelight ?aehvalue ?genderseparation ?presencevalue ?culturevalue
?securityvalue ?ambiguityvalue ?helpvalue ?choicevalue ?hierarychyvalue ?accessvalue
?helpp1value ?expertvalue ?aehapproved where {
?country <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://cae-
light.qmul.net/CAE-L.owl#UK> .
?country <http://cae-light.qmul.net/CAE-L.owl#hasCAE> ?caelight .
?caelight <http://cae-light.qmul.net/CAE-L.owl#hasAEHVValue> ?aehvalue .
?caelight <http://cae-light.qmul.net/Group.owl#hasGenderSeparationValue>
?genderseparation .
?caelight <http://cae-light.qmul.net/Language.owl#hasPresenceValue> ?presencevalue .
?caelight <http://cae-light.qmul.net/Language.owl#hasCultureValue> ?culturevalue .
?caelight <http://cae-light.qmul.net/Data.owl#hasSecurity> ?securityvalue .
?caelight <http://cae-light.qmul.net/Lesson.owl#hasAmbiguityValue> ?ambiguityvalue .
?caelight <http://cae-light.qmul.net/Lesson.owl#hasHelpValue> ?helpvalue .
?caelight <http://cae-light.qmul.net/Lesson.owl#hasChoiceValue> ?choicevalue .
?caelight <http://cae-light.qmul.net/Lesson.owl#hasHierarchyValue> ?hierarychyvalue .
?caelight <http://cae-light.qmul.net/Lesson.owl#hasAccessValue> ?accessvalue .
?caelight <http://cae-light.qmul.net/Authority.owl#hasHelpValue> ?helpp1value .
?caelight <http://cae-light.qmul.net/Authority.owl#hasExpertValue> ?expertvalue .
?caelight <http://cae-light.qmul.net/Authority.owl#hasAEHApprovedValue> ?aehapproved .
}
```
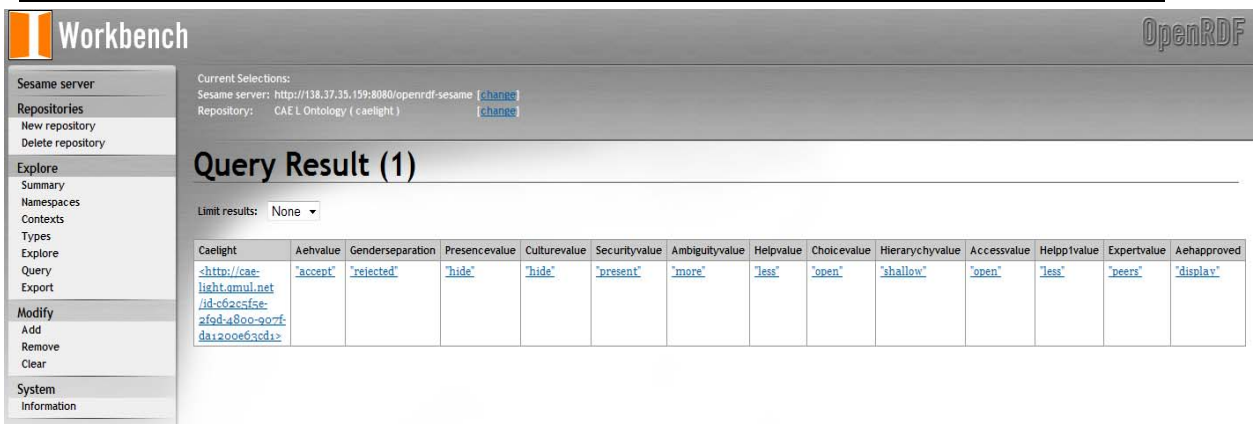

Figure 5.6: Sesame workbench query results.

Figure 5.6 shows the results that can be expected from the standard SPARQL query to the CAE-L repository when requesting a CAE-L stereotype. Of course, these results are visualised in Sesame,

using its visualisation engine and are not appropriate for direct use in an AEH. However, the next stage details how the CAE-L application service will parse these results for delivery.

5.3 CAE-L SERVICE APPLICATION

Following on from the creation of the CAE-L ontology in Protégé and the Sesame repository, the next stage in the framework is to create a service application that will be able to query the repository and format the results in the correct manner.

To this end, a Java program has been written. The stages of use for this program are:

1. Which country's ontology instance is required? This is passed to the program as an argument from the web service wrapper (this is detailed in the next section).

```
public class CAELightOntology {

    public static void main(String args[]) {
        System.out.println(args[0]);
```

2. A connection to the Sesame repository is made:

```
serverSesame = "http://138.37.35.159:8080/openrdf-sesame";
repositoryID = "caelight";
repository = new HTTPRepository(serverSesame, repositoryID);
String xml=null;
```

3. The SPARQL query for the requested country is created. As can be seen below, this string is the same (except for the country name) as that used early in the Sesame repository query page.

```
String sparqlCountry="select DISTINCT ?caelight ?aehvalue
?genderseparation ?presencevalue ?culturevalue ?securityvalue
?ambiguityvalue ?helpvalue ?choicevalue ?hierarychyvalue ?accessvalue
?helpp1value ?expertvalue ?aehapproved where { "+
    "?country <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
<http://cae
        -light.qmul.net/CAE-L.owl#"+args[0]+"> . "+
    "?country <http://cae-light.qmul.net/CAE-L.owl#hasCAE> ?caelight .
"+
    "?caelight <http://cae-light.qmul.net/CAE-L.owl#hasAEHValue>
?aehvalue .
        "+
    "?caelight http://cae-
light.qmul.net/Group.owl#hasGenderSeparationValue
        ?genderseparation . "+
    "?caelight http://cae-light.qmul.net/Language.owl#hasPresenceValue
        ?presencevalue . "+
    "?caelight <http://cae-
light.qmul.net/Language.owl#hasCultureValue>
        ?culturevalue . "+
    "?caelight <http://cae-light.qmul.net/Data.owl#hasSecurity>
        ?securityvalue . "+
    "?caelight <http://cae-
light.qmul.net/Lesson.owl#hasAmbiguityValue>
        ?ambiguityvalue . "+
    "?caelight <http://cae-light.qmul.net/Lesson.owl#hasHelpValue>
        ?helpvalue . "+
    "?caelight <http://cae-light.qmul.net/Lesson.owl#hasChoiceValue>
        ?choicevalue . "+
    "?caelight <http://cae-
light.qmul.net/Lesson.owl#hasHierarchyValue>
        ?hierarychyvalue . "+
    "?caelight <http://cae-light.qmul.net/Lesson.owl#hasAccessValue>
        ?accessvalue . "+
    "?caelight <http://cae-light.qmul.net/Authority.owl#hasHelpValue>
        ?helpp1value . "+
    "?caelight <http://cae-
light.qmul.net/Authority.owl#hasExpertValue>
```

```
        ?expertvalue . "+
    "?caelight <http://cae-
light.qmul.net/Authority.owl#hasAEHApprovedValue>
        ?aehapproved . "+
    "}";
```

4. This string is then used to send a query to the repository

```
TupleQuery tupleQuery =
con.prepareTupleQuery(QueryLanguage.SPARQL,
    sparqlCountry);
TupleQueryResult result = tupleQuery.evaluate();
```

5. The result from this query is then parsed for the relevant information and saved in a 'Value' instance.

```
    if (result.hasNext()) {
        BindingSet bindingSet = result.next();
        Value aehvalue = bindingSet.getValue("aehvalue");
        Value
genderseparation=bindingSet.getValue("genderseparation");
        Value presencevalue = bindingSet.getValue("presencevalue");
        Value culturevalue = bindingSet.getValue("culturevalue");
        Value securityvalue = bindingSet.getValue("securityvalue");
        Value ambiguityvalue = bindingSet.getValue("ambiguityvalue");
        Value helpvalue = bindingSet.getValue("helpvalue");
        Value choicevalue = bindingSet.getValue("choicevalue");
        Value hierarychyvalue =
bindingSet.getValue("hierarychyvalue");
        Value accessvalue = bindingSet.getValue("accessvalue");
        Value helpp1value = bindingSet.getValue("helpp1value");
        Value expertvalue = bindingSet.getValue("expertvalue");
        Value aehapproved = bindingSet.getValue("aehapproved");
```

6. The parsed result is placed into the correct XML format

```
xml="<?xml version=\"1.0\"?>"
+
"<!DOCTYPE cael []>" +
"<cael version=\"1.0\" aeh=\"\"
    xmlns:xsi=\"http://www.w3.org/2001/XMLSchema-instance\"
    xsi:noNamespaceSchemaLocation=\"caels.xsd\">"
+
    "<countryCode name=\""+args[0]+"\" threela=\""+args[1]+"\"
        twola=\""+args[2]+"\" numeric=\""+args[3]+"\"/>"
+
    "<authority help=\""+helpp1value.toString()+"\"
        expert=\""+expertvalue.toString()+"\"
        aehApproved=\""+aehapproved.toString()+"\"/>"
+
    "<group genderseparation=\""+genderseparation.toString()+"\"/>"
+
    "<language presence=\""+presencevalue.toString()+"\"
        culture=\""+culturevalue.toString()+"\"/>"
+
    "<lesson hierarchy=\""+hierarychyvalue+"\" help=\""+helpvalue+"\"
        access=\""+accessvalue+"\" choice=\""+choicevalue+"\"
        ambiguity=\""+ambiguityvalue+"\"/>"
+
    "<data security=\""+securityvalue+"\"/>"
+
    "<comment>Comment text for the "+args[0]+"'s CAE-L
        description</comment>"
+
"</cael>";
```

7. Finally, the XML result will be returned to the Web Service.

As an example using this Java service application a request for India's CAE-L instance will return the following XML file:

```
<?xml version="1.0"?><!DOCTYPE cael []>
<cael version="1.0" aeh="reject"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="caels.xsd">
        <countryCode name="India" threela="IND" twola="IN"
numeric="356"/>
        <authority help="more" expert="teachers" aehApproved="hide"/>
        <group genderseparation="rejected"/>
        <language presence="show" culture="show"/>
        <lesson hierarchy="deep" help="less" access="limited"
choice="open" ambiguity="more"/>
        <data security="absent"/>
        <comment>Comment text for India's CAE-L description</comment>
</cael>
```

5.4   CAE-L WEB SERVICE

The final stage in this process is to describe the CAE-L Web Service. The 'cael.wsdl' file has been created to serve this purpose (see Appendix E for the complete file). The 'cael.wsdl' web service has a graphical representation in *Figure 5.7*.
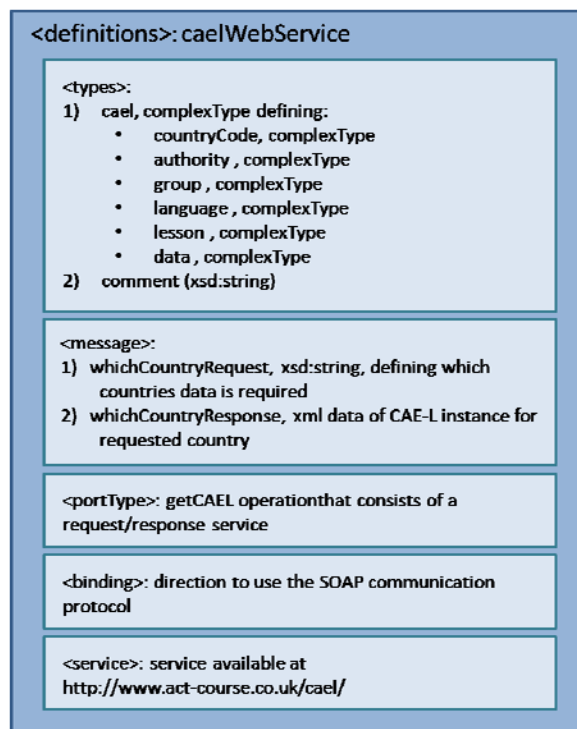
Figure 5.7: The CAE-L web service overview.

This web service describes the 'type' of data transferred (in this case, the output type is an XML tree described using the 'complexType'), the input and output parameter 'messages' (the input parameter 'whichCountryRequest' is a text string 'xsd:string' – such as country name or code; whilst the output 'whichCountryResponse' is linked to the 'Type' described above); the operation ('getCAEL') that is accessed through the port ('portType'); the nature of the transport 'binding' (i.e., how the messages are transmitted, in this case by using REST) and finally the address of the 'service' itself (i.e., where the actual web service may be found, if the system is not using a web service directory).

In examining the 'message' in more detail, it is possible to see how the XML file returned by the Java application service described above is handled by the CAE-L web service. *Figure 5.8* below shows some more detail of the 'whichCountryResponse' message. Indeed, it can be seen that this links directly to the 'cael' 'complexType' description. This in turn links to the related sub-types (countryCode, authority, group, language, lesson, data and comment) and their content description.
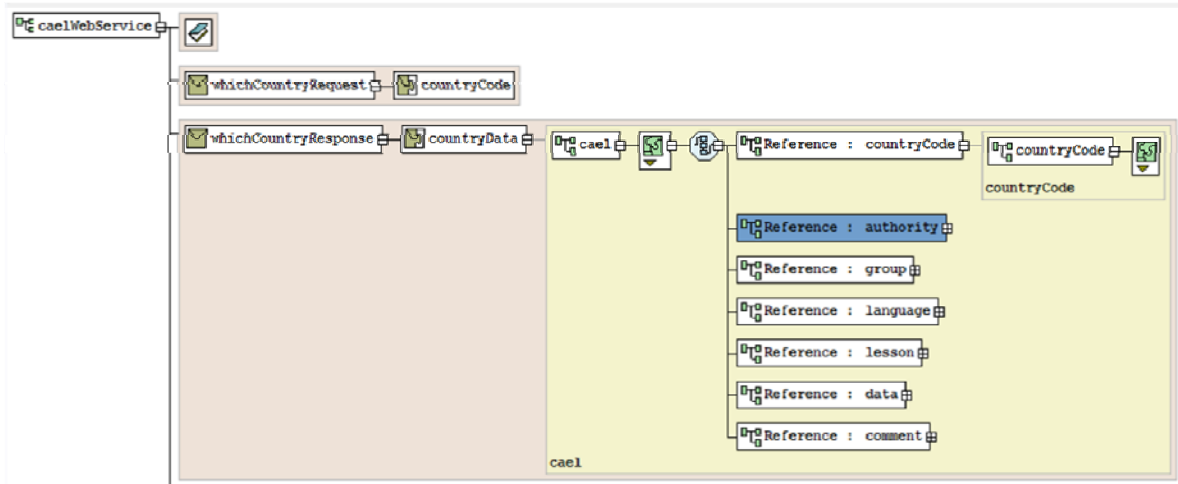
Figure 5.8: The CAE-L web service message detail.

The WSDL code describing the 'countryCode' type is:

```
<xsd:element name="countryCode">
      <xsd:complexType>
            <xsd:attribute name="name" use="required" type="xsd:string"/>
            <xsd:attribute name="numeric" use="optional"
type="xsd:integer"/>
            <xsd:attribute name="threela" use="required"
type="xsd:string"/>
            <xsd:attribute name="twola" use="optional" type="xsd:string"/>
      </xsd:complexType>
</xsd:element>
```

Here it can be seen that the 'countryCode' type is a complexType (as shown in *Figure 5.7*) and this contains four attributes called 'name', 'numeric', 'threela' and 'twola'. This matches exactly the structure of the XML tree returned by the Java service application:

```
<countryCode name="India" threela="IND" twola="IN" numeric="356"/>
```

The WSDL file also determines which of these attributes is required through the 'use' <xsd> attribute, and that the 'numeric' attribute must contain an integer, whilst the others must be strings.

As can be seen from the entire WSDL file in Appendix E, this web service describes the entire CAE-L XML structure. Therefore, when a country request is made by an AEH (for example, but the service would be open to any requesting application) it will receive as a response the XML complexType.

5.5   CAE-L IN ADAPTIVE EDUCATIONAL HYPERMEDIA SYSTEMS

The previous sections detailed the manner in which the CAE-L stereotypes can be stored, queried and rendered for delivery to an unknown AEH engine. What happens when that unknown engine receives the information is the next stage in the adaptive process.

This next section outlines a possible adaptation type to that unknown engine (it could for example be Moodle, MOT or WHURLE), it does this by presenting a series of screenshot mock-ups that have specifically been created to explore the possibilities of CAE-L level adaptation and receive user feedback on them (in Chapter 6) before progressing any further in implementing such an adaptation layer.

To this end, *Figure 5.9* shows the overall design for an example AEH website.
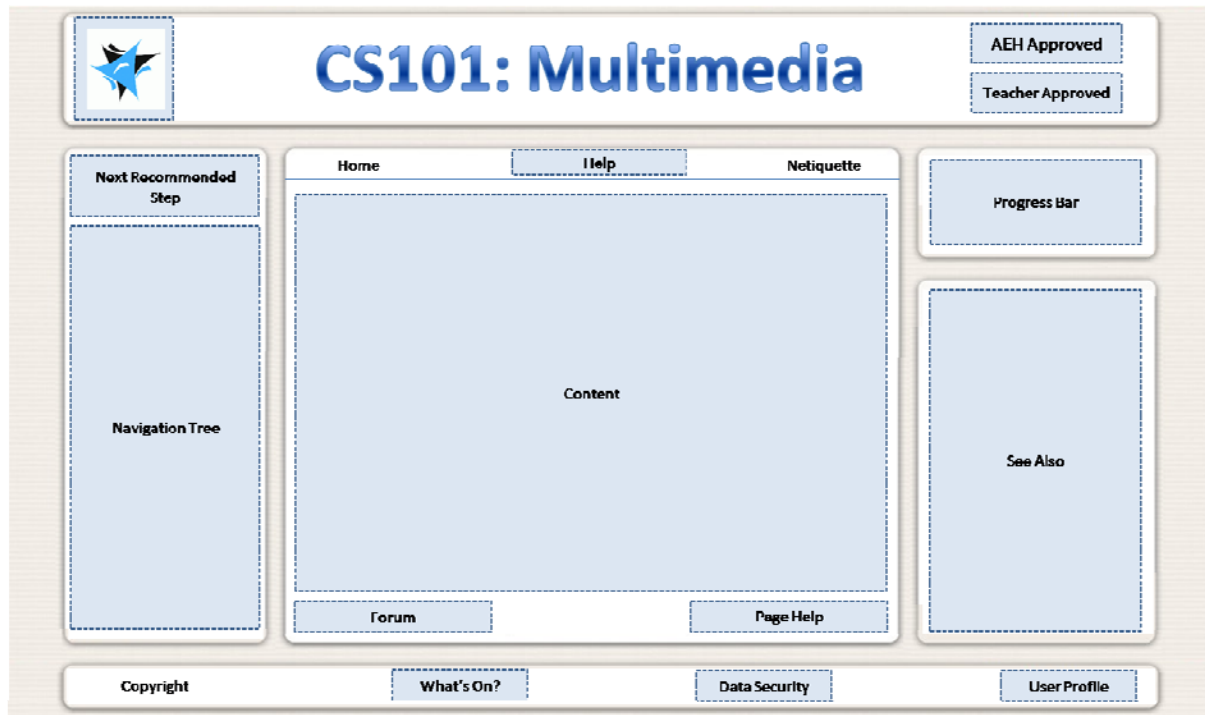
Figure 5.9: An example website designed to showcase the CAE-L adaptation features.

As can be seen, this design allows for a more modular approach to site creation (as championed by Moodle) with multiple independent sections that can each be changed as required by the adaptation rules, in this case outlined by the CAE-L stereotype. The grey zones (with a dashed border) indicate sections that may be adapted. Note that, unlike many adaptive systems, the CAE-L adaptive layer lends itself to user interface changes. This level of adaptation has been used in this example (the CAE-L changes are not limited to this) to highlight the potential of cultural adaptation. The consequences of this choice will be examined in greater detail in Chapter 6 and 7.

Figure 5.10 goes into greater detail about the types of adaptation that are to be described for this example, as well as indicating how the CAE-L stereotype informs this adaptation. These changes and CAE-L concepts are:

- Authority::expert & Logo

    The logo aspect of the webpage can come in many different forms, either that of the AEH system, the development group, the institution or an abstract design, etc … However, using the CAE-L stereotypes it is possible to direct the choice of logo, by using the 'Authority::expert' concept (where the course designer is permitted to do this; for example, some authors may be required to use a university logo rather than any one they chose).

    Those cultures with a concept value of 'teacher' have a greater respect for authority figures, and the logo should reflect this. An example of such a reflection could be using the official university logo, instead of some custom-made one.

    On the other hand, those cultures which have the concept value of 'peers' tend to think of themselves as important as any institution, and the logo could in this case be of a more personal nature (for example a group of happy students, even the student's avatar).

130
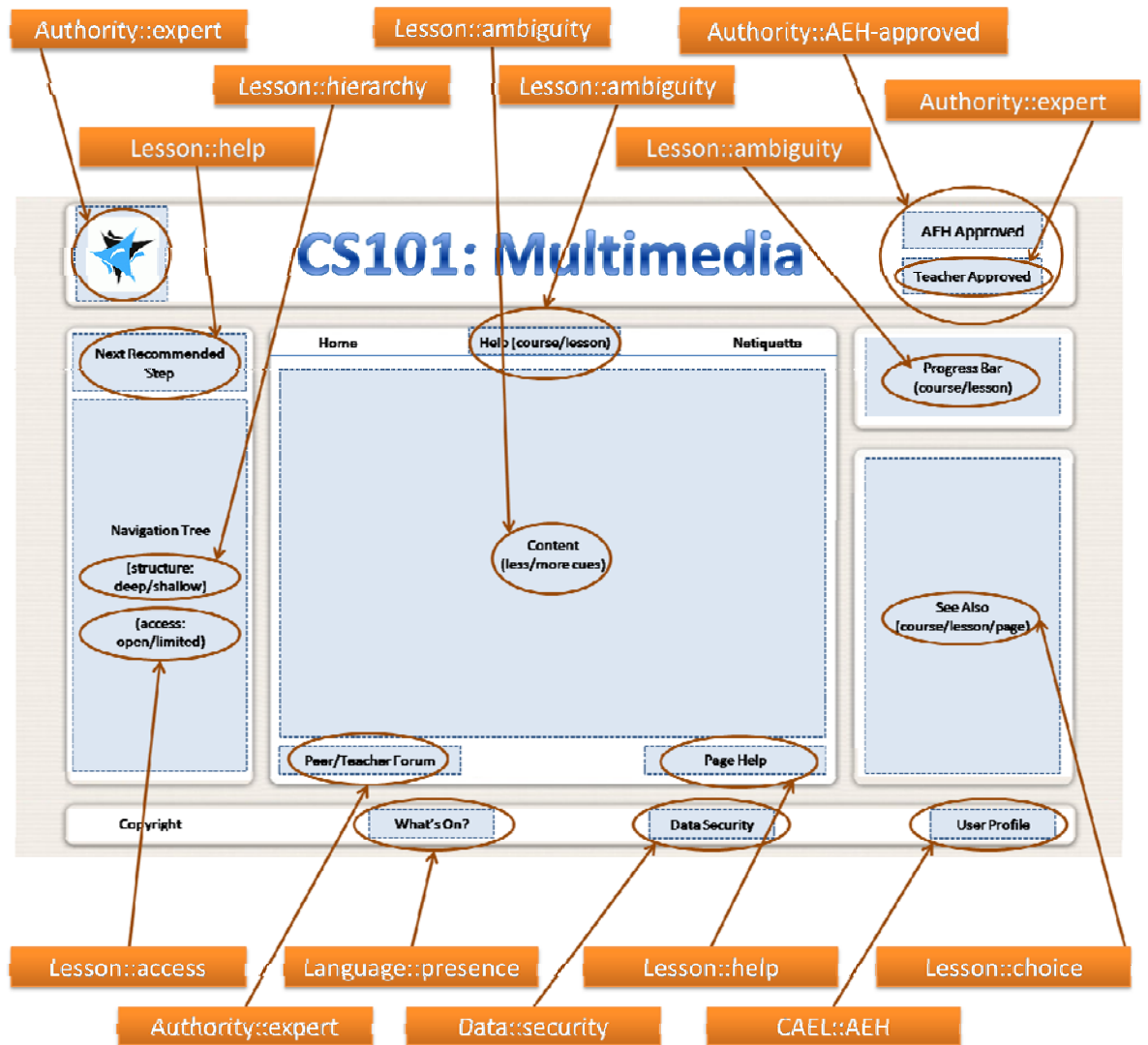
Figure 5.10: The example webpage, showing the interaction between CAE-L concepts and the site sections/functions.

- Lesson::help & Next Recommended Step

    As described in Chapter 4, this concept indicates if the presence of additional support materials and structures is required. In this example, this has been used to determine if the 'Next Recommended Step' (NRS) functionality should be displayed to the student or not. If the CAE-L concept has a value of 'less' (i.e., to reduce uncertainty) then the NRS should be displayed; however, if that value is 'more' then it will not be displayed.

    This function (when present) aids the students in deciding where to go next, instead of the lesson navigation tree, 'see also' section or any other navigation function. This function can reduce uncertainty (and therefore cognitive load) for the learner.

- Lesson::hierarchy & Navigation tree structure

    Students from some cultures prefer to have a more structured lesson domain presented to them, with related concepts being displayed further down the navigation tree as child concepts. Others prefer to have a flatter navigation structure, with related concepts being displayed as siblings, rather than as children. In this case, the CAE-L concept 'lesson:: hierarchy' value of 'deep' indicates students who prefer the former, whilst the value of 'shallow' indicates students who prefer the latter approach.

- Lesson::ambiguity & Content

    This section, along with the navigation tree, is where most current AEH system perform their adaptation (for example, selective content 'atoms', expanding text, link inclusion etc …). However, in this example, there is only a limited degree of adaptation applied. This has been done for two reasons:

    1) to allow the example to focus on interface changes, as too many subtle changes may be overlooked when it comes to the evaluation of these screenshots.

    2) To not impinge on the adaptation performed by the other AEH systems. In this way a CAE-L adaptation layer can be included in extant AEH systems without having to completely re-write their adaptation and presentation engines. In this way, CAE-L can be seen to complement the previous work in this field rather than re-writing it.

    Due to this, there is only one type of adaptation used in the 'Content' section, that of inline linking. The CAE-L 'Lesson::ambiguity' concept value determines how many redundant cues are given to a student. In this case, a value of 'less' indicates that more redundant cues should be given ('less' shows that the student requires 'less' ambiguity in their learning environment). To do this, hypertext links will be inserted into the content – these will mirror links from elsewhere on the page (specifically the 'See Also' section). Student's whose cultures have a concept value of 'more' will not receive these cues and so the links will not be displayed.

- Lesson::ambiguity & Help

    This is the second of the three sections that use the 'Lesson::ambiguity' concept (the third being the 'progress bar' detailed below). Once again the goal here is to provide redundant cues for the student to reduce uncertainty and confusion. To this end, the 'Help' link here will link to one of two places.

    The first is to a course support page – here they will have access to any issues that affect the students at a high level. This reduces the amount of redundant support.

    The second is to link to a lesson level support page (this may well be a sub-section of the course support page). The goal here is to provide more specific help for students who are stuck on this page. Rather than direct them to the course support and let them find their own answers (which allows for a higher degree of synchronicity) they will be directed closer to their answer.

    Therefore, CAE-L stereotypes with a value of 'less' will be directed to the lesson level support pages (giving more relevant [and redundant] information concerning the current page) whilst those with a value of 'more' will be directed to the course support page.

    Note that this is not the only 'help' functionality available; see the 'See Also' and 'Page Help' section descriptions.

- Lesson::ambiguity & Progress Bar

    The progress bar is another redundant cue for the students, hence cultures that require a lower degree of uncertainty in their education will use this more than those that do not.

    In this example, the progress bar can have two settings, either 'course' or 'lesson'. CAE-L stereotypes that have the 'Lesson::ambiguity' concept value of 'less' need more redundant cues (less ambiguity), and as such the progress bar will display higher level information. In this case that means showing their progress through the entire course (low level feedback).

    Compare this to those cultures whose CAE-L stereotype has this concept value set to 'more'. Here, less feedback is useful to reduce uncertainty, and as such the progress bar will show their progress through a lesson – a higher grained feedback mechanism than that for the course.

- Authority::AEH-approved & statement displays

    The two sections on the upper right side of the outline (AEH approved and Teacher Approved) are controlled by two CAE-L concepts. However, in this case, it is the

concept of 'Authority::AEH-approved' that decides if both of these sections are displayed. What is displayed in these sections is further controlled by the second concept, as follows.

1) 'AEH-approved', this section should be replaced by a statement that shows that whilst this is an adaptive lesson, the content has been approved.

2) 'Teacher approved', this section's value is controlled by:

- Authority::expert & Teacher Approved

  Some lessons should be seen to have been approved by persons higher in the hierarchy (than the students, or even teacher).

  Hence, if the value of this concept is 'teacher', then it indicates that a higher degree of authority should be used when compared to the value of 'peer' (note this concept does *not* mean that the teachers and peers should only ever be used when considering these issues, as is the case in the current example). So the 'teacher' value cultures should have the university approval, say by inserting the university logo, whereas for the 'peer' value cultures it would be sufficient to indicate that the lesson author has approved it.

- Lesson::access & Navigation tree access

  This is the second of two concepts that control the structure of the course navigation tree. The first 'Lesson::hierarchy' determines if the student's culture has a preference for deep vs. shallow tree structures.

  This concept has been included, as some cultures prefer to have more open access to data then others. In this example, this has been used to determine how much additional structural data should be included in the navigation tree.

  Cultures with a value of 'open' for this concept would prefer open access to information. From a course navigation tree point of view this could, e.g., be used to display information for related lessons. The example given in *Figure 5.9* shows the 'introduction' page for the 'multimedia' lesson of the 'CS101' course. Students who prefer an open access to information could have navigation information for the related lessons in the same course.

  On the other hand, students whose culture's value for this concept was 'limited' prefer to restrict access to unnecessary information. Hence in this case navigation information for the lesson itself should be given, but additional information from the other lessons in the same course should be removed.

- Authority::expert & Discussion Forum

  Most online lessons these days include a link to a discussion forum (or some other form of social interaction). This forum is for the students to discuss their problems with the course/lesson, but may be used for more than that, as they often contain a general 'open chat' area as well.

  The CAE-L stereotypes can direct the use of this functionality. In the case where the value for the 'Authority::expert' concept is 'teachers', then this link should direct the student to the a moderated forum, where the teacher monitors student issues and can answer their questions directly (or pass them onto assigned forum assistants).

  For cultures where the value of this concept is 'peers' then this link would direct them to a more open use discussion forum, where they can discuss issues with their peers. This may or may not involve a teacher in some form of oversight role, but it certainly would not involve the teacher as heavily as the previous case.

- Language::presence & What's On?

  Some cultures have a flexible approach to the inclusion of additional cultures, other than their own, in their education. This function is designed to link to local cultural sites, be it in the form of local student support (for example, support for Chinese students in France), local university events (e.g., which band is playing where) or

local cultural events (e.g., direction for the local sights, such as museums). These are, of course, only a few examples of possible links. The goal of this function however is to bring the events from their current setting to the students' attention. This function can additionally be directed to be appropriate for the current educational setting – for example, in a Computer Science course, perhaps directions to a Science Museum would be included.

This link is only to be included if the CAE-L value for this concept is set to 'show', otherwise, if it is set to 'hide', it will not be shown.

- Data::security & Data Security

    The 'Data::security' concept was created to describe the need (or lack) for an easily accessible data security statement, as the students from some cultures would prefer to have easy access to the AEH's data security statement and objectives. This statement should clearly describe the security policy used by the AEH designers as well as the university.

    If the value of this concept is set to 'present', then this link will be displayed, otherwise if the value is set to 'absent', then it will be hidden.

- Lesson::help & Page Help

    There have been several 'Help' settings described so far; this function however is far more specific than any of them. This link would take the student to specific page help information. This would be short and to the point so as to provide additional help without increasing a student's cognitive load.

    If the value of 'Lesson::help' is 'more', then this link will be present, whereas if it is 'less', this link will be absent.

- CAEL::AEH & User Profile

    Students from certain cultures were more concerned with the collection and storage of their personal data than others. This function has been added as a result of that concern. The 'user Profile' link will take the student to a page where they can readily access and manipulate their user data. This is an easily available link that simplifies student access to their data; however, access to a user's profile should always be available in an AEH system, even if that access is somewhat more obscure (for example through a Help page).

    CAE-L stereotypes with this value set to 'accept' will have the link to this function present, whereas those with the value set to 'reject' will not have the link available.

- Lesson::choice & See Also

    As described in Chapter 4, this concept describes how complex the presentation of lesson materials should be. In the example given in *Figure 5.9*, this has been used to monitor and control the 'See Also' section of the webpage.

    This section may have multiple levels of information, some redundant to the previous sections above. Links that may be of interest to the student are displayed here; these links may be relevant to the course, the lesson or specific to the page.

    CAE-L stereotypes that have the 'Lesson::choice' concept value set to 'open' will have access to links from all three level (course/lesson/page), as the students from these cultures prefer to make their own choices as to what pages they visit and when.

    Compare this to those students from cultures with this concept value of 'limited' – they would prefer to have reduced choice, so that their education can be more structured. These students would only have access to the links that concern the current 'page'.

Other webpage aspects:

Having examined the adaptive aspects of the example webpage detailed in *Figure 5.9*, there remain a few aspects that have yet to be addressed and they are:

- Home

    Any well designed webpage should have a link that will take the user to a set place. This helps in case they ever get lost within the website, or forget what they were doing, or any other reason for them to refresh their web surfing location.

    As such, the CAE-L example webpage includes this standard feature as well. This would allow learners to go back to their homepage – such as the course listing or welcome page.

- Netiquette

    The CAE-F ontology concept of 'Group::discourse' was not included in the CAE-L ontology. As such, the example given in *Figure 5.9* could not take this aspect into account. However, in a multi-cultural learning situation there may be some cultures that prefer 'subdued' discussion and rhetoric, whilst others prefer a more forthright approach.

    As this mix of students could potentially cause problems, it was decided to include the 'Netiquette' link as a major aspect of the CAE-L example webpage. This will take students to a page that details how they should behave (Net etiquette) when interacting with other students. Whilst this is not adapting the presentation of materials, it should help reduce any potential problems through increasing understanding between different groups.

- Copyright

    This is quite straight forward: it details the date and ownership of the copyright for the webpage.

5.5.1 EXAMPLE CAE-L WEBPAGE: CHINA

Figure 5.11: the example AEH webpage using the cultural stereotype for China.

Using the experimental design described above it is possible to create an instance of a webpage for each country that has a CAE stereotype. *Figure 5.11* shows the design of the webpage for China.

This image is created using the CAE-L ontology values for the China cultural stereotype, and assigning the functionality as described in the section above. Hence:

- Authority::expert & Logo

  Concept value = 'teacher' the appropriate university logo is displayed.

- Lesson::help & Next Recommended Step

  Concept value = 'less', therefore the NRS function is not displayed.

- Lesson::hierarchy & Navigation tree structure

  Concept value = 'deep', therefore deep tree data should be displayed.

- Lesson::ambiguity & Content

  Concept value = 'more', therefore fewer redundant cues are needed; and there is no need for inline links.

- Lesson::ambiguity & Help

  Concept value = 'more', therefore this link should point to the course support page.

- Lesson::ambiguity & Progress Bar

  Concept value = 'more', therefore the progress bar should show the progress through the entire course.

- Authority::AEH-approved & statement displays

  Concept value = 'display', therefore the approval and authority statements should be displayed.

  - Authority::expert & Teacher Approved

    Concept value = 'teacher', therefore the authority statement should indicated that the appropriate university has approved the course.

- Lesson::access & Navigation tree access

  Concept value = 'limited', therefore only the links pertaining to the current lesson should be shown.

- Authority::expert & Discussion Forum

  Concept value = 'teacher', therefore this link will take the student to a teacher (or approved assistant) moderated discussion forum.

- Language::presence & What's On?

  Concept value = 'show', therefore this link will be displayed

- Data::security & Data Security

  Concept value = 'present', therefore this link will be displayed

- Lesson::help & Page Help

  Concept value = 'less', therefore this link will *not* be displayed.

- CAEL::AEH & User Profile

  Concept value = 'accept', therefore this link will be displayed

- Lesson::choice & See Also

  Concept value = 'open', therefore the additional links to all levels of the course (course, lesson and page materials and related webpages) will be present.

5.6 SUMMARY

This chapter has taken the CAE-L cultural stereotypes defined in Chapter 4 and built on this foundation towards an implementation methodology.

This approach involves persistent storage of the CAE-L ontologies in an online database, openly accessible through the use of SPARQL queries. An example of a query system has also been presented, with the use of Web Services. The CAE-L web service is designed to accept a query from any system (most likely however an AH system) as long as that system also sends the country that the information is required for. This is then passed to a Java program that assembles the SPARQL query and analyses the response. Finally the web service sends the CAE-L ontology instance for the requested country back to the AH system in the form of an XML file.

The AH system can use this data in any way it and its system designers require.

In the case of this chapter, a fictional AEH system was said to apply them towards the creation of a series of sample webpages. These webpages all relate the same information but show the changes in functionality and presentation that are made due to the CAE-L stereotypes.

There are many ways in which the CAE-L stereotypes can be implemented to affect an AEH, by adding a cultural stereotype adaptive layer (an example would be within the presentation layer of the LAOS framework [Cristea and De Mooij, 2003c]). The example detailed in this chapter focused on interface changes, with the inclusion of different types and levels of functionality dependent on the stereotype involved. However , there was also a small amount of content presentation and navigational tree adaptation, which more traditional AEH systems have focused on.

These examples have been designed specifically so that they can be used to perform an initial evaluation of the suggested approaches outlined for the CAE-L adaptation. As such they are to be considered a first step towards creating a culturally sensitive AEH system.

5.7 NEXT

As the example webpages can all now be created, they will be used in the next chapter to evaluate this approach towards designing and creating a cultural layer of adaptation. Which of these features are acceptable to the students and do the CAE-L findings map from the CAE questionnaire to the AEH system?

CHAPTER 6:

CAE-L FORMATIVE EVALUATION

6   CAE-L FORMATIVE EVALUATION

6.1   INTRODUCTION

In Chapter 5, the CAE-L ontology was applied towards creating a series of webpages, with each page (one page per country) adapted for the delivery of the same example, according to the findings of the CAE study.

The sample webpages have been collected and in this chapter will be used to perform a formative evaluation of the CAE findings. This is a formative evaluation as these findings will feed into a final summative evaluation (Chapter 7) using an extant AEH in a real world learning situation.

As a reminder the CAE study has:

- Created a questionnaire to study the effect of using Geert Hofstede's cultural indices in education, as well as examine the cultural responses to culture and AHS in education.
- Taken the results of the questionnaire and from their analysis has created two ontologies, the CAE-F ontology, which describes in detail all aspects of an adaptive, cultural stereotype. Additionally, it has created the CAE-L ontology, a sub-set of CAE-F, which includes those concepts that are considered easiest to create an initial test implementation of an adaptive layer within an AEH system.
- Using the CAE-L ontology, a mock-up of an AEH sample implementation was created (as a series of webpages).

This evaluation has been created specifically with these webpage mock-ups in mind. By using these pages and creating a user evaluation questionnaire around them, the goal is to get enough feedback to:

1. Check that the functionality provided in the example is acceptable by the user.
2. That each student is content with their own cultural stereotype.
3. In so doing, confirm that the findings of the CAE questionnaire and the implementation of the CAE-L ontology are correctly adjusted for each of the cultures tested.

It is this last point that is the most important. Before moving into Chapter 7 it is vital to know that the conclusions drawn from the CAE analysis have been correctly and appropriately used. In creating a series of test pages, it is possible to get a formative evaluation performed that will achieve this.

6.2   COUNTRIES (STUDENTS) SELECTED

As this is a formative evaluation, the focus was on getting smaller amounts of quality information. To this end, the countries to be studied were selected on the following basis:

1. That they had a CAE-L stereotype.
2. That there were students available, who had the time to complete the full questionnaire.

As this second point involved a more time intensive procedure than the original CAE questionnaire, only a few students were readily available for this evaluation.

The countries chosen and the numbers of student responses are detailed in *Table 6.1*.

Country	N
China	**4**
Germany	**1**
India	**5**
Ireland	**4**
Netherlands	**1**
United Kingdom	**2**

Table 6.1: this table lists the countries chosen to take part in this evaluation and the number of student responses.

6.3 QUESTIONNAIRE

The questionnaire was designed to examine the choices made in the interpretation of the CAE-L stereotypes into a webpage. These choices have been previously outlined in Chapter 5. However, it is to be evaluated if they truly represent each country's stereotype in practice. To address this issue, each questionnaire was created using three sample screenshots of a webpage in the domain of Computer Science (specifically an introduction to Multimedia). An example of the Chinese version of this was seen in *Figure 5.11*.

The reason behind giving each questionnaire more than a single screenshot (in which a student could be asked their opinion of a website adapted to their own cultural stereotype) was because a more comparative evaluation was desired. Three webpages were chosen as being the correct number of examples to give to each student, as more than that and the students may be overwhelmed with information, whilst less than this number would not allow for a reasonable comparison. In fact, perhaps a comparison of two would have been enough for noticing differences between them, but the intention was to give them a wider range of differences, without at the same time overwhelming them with information.

Therefore, each questionnaire contained three sample webpage screenshots, only one of which was created using their own CAE-L stereotype following the process outlined in Chapter 5. This was followed by a short series of questions for the respondent to complete, along with a comments section. *Table 6.2* shows the distribution of country stereotypes to students received within their questionnaire. The other two pages, besides the one corresponding to one's own country's stereotype, were chosen in such a way that a diversity of features can be observed. For this purpose, a *function of diversity* (distance) between two stereotypes was defined as follows:

$$d\big(S_i, S_j\big) = \sum_{k=1}^{\max\,(|features(CAE-L)|)} \{if\big(feature_i\,! =\, feature_j\big)\ then\ 1\ else\ 0\}$$

where (as per *Table 4.2*):

$$\max(|features(CAE - L)|) = 13$$

Conversely, the diversity function has the property of symmetry, similar to the Euclidian distance, as in:

$$d\big(S_i, S_j\big) = d\big(S_j, S_i\big)$$

With this diversity function defined, by selecting three pages, it is possible to compute three different diversity distances between the three pages. For instance, if the stereotype pages for China, UK and Germany are selected, the three diversity figures are:

$$d(S_{China}, S_{UK}) = d(S_{UK}, S_{China}) = 9;$$
$$d(S_{UK}, S_{Germany}) = d(S_{Germany}, S_{UK}) = 11;$$
$$d(S_{Germany}, S_{China}) = d(S_{China}, S_{Germany}) = 5;$$

In order thus for the students to be able to observe the diversity of features for adaptation, and make an informed choice, they were presented with the stereotype for their own country, and the other two pages were selected in such a way that at least one of the three diversity distances was greater than five:

$$\exists i, j\ with\ d\big(S_i, S_j\big) \geq 5$$

In other words, between the three stereotypes selected, there is at least one pair with around 40% of the features different from each other. This was considered sufficient to highlight differences of cultural layout adaptation. The resulting distribution of pages is shown in *Table 6.2*:

target students	page 1	page 2	page 3
CHN	China	Netherlands	India
DEU	UK	Germany	Netherlands
IND	China	Germany	India

IRE	Ireland	Netherlands	China
NLD	China	Ireland	Netherlands
GBR	China	UK	Germany

Table 6.2: shows which countries CAE-L stereotypes were used to create the questionnaires for each country taking part.

As an example, if the questionnaire respondent was Irish, then they would receive the questionnaire with three sample webpages that had been designed using the stereotypes for Ireland, the Netherlands and China, respectively. They would then be given time to read and respond to the questionnaire before returning it. Please also note that *Table 6.2* also shows that the pages were presented in random order to the students, in order to avoid any subliminal messages and bias.

6.3.1 QUESTIONNAIRE INTRODUCTION

The process for completing the questionnaire is given at the beginning of the questionnaire itself, so that the students know what to do. The text is given here:

"This questionnaire has been developed to study the effect that culture (and nationality) has upon a person's educational preferences and requirements. By completing this questionnaire you will be part of my research project that aims to improve the delivery of education across the web.

The questionnaire should take about 20 minutes to complete and the information gathered is anonymous and will only be used for research purposes.

The data collected will not be used for any other purposes other than the research goals stated above, nor will anyone other than myself have access to this data. This research is supported by the University of Nottingham, UK.

The questionnaire consists of 4 sections. In sections 1-3 a screenshot of a webpage is given followed by a short description of the webpage and its functionality, which is then followed by a questionnaire for each section. Please examine the screenshot and read the description carefully. Once you have done this the following page contains the short questionnaire, please answer this before moving onto the next section.

Section 4 contains the final series of questions, answer these once you have completed sections 1-3, please ensure that you fill in your nationality in this section.

Note that the screenshots are all from a proposed adaptive education system, a short description follows:

"Adaptive Education System is a on-line system that will measure your personal behaviours and preferences, store them and use these to alter the nature of the education given to you. The aim is to deliver a personalised and unique education to you - and in so doing give you the best education you can receive."

Once you have completed the questionnaire please send it back to the following email address:

craig.stewart@elec.qmul.ac.uk"

In addition to this the following 'Note' was added:

"Note –in the following description these two definitions are used:

- *'course' – this applies to a series of lessons grouped together under one subject heading*
- *'lesson' – this is a single teaching unit (equivalent to a lecture)."*

These definitions above are required because the usage of the term 'lesson' to denote a single lecture and 'course' to denote a group of lectures is not always obvious, especially across multiple cultures.

6.3.2 QUESTIONNAIRE SCREENSHOTS & DESCRIPTION

Following this introduction there are the three pages representing the three stereotypes as described previously. On each page there is a single screenshot and a short list of the functions available. An example of a single page is show in *Figure 6.1*.

As can be seen from *Figure 6.1*, the functions that change between different examples have been highlighted. This was done because otherwise the changes can sometimes be too subtle for the

reader to notice straightaway. Also this allows the reader to connect each section of functionality in the screenshot with the description text listed below. This will make it easier for the reader when it comes to compare the page, as well as get used with the naming conventions used by the questionnaire, before filling it in.

Page 1

Description

A student accessing this personalised online lesson has access to the following functions:

1. The 'Lesson Navigation' tree which gives in depth details concerning the current lesson.
2. A 'Discussion Forum' that allows you to post questions to the teacher.
3. The 'Help (CS101)' link which takes you to the course support page.
4. A 'Progress' bar which shows you how far through the course materials you have come.
5. A statement showing that this personalised lesson has been approved by the University.
6. A 'What's On Locally?' link, which will take you to a new page with a list of local venues and events that are connected to the lesson (such as a workshop or science museum).
7. A 'User settings' link which will allow you to access the database of personal data that has been stored concerning your educational background.
8. A 'Data Security' link that will take you to a page detailing the data security policy of the personalised lesson.
9. And finally the 'Additional Information' links which give a series of informative and useful links to pages outside of the current lesson for the course, lesson and current page.

Figure 6.1: An example of one of the screenshot & description pages from the evaluation questionnaire.

6.3.3 QUESTION PAGE

The final section of the questionnaire is the last page which contains the questions. These were kept to a minimum, in order to make it easy for the students to reply to them. For this reason, whilst all features are represented in the questionnaire, some were grouped, for compactness (e.g., features regarding lesson and course are grouped in one question).

These questions have been created specifically to determine the desirability of many of the functions included. Of course, these functions were designed with the CAE-L stereotype in mind, and so from

the responses to these questions it is possible to draw inferences as to the suitability of using the CAE-L stereotypes in specifying the web design of educational interfaces.

Those questions are:

Questionnaire

My Nationality is: _____

* Delete as appropriate

1. I would prefer to have a progress bar that showed: [Lesson]/[Course]* progress.

2. I think the approval statement "Personalised Lesson <university> approved!" should be [included]/[left out]*.

3. The 'Additional Information' section needs information [specific to the page]/[specific to the course]*.

4. I prefer a 'Lesson navigation' section that gives detail on [the next few lessons]/[the current lesson]*.

5. The 'Data Security' link should [always]/[never]* be available.

6. The 'User Settings' link should [always]/[never]* be available.

7. The 'What's On Locally?' link should [always]/[never]* be available.

8. I prefer a discussion forum where I can talk to [the teacher]/[my friends]*.

9. The main 'Help' link should connect to the [course support]/[lesson support]* pages.

10. The 'Page Help' link is [very]/[not very]* useful.

11. Links in the main text (such as 'blogging') [should]/[should not]* be present.

Comments:

I prefer the interface described on PAGE [1]/[2]/[3] because:

6.4 RESULTS & ANALYSIS

As can be seen in *Table 6.3*, there were 17 responses to the evaluation questionnaire, with responses per country varying from 1 to 5. Whilst this sample size is small and it would be impossible to draw any firm conclusions from it, this evaluation was considered formative in nature and focussed on investigating the initial feedback from the respondents, so that ideas and suggestions could be drawn for future development.

Table 6.3 shows the responses from the questionnaires respondents. Each country is broken down into the responses for each question, where for each question the expected result for that country is shown (in the 'Expect' Column) followed by the nature of the response. So for example, for China, question 1 ("I would prefer to have a progress bar that showed: [Lesson]/[Course]* progress."), the expected answer (according to the CAE stereotype) would be 'course' rather than 'lesson'. Of the four responses that were received for this question, ('nyny', y = matches expectations and n = does not match), two matched this expected response and two did not. So the more that a country matches

the expectations (as derived from the CAE findings of previous chapters) the more 'y's there should be. This information can be found in the 'Matches' row, so in China's case there were 31 out of a possible 44 correct matches in the responses.

The final row of *Table 6.3*, is the 'Page' row. As can be seen from the evaluation questionnaire, the students were also asked which of the three selections they were given did they prefer? The responses to this question are shown here, with the number of correct matches per country being displayed. For example China had two correct matches (two of the respondents chose the China page as their favourite) out of the four respondents.

	CHN		DEU		IND	
	Expect	*Confirm*	*Expect*	*Confirm*	*Expect*	*Confirm*
Q1	course	nyny	lesson	n	course	nyyyy
Q2	present	yyny	left out	y	left out	nnyyy
Q3	course	yyyn	page	n	course	ynyy
Q4	current	yyyy	next	n	current	nynny
Q5	always	ynyn	never	n	never	ynyny
Q6	always	yyyy	never	n	never	nynny
Q7	always	yyyn	always	y	always	yyyyn
Q8	teacher	yyyn	friends	y	teacher	yyynn
Q9	course	nyyn	lesson	n	course	nnyyy
Q10	not	yyyy	very	y	not	nyyyn
Q11	absent	nnny	present	y	absent	yyyyy
Matches	31/44		5/11		35/55	
Page	2/4		0/1		1/5	

	IRE		NLD		GBR	
	Expect	*Confirm*	*Expect*	*Confirm*	*Expect*	*Confirm*
Q1	course	nnyn	course	n	course	yy
Q2	left out	nyyy	left out	y	left out	yn
Q3	course	nnyn	page	y	course	yn
Q4	current	nnyn	next	n	current	ny
Q5	never	nnnn	never	y	never	nn
Q6	never	nnny	never	y	never	nn
Q7	never	nnnn	always	y	never	yn
Q8	teacher	yyyn	friends	y	teacher	yy
Q9	course	ynyy	course	n	course	yn
Q10	not	nyny	very	y	not	nn
Q11	absent	nnnn	absent	y	absent	yn
Matches	15/44		8/11		9/22	
Page	0/4		0/1		1/2	

Table 6.3: shows the responses from the evaluation questionnaire respondents.

From an initial examination of these responses, it seems that overall the students did not often chose their correct page for their country, with only four matches out of a possible seventeen (24%).

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However, looking more closely at the question responses, it seems that the story may be a little more complex than at first glance. China, India and the Netherlands all have a high number of correct responses to the questions. To investigate this further, an additional analysis was conducted into the spread of responses across the questions.

Table 6.4 shows the results of this analysis. The 'y' and 'n' responses were converted into numbers following a simple approach, the idea being that a 'y' counts as +1 towards a questions final score (therefore the more correct numbers the higher the figure given next to each questions), whereas an 'n' counts as a -1 towards the same score (therefore the lower the figure). So for example for China question 1, 'nyny' becomes +1, -1, +1, -1 equals 0. If the responses for a given question match the CAE expectations, then the final summed result will be positive, whereas if the differ from the expected result the final figure will be negative. This approach was taken as if the responses to a question are random, then the final summed figure should be at or close to 0, that is all of the 'y's and 'n's cancel each other out. To ensure an equal base for the analysis, each of the summed results was then divided by the number of responses. Hence, for questions 2 for China the summed response was 2 ('yyny', +1+1-1+1) this was then dived by 4 as this was how many responses to the China questionnaire there were. The overall formula for the *stereotype match of a question* is as follows:

$$M_{Qi} = \frac{\sum_{k=1}^{|Nr(yes)|} 1 - \sum_{k=1}^{|Nr(no)|} 1}{\sum_{k=1}^{|Nr(yes)|+|Nr(no)|} 1}$$

Following this summation of results, a t-test against a hypothesised mean of 0 was carried out and the results are included in *Table 6.4* in the 'p value' column. If there is a significant difference between the actual result and the expected mean (of 0) then 'p' will be less than 0.1.

	CHN	DEU	IND	IRE	NLD	GBR
Q1	0	-1	0.6	-0.5	-1	0
Q2	0.5	1	0.2	0.5	1	0
Q3	0.5	-1	0.2	-0.5	1	0
Q4	1	-1	-0.2	-0.5	-1	0
Q5	0	-1	0.2	-1	1	-1
Q6	1	-1	-0.2	-0.5	1	-1
Q7	0.5	1	0.6	-1	1	0
Q8	0.5	1	0.2	0.5	1	1
Q9	0	-1	0.2	0.5	-1	0
Q10	1	1	0.2	0	1	-1
Q11	-0.5	1	1	-1	1	0
Page	2/4	0/1	1/5	0/4	0/1	1/2
% match	66%	45%	60%	34%	72%	32%
p' value	**0.02**	0.779	**0.027**	0.111	0.138	0.341
mean	0.409	-0.091	0.273	-0.318	0.455	-0.182
StDev	0.491	1.044	0.35	0.603	0.934	0.603

Table 6.4: showing the results of the analysis for each country's evaluation responses

As can be seen from the results in *Table 6.4*, only two of the six countries examined have a significant difference to the hypothesised mean, these are China and India. Not only do both countries differ significantly, but they have a positive mean score (China = 0.409 and India = 0.273). As explained above, if a countries response matches the CAE stereotype, then the final figure should be positive (with all positive matches giving a result of 1). Hence the student responses for both China and India match their CAE stereotypes.

Compare this to the findings for the Netherlands; here the percentage of correct matches is 77% (compared to 66% and 60% for China and India respectively), which at first glance appears to be much more positive than either China or India. However, in examining the standard deviation for both countries, it can be seen that the Netherlands is much higher (0.934), which results in the higher 'p' value of 0.138.

The result for Germany appear to be quite balanced between matching and not matching the CAE stereotype. This results in a mean that is very close to the hypothesised mean of 0 (-0.091). Also these results have the largest standard deviation of all the countries at 1.044, resulting in an extremely high 'p' value (0.779). Therefore all that can be concluded concerning the Germany stereotype evaluation is that the results seem quite close to being random. Considering that there was only one response for the Germany questionnaire, clearly more responses would be needed before any further information could be extracted.

Finally, in the results for both Ireland and the UK, both mean values are negative (-0.318 and -0.182 respectively), which indicates that the results are contrary to those expected from the CAE stereotypes. Specifically Ireland, which has four responses, has a 'p' value of 0.111, which is rather close to the 0.1 boundary of significant results. Of course, nothing significant can be drawn from this result, but it does seem as if there may be a mismatch between the CAE stereotype for Ireland and the Irish students. The results for the UK are much less informative, with only two respondents and a 'p' value of 0.341. Thus more information needs to be gathered before any firm conclusions can be drawn.

A similar analysis can also be carried out for the questions rather than the countries. In this case, it is interesting to see which questions tend to find the correctly matching responses.

Question	% match	Mean	StDev	P
Q1	41%	-0.317	0.634	0.276
Q2	71%	0.533	0.408	**0.024**
Q3	59%	0.033	0.712	0.913
Q4	47%	-0.283	0.749	0.397
Q5	35%	-0.3	0.837	0.42
Q6	47%	-0.117	0.917	0.768
Q7	59%	0.35	0.758	0.31
Q8	76%	0.7	0.346	**0.004**
Q9	53%	-0.217	0.634	0.441
Q10	65%	0.367	0.804	0.315
Q11	53%	0.25	0.88	0.518

Table 6.5: showing the results of the analysis for each question's evaluation responses

Table 6.5 shows the results of this analysis. As can be seen from the first glance, the majority of the questions offer no significant result. however Question 2 ("*I think the approval statement "Personalised Lesson <university> approved!" should be [included]/[left out]*.*") and Question 8 ("*I prefer a discussion forum where I can talk to [the teacher]/[my friends]*.*") are both significant in their responses.

Significance here means that the results to the questionnaire are not random (i.e., they differ from the hypothesised mean of 0) and as both of their means are positive (Q2 at 0.533 and Q8 at 0.7), this indicates that overall the responses to these questions match the CAE stereotype expectations.

6.5 SUMMARY

There are several conclusions that can be drawn from this evaluation:

1. It appears that the CAE stereotypes and the conclusions drawn from them in the development of the sample screenshot for both China and India are broadly correct.

2. There is not enough information to draw any conclusions for the other countries; however, the results for Ireland do tend to show that there may be a mismatch between the CAE stereotype and the conclusions used for the screenshot when presented to actual Irish students.

   Is this mismatch due to erroneous conclusions – are there problems arising from the design of the screenshot's web interface? Or is this due to a more fundamental issue with the CAE stereotype? In examining the Irish students responses it can be seen that there is 100% disagreement with questions Q5 (Data security), Q7 (What's On Locally) and Q11 (Links in content text). This may be because these students prefer more information present on the webpage or (in the case of Q11) that 'in line' links are considered a standard part of a hypertext webpage. It may also be that the design of the question is not very discerning, or that it does not correctly get its meaning across. Another series of investigations would have to determine the location of this issue, be it the questionnaire, the website design or the CAE stereotype.

3. In analysing the results for each question, it seems that only Q2 and Q5 are able to discern the correct responses across the 6 countries ('correct' in this case means either 'match' or 'mismatch', as long as a significant result is gained). The other questions may need to be re-examined to determine if they need re-written to correctly address the issues being investigated.

Of course these are only preliminary conclusions and more data is required to continue this formative evaluation. Beyond the examinations of the question text, it is also useful to re-examine the structure of the questionnaire itself, especially in light of the responses to the 'I prefer page X' question. Although in many cases there is a reasonable match between the expected response to a question and the actual response (52% of all questions asked was a correct match), there is only a very low (24%) match with the actual student choice of preferred page. What is the cause of this? It seems that whilst students may prefer the individual sections from their CAE stereotype, they do not prefer the overall page arrangement.

A more likely explanation is that the page differences in arrangement are too subtle for the students to accurately perceive the difference. Therefore it may be necessary to amend the evaluation questionnaire to focus on the functional and presentational aspects. In this way, only a single screenshot would be presented (an amalgam of the various functions and suited to no specific country) and the functional aspect discussed in a little more detail before the questions are asked.

6.6 NEXT

In the next chapter, the findings from this chapter are merged with those from previous ones to investigate the implementation and use of CAE-L in an actual adaptive environment (ADE) in use in the classroom. This summative evaluation will herald the penultimate aspect of the research presented in this thesis.

CHAPTER 7:

SUMMATIVE EVALUATION IN ADE

7 SUMMATIVE EVALUATION IN ADE

7.1 INTRODUCTION

The purpose behind the research presented in this chapter is to perform an in situ evaluation of the usage of an AEH system implementing the CAE-L adaptation techniques. Whilst the previous chapter performed an initial small-scale evaluation using some potential screen mock-ups, the focus here will be on a larger scale examination, containing both quantitative and qualitative experiments.

The first experiment is designed to focus on one group of students (Romanian) as opposed to the previous evaluation which was wider in range and smaller in scope. These students would be given access to lessons presented in ADE, and then their opinions were collected and measured.

Not only this, but the second study was designed as a structured interview, involving a small scale number of students, but with the focus of determining if the Romanian CAE stereotype is an accurate one.

Hence both studies are aimed at addressing the ongoing concern over the small sample size of the CAE respondents. This small sample size makes it difficult to draw any strong conclusions from the analysis presented in this thesis. The research given in this chapter specifically investigates the Romanian students, to see if the conclusions drawn in previous chapters are accurate, and how much faith can placed in the generic CAE conclusions, which will be discussed in more detail in the next and final chapter.

7.2 ADE MODIFICATIONS

ADE [Scotton *et al*, 2011] was introduced in Chapter 2 as the AEH system of choice for use in this research, as it is readily available for extension and adoption of the CAE-L stereotypes. ADE has been developed at the University of Warwick by Joshua Scotton, under the guidance of Dr Cristea of the IAS (Intelligent and Adaptive Systems [IAS, 2011]) group. The IAS group has a long history of AEH development, and as such is well placed for application of the CAE-L stereotype within their AEH systems.

To this end an adaptive presentation layer was added to the ADE system that could implement the types of adaptation presented and discussed in Chapters 5 & 6, such as displaying differing levels of 'help' depending on the culture of the student viewing the lesson. ADE did this by dynamically adapting the layout and presentation of courses based on the adaptation strategy, as devised through access to the CAE-L instances (these instances were placed directly in the ADE system's user model rather than through access to the web service due to practical time saving issues during the experiment). The modular separation of concerns (i.e., content from user model from adaptation model, from presentation model etc …) built into ADE made this extension relatively straightforward.

7.3 CAE-L SUMMATIVE EXPERIMENTAL DESIGN

7.3.1 STUDENT COHORT

The following experiments were performed during the Spring term of the 2010/11 academic year at the Universitatea Politehnica Bucureşti (UPB, Politehnica University of Bucharest), Romania. A class of third year electronic engineering students (studying in the Web Application Development course) was presented with adaptive lessons created in ADE. There were 28 students in this class, of mixed genders (approximately 25% female) and all aged between 21-23 years old. Whilst technically knowledgeable, they had had no exposure to AEH systems before.

7.3.2 EXPERIMENTAL PROCEEDURE

7.3.2.1 QUANTITATIVE EXPERIMENT FOR THE GBR VS. ROU GROUPS (EXPERIMENT 1)

1) The student cohort was randomly split into two groups. This was done through the dissemination of student IDs on a first come first served basis, with each ID being numbered from 'student11' to 'student39'. The first group consisted of all of the even numbered students and the second group all of the odd numbered students. Ids 1 to 10 were used for a preliminary testing of system, and not included in the final analysis.

2) Two lessons were created in ADE, the first is on PHP and the second covers Perl. These were used as revision lessons: that is the students were taught these subjects in previous classes, but as knowledge of these areas is a requirement for the course, a pair of revision lessons was considered desirable.

3) The first group of students (group A, the odd numbered students) is given access to the PHP lesson (lesson 1) that has been adapted to them using the Romanian (ROU) CAE stereotype. The second group (group B, the even numbered students) has the lesson adapted to them using the modified British (GBR) CAE stereotype. The GBR stereotype was used, as 16 of the 27 CAE-F concepts differ from the ROU stereotype and as such can be used a good comparison. So:

$$max_{i=1..all\ countries}[d_{CAE-F}\ (S_{Romania},\ S_i)] = d_{CAE-F}\ (S_{Romania},\ S_{UK}) = 16;$$

where d_{CAE-F} is defined similarly to the diversity distance in Chapter 6, by replacing however *features(CAE-L)* with *features(CAE-F)*, and with:

$$max(|features(CAE-F)|) = 27\ )$$

Comparing two similar stereotypes would minimise any results that would be noticeable. In order to ensure that the two user interfaces were as different as reasonably possible some extra mismatches were inserted in the GBR stereotype (in the cases where GBR and ROU both match). The two instances of this being the navigation menu and the logo, which were both replaced with their opposite number. In the case of the logo, this was replaced with a 'peers' value (i.e., an image of students) rather than a 'teachers' logo (an institutional image), and in the case of the navigation bar, the 'deep' structure was replaced with the 'shallow' structure. In this way, it is possible to obtain the maximum diversity distance possible and at the same time investigate the effect that culture may have on logo design and navigation bar structure, both important considerations when designing an adaptive interface:

$$d_{CAE-F}\ (S_{Romania},\ S_{UK-modified}) = 18;$$

This figure is now equal to the maximum features from CAE-F which were implemented in ADE. These differences were enforced to ensure that the study would tease out any difference of opinions from the students between the two structures.

4) The students were then given access to the PHP lesson, after a short introductory presentation. They were then allowed 4 days to read and revise using ADE. Progress through each lesson involves:

    4.1) Logging in to ADE, http://ade.dcs.warwick.ac.uk/ADE-RO/

    4.2) Completing the pre-test (see *Figure 7.1*), which consists of a series of 21 questions designed to determine the students background knowledge of the subject (full text of the pre- and post-test is available in Appendix G). The results of the pre-test would be used, along with those of the post-test, to determine any difference in learning efficiency between the two groups of students.
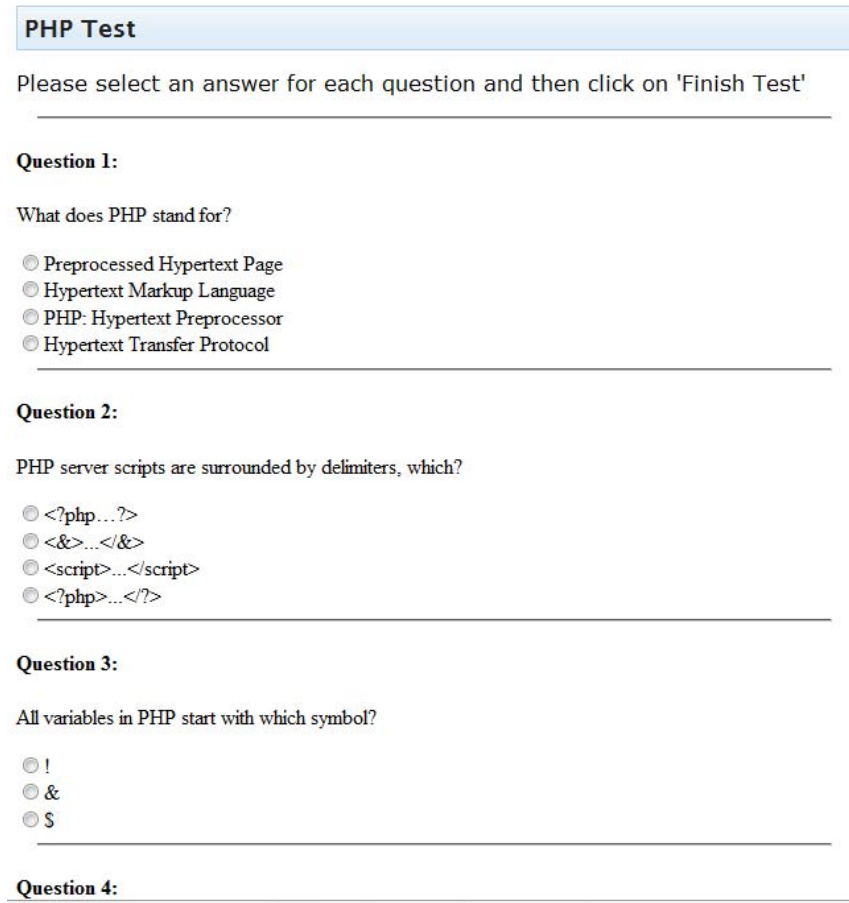
Figure 7.1: A screenshot of the PHP pre-test in ADE.

4.3) Viewing the lesson, once the pre-test is completed, the students chose to access the PHP lesson. What they see will be determined by the CAE stereotype of the group. Hence those using the ROU stereotype will see the lesson interface presented in *Figure 7.2*, whilst those students using the GBR stereotype will see the interface shown in *Figure 7.3*. These design features link back to those discussed in the previous chapters.

Figure 7.2: A screenshot of the PHP course in ADE – adapted using the ROU CAE-L stereotype.
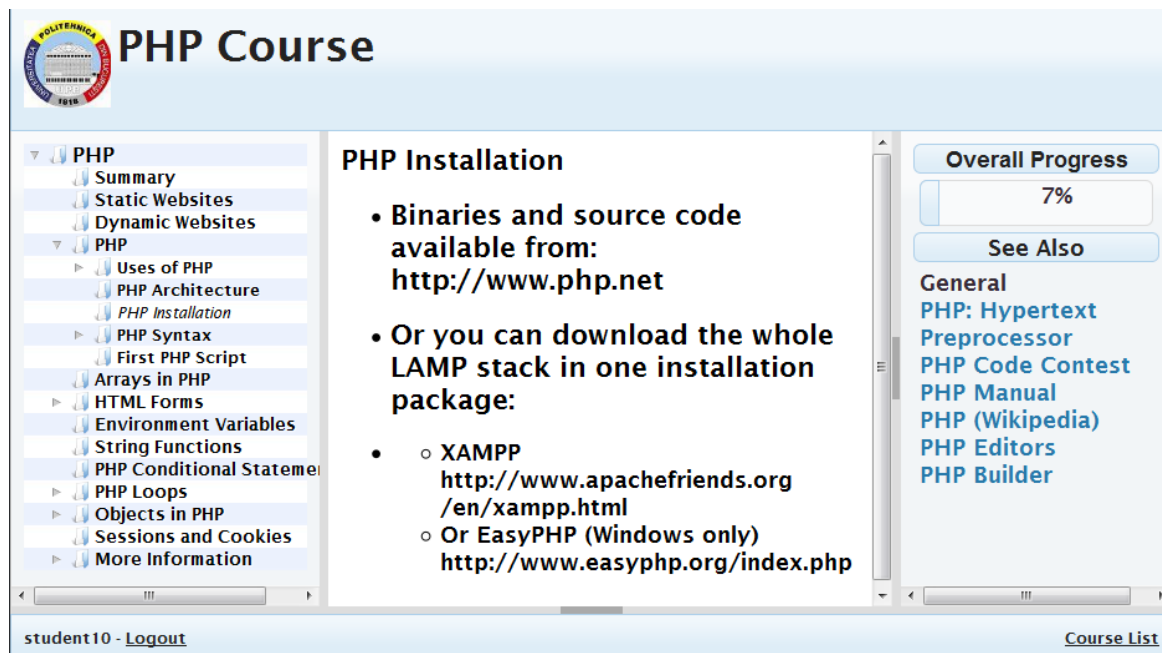
Figure 7.3: A screenshot of the PHP course in ADE – adapted using the GBR CAE-L stereotype.

As can be seen from the two figures, the design of the interface closely matches that presented in the previous two chapters, as do the types of adaptation in use, such as 'course' (Overall) versus 'lesson' progress, a 'Next Recommended Step' button, more 'help' links, and so forth.

4.4) The students then work their way through the course materials at their own pace.

4.5) After completing the post-test, which is the same as the pre-test, they are given an additional link to the quantitative evaluation questionnaire (see section below for more details) and the lesson is finished.

5) After four days, the lesson is closed (becomes inaccessible) and the second lesson (on Perl) is made available. In the Perl lesson (lesson 2), group A is given access to the content adapted to them using the modified British CAE stereotype, whilst group B uses the Romanian CAE stereotype. This is a crossover experiment, and it was used here, as there is no easy way to introduce a control group: having a control group that did not have access to the AEH system may well bias their results one way or the other. As such, this would not be morally defensible, as the results of their learning directly affect their course mark and their final degree. Therefore, it was decided to have each group access as similar lesson materials as possible. Group 1 thus initially views the ROU adaptation for the PhP lesson, followed by the GBR version of the Perl lesson, whilst Group 2 views the GBR adaptation of the PhP lesson, followed by the ROU adaptation of the Perl lesson. Therefore both groups view one ROU and one GBR adaptive scenario. This also has the advantage that this will help ensure that any perceived differences in the response are not due to the make-up of the group – as the ROU and GBR results will be collated before analysis, or the order of presentation of the stereotypes.

6) The students progress through the lesson as described above and the same evaluation procedure is applied.

7.3.2.2 QUALITATIVE STUDY EXAMINING THE VALIDITY OF THE ROU STEREOTYPE (EXPERIMENT 2)

The second of the two studies performed with the Romanian students was to directly interview three of them from the same cohort as described above. The purpose of this study is to gather, through use of a structured interview technique [Sociology central, 2011][PARE, 1997], responses from these students, and compare them directly with those extrapolated from previous experimental data (the CAE questionnaire, Chapter 3). In so doing, it is possible to examine the validity of the Romanian CAE stereotype. Considering the small sample sizes used to create the stereotype any further validity confirmation is a welcome addition – any mis-matches between the studies would invalidate the stereotype.

The correct methodology of a structured interview is to ensure that the same procedure is applied in every interview. Hence a question script was created (as given in Appendix E) that would be read to each student. The procedure for this study was to invite one student volunteer at a time into an otherwise empty room, the interviewer would then shortly explain what was to happen and direct the student to the ADE lesson on the screen. The interviewer then reads the interview script aloud, waiting for the student's responses at the appropriate times. It is worth noting that there were two types of responses allowed, 'binary' and 'open answer'. For example, see Question 1:

---

1) [interviewer points at the progress bar] This bar showed you your progress throughout the lesson,

      i) did you notice this? {yes, no}

      ii) did you find it useful? {yes, no}

      iii) how else would you otherwise prefer this? {open answer}

The {yes, no} are the possible binary responses to that question and the student was encouraged to select one of these answers only. The {open answer} indicates where an 'open answer' type response is permitted and the students would be allowed to give any response they wished to this.

Each interview was recorded, so that the responses could be later examined.

Once the interview was over, then the student was thanked and led out of the room.

7.3.3 ANALYSIS PROCEDURE

As with earlier statistical analyses in this thesis, the small number of students means that any extrapolation to the wider group (in this case all Romanian students in higher education) is very tentative and non-parametric methods must be used (a short analysis using parametric methods is added at the end of section 7.4.1.3 as it may give more information over this data, but with the proviso that sample size may well restrict the use of this).

In the following, the evaluation methods and analyses that have been performed are detailed.

7.3.3.1 QUANTITATIVE ANALYSES FOR THE GBR VS. ROU GROUPS (EXPERIMENT 1)

After each student completed one of the ADE lessons (be it PHP or Perl), they were sent to an online questionnaire (http://www.joshuascotton.com/survey/index.php? sid=38328&lang=en)(*Figure 7.4*).

This questionnaire consists of 10 questions and 3 comment areas. The questionnaire was designed based on the first version given in the previous chapter on formative evaluation, but simplified to reduce uncertainty. Such simplifications include not asking the respondents to examine three samples and then asking them to comment on potentially similar UI aspects, the focus in this questionnaire was deliberately targeted at the UI aspects that clearly differentiate between the GBR and ROU stereotypes. After it was designed, the questionnaire was evaluated (by 3 members of the target audience, who were then not allowed to submit responses to the final version), re-designed and finalized before delivery.

The Hypothesis for this experiment and the foundation for the design of this questionnaire is:

H0: there is no difference between the responses to the questionnaire from students completing the Romanian formatted lesson when compared to those completing the British formatted lesson.

Note: that this overall approach is slightly different for those students who have volunteered for the qualitative evaluation, as described below as inclusion in the qualitative evaluation means exclusion from the quantitative one.

To determine if the Null Hypothesis should be accepted or rejected, the following procedure was followed:

1) Determine if there is no significant difference between the two groups, compare gAL1 (Group A, Lesson 1: on PhP) with gBL2 (Group B, Lesson 2: on Perl)(both groups using ROU stereotype) and, respectively, gBL1 with gAL2 (both groups using GBR stereotype). This initial analysis is to determine if it is safe to join the results of the two groups together.

2) *If* there is no significant difference, then combine the similar CAE groups and determine if there is a difference between the two CAE stereotype adaptation responses. As later analyses aim to compare ROU and GBR stereotype responses, the distinction of which group and which lesson becomes

irrelevant after this check, resulting in two summed groups for comparison (ROU stereotype students vs. GBR stereotype students). Hence compare [gAL1+gBL2] with [gBL1+gAL2] using the Mann-Whitney-U test for comparing two groups spread for a given question.

Figure 7.4: A screenshot of the CAE Evaluation questionnaire given after the ADE PHP course (See Appendix H for full text).

7.3.3.2 QUALITATIVE ANALYSES EXAMINING THE VALIDITY OF THE ROU STEREOTYPE (STUDY 2)

As the goal of this study was to collect a set of opinions, these opinions were then examined and directly compared to the CAE-L ROU stereotype. Additionally, any other relevant topics or issues raised by the students are also noted.

There is no further form of analysis applied to these responses.

7.4 RESULTS

7.4.1 EXPERIMENT 1: ROU VS. GBR (DOES STEREOTYPE MATTER?)

As stated previously, the first part of this analysis was to determine if there was a significant difference between each of the ROU groups (those given Lesson 1 and those given Lesson 2) and each of the GBR groups (same). An analysis has shown that there are no such significant differences.

Following on from this, the evaluation data were analysed to determine if there was a statistical difference between each of the two groups' (ROU and GBR interface adaptations) responses to each question. As done also in Chapter 3, the data were initially analysed with a Kruskal-Wallis one-way analysis of variance by ranks (this was once again the appropriate test due to sample size restrictions). This test determined if there were any significant differences between the responses for a question, based on the respondents' CAE interface assignment. The result of the test gives a 'p' value which indicates the significance of the difference between the sets of data within the group.

The Null Hypothesis for analysing these data was that there is no significant difference between each of the CAE interface respondents when it comes to answering the evaluation questions.

The results from the K-W test for each question are shown in *Table 7.2*. These results show that there exists a statistical difference (at the $p <= 0.05$ boundary) for questions 6 and 7. Further information on the analysis for each question follows in Sections 7.4.1.1 and 7.4.1.2.

Table 7.1 details the number of respondents ('n' values) for the questionnaire respondents. This number does not include those students who did not complete the pre- and post- test for both the PHP and Perl ADE lessons.

Country	N
Romania (ROU)	13
United Kingdom (GBR)	18

Table 7.1: the numbers of respondents for the two types of interfaces (note: 'country refers to the interface used not the nationality of the respondent – all of whom were Romanian)

Question	'p' value
Q1: "The progress bar was informative."	0.371
Q2: "The progress bar should display progress over a series of lessons not just one."	0.770
Q3: "I liked the logo in the top left corner of the lesson."	0.779
Q4: "The 'See Also' panel contained enough useful information."	0.832
Q5: "The hierarchical structure of the Navigation menu was clear and easy to use."	0.574
Q6: "The hierarchical structure of the Navigation menu should be displayed has too many links (I prefer having the overview structure only, and navigating down from there myself)."	0.024
Q7: "The link displaying information about local events is not needed."	0.024
Q8: "The 'Help' link (often found in the lower right corner of the content panel) is valuable."	0.733
Q9: "The 'Help' link (in the content panel) should be active on every page."	0.836
Q10: "Links to additional information should be present in the main text of the content panel (centre). (I.e., I would like to see not only plain text, but also text with links in it)."	0.558

Table 7.2: showing the results of the Kruskal-Wallis analysis for each question's evaluation responses

To further examine these questions. a post-hoc evaluation was performed: a non-parametric 'pairwise' (Mann–Whitney U) test was performed. As there were only to be two tests (one between ROU and GBR for each of the questions Q6 and Q7), there is no need for any adjustment to be made to address the increased risks of Type I errors.

7.4.1.1 QUESTION 6

"The hierarchical structure of the Navigation menu should be displayed has too many links (I prefer having the overview structure only, and navigating down from there myself)."

As can be seen from *Table 7.2*, evaluation question 6 was significantly different at the $p<0.05$ boundary. In examining *Figure 7.5*, It can be seen that the students given the GBR stereotype

generally 'agree' with the statement, and the students given the ROU stereotype seem to be neither in agreement nor disagreement.
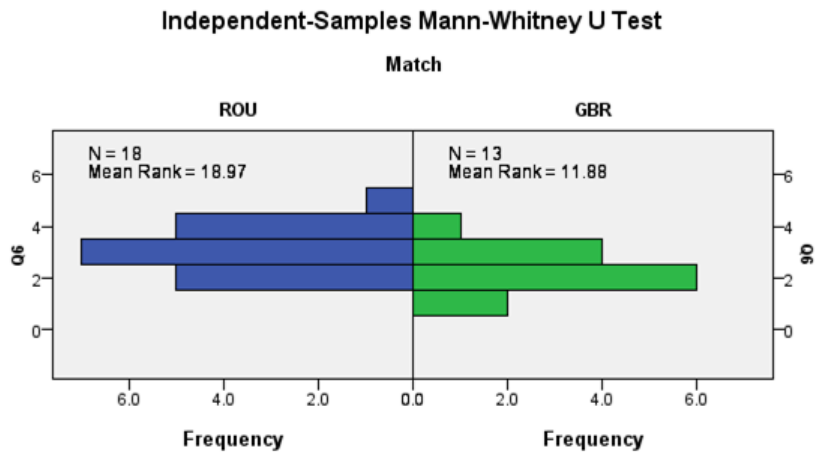
Figure 7.5: The results of the Mann Whitney U analysis for evaluation Q6.

Remember that due to the similarity between the ROU and GBR CAE-L stereotypes in terms of their logo and navigation tree concepts that a deliberate inconsistency was added to the GBR stereotype. The ROU stereotype should be the same as the GBR one, hence the above figure can be considered a test between:

Q6 ROU = CAE-L ROU stereotype **match**

Q6 GBR = CAE-L GBR stereotype **mismatch**

Therefore, the fact that the students given the 'mismatch' (GBR) stereotype tend to 'agree' with the statement that there are "too many links" would seem to imply that they do *not* like the usage of the 'incorrect' stereotype option. To be accurate, it also needs to be noted that those students who are given the 'match' (ROU) do not seem to find the navigation bar either agreeable or disagreeable (it would be expected that they would 'disagree' with the statement). However, this may be because the navigation bar structure matches their expectations and desires and therefore they do not take as much notice of it as those who are given the mismatched concept value.

7.4.1.2 QUESTION 7

"The link displaying information about local events is not needed."

As can be seen from *Table 7.2*, evaluation question 7 was significantly different at the p<0.05 boundary. In examining *Figure 7.6*, it can be seen that the students using the ROU stereotype generally 'agree' with the statement, and students using the GBR stereotype seem to be neither in agreement nor disagreement.

Considering the statement displayed in evaluation question 7 (and that unlike Q6, this is not one of the two instances where a deliberate mismatch has been introduced) it is expected that the ROU interface students would 'disagree' with this. In that, their 'Language::presence' concept is set to 'show', therefore indicating their expected desire to have local events given to them. The response to this question however, indicates a significant difference at the p<0.05 boundary in the ROU interface students agreeing with the statement. The students presented the GBR stereotype are ambivalent to this, which is partially to be expected as they did not have the 'What's On?' Link displayed (as determined by their stereotype), but the question was left in, as they were shown the link in the initial introduction to ADE, and it is possible that they could have considered it a useful aspect of the system, and they have seen it in the counter-stereotype anyway.
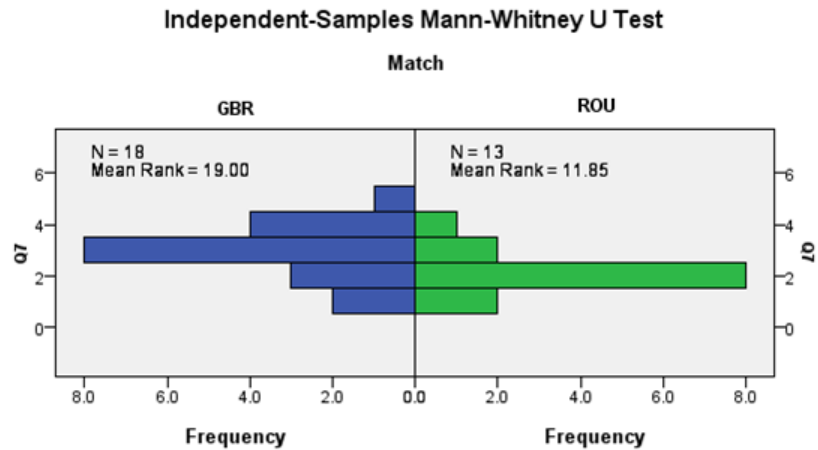
Figure 7.6: The results of the Mann Whitney U analysis for evaluation Q7.

The reason for these results is unknown at the present time, but it is possible that the 'What's On?' links are not useful enough for the ROU interface students (the links used consisted of: MSc in Cognitive Systems - University of Warwick; FC Steaua Bucharest; Filarmonica 'George Enescu'; Romania Tourism and UK Tourism). These links could have been not representing the correct 'local' information for the Romanian students, and as such their potential value was undermined. Thus, this issue requires further study to determine.

7.4.1.3   DEGREE OF CHANGE

One of the most interesting results of this study was gathered from the scores of the pre- and post-tests. These scores were combined (ROU vs. GBR) and further analysed. Specifically, a Mann Whitney U test was performed between the two groups, to determine if there were any differences between them. The two differences that were examined were:

1) the percentage increase in scores – that is, each student's pre-test was compared to their post-test and the percentage change noted. So, for example, if Student A got 13 out of 21 in the pre-test and then got 15 out of 21 in the post-test then this would be a 9.5% increase in their score.

2) the degree of change to their scores (as a percentage) – in this case, the score from the pre-test is taken as the baseline score and the post-test score is compared against this. So in the above example this would equate to a 15.4% degree of change (15 = 115.4 % of 13).

Using the results from both of these approaches, the two groups were analysed. The first approach (percentage increase) shows no significant difference, but it does indicate an interesting trend. Students given the matching interface (ROU) had a 5.2% increase in their post-test scores when compared to the pre-test ones, compared to a 0.8% increase for those students using the GBR interface.

Figure 7.7 shows the results of the analysis of the second set of differences (degree of change). In this case, a minor significant difference was found (at the $p<0.1$ boundary). Whilst this was not as significant as the other results discussed in this thesis, it was considered important, as it goes on to strengthen arguments for the trend noted previously. In this case, ROU interface students had a 7.9% degree of change, whilst the GBR interface students had a 1.4%.

As previously mentioned for this data it is possible to also perform a similar parametric analysis, although sample size concerns mean that any conclusions drawn must be carefully considered, but these more powerful analysis techniques may add further valuable information to the analysis of this data.

Independent-Samples Mann-Whitney U Test
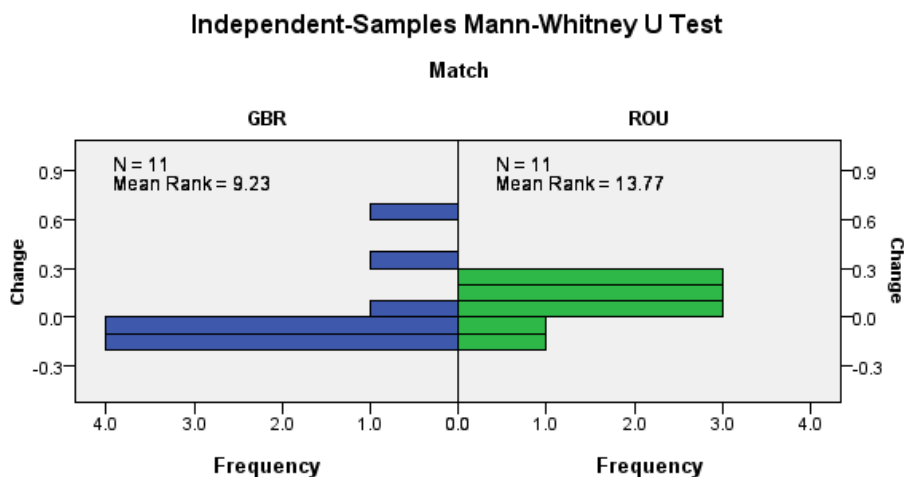
Figure 7.7: The results of the Mann Whitney U analysis for the degree of change in scores for the ROU vs. GBR evaluation.

In the case of a parametric analysis a Student's T-Test was used to compare the results of the GBR and ROU pre- and post- test scores. The null hypothesis is that there is no difference between the two groups @@@

Once again it seems that those students given the interface with the correct CAE stereotype performed better than those that were not. This is a promising result for the CAE approach.

7.4.2 STUDY 2: ROU STEREOTYPE, MATCH OR MISMATCH WITH ROMANIAN STUDENTS

In this study, the results of the interview were noted in two ways, the questions with a binary result were either a match (they were the expected result according to the CAE stereotype) or a mismatch. The 'open answer' questions were recorded and notes made as to these responses.

Table 7.3 shows the results for the binary questions, which will be discussed first, and the open answer questions will be used to investigate those questions whose meaning is a little less certain (i.e., they do not all match the expected result).

	Subject 1	Subject 2	Subject 3	Expected Result	Match
Q1 ii	yes	yes	yes	yes	Y
Q2	lesson	lesson	course	course	
Q3 i	no	yes	no	no	
Q3 ii	institution	casual	institution	institution	
Q4 i	yes	yes	yes	yes	Y
Q4 ii	yes	yes	no	yes	
Q5	yes	yes	yes	no	N
Q6	no	yes	yes	yes	
Q7	no	no	no	yes	N
Q8	yes	yes	yes	yes	Y
Q9	no	no	no	no	Y
Q10	yes	yes	no	yes	
Q11	yes	yes	yes	yes	Y

Table 7.3: the results for the binary questions from the structured interviews (in the 'Match' column 'Y' indicates an exact match with the expected response, and 'N' indicates a complete mis-match, those questions with a mix of match/mis-match responses have no value here).

As can be seen from *Table 7.3*, there are 7 questions where the interviewees all give the same response (Q1 i, Q4 i, Q5, Q7, Q8, Q9 and Q11). Of these, 5 match the expected result (Q1 i, Q4 i, Q8, Q9 and Q11), with the remaining two questions (Q5 and Q7) not matching – this gives a 71% match of

these strongly agreed on answers. It is worth noting that out of the entire table there are 26 out of 39 answers (67%) that match the expected result (this includes those questions where a consensus was not achieved), well above the expected 19 (50%) if the answers were random.

Therefore, with respect to the consensus questions (where all three students gave the same answer) it seems that the Romanian students were strongly in favour of additional help and guidance (all five questions involved additional levels of help, guidance or information). This is to be expected, considering that Romania has been confirmed as a High UAI culture.

Of the remaining two questions, Q5 discussed the navigation hierarchy - remember the students were presented with a deliberately mismatched hierarchy (it was flat rather than deep) and as such they would be expected to say 'no', that they were not happy with this structure. As it turns out, they were happy (they all said 'yes'). The reason for this is unknown, and this result does not match the CAE result nor the original Hofstede result. The result for Q7 is not what would be expected, but it does match the significantly different result as determined in Section 7.4.1.2, of the quantitative evaluation, and so this finding does strengthen that.

Of the remaining questions there is little that can be definitely concluded, but with recourse to the script of each interview it is possible to attempt to draw further conclusions for the uncertain questions (Q2, Q3i, Q3ii, Q4ii, Q6 & Q10). The interview response scripts are presented in Appendix F: Structured Interview Questionnaire Responses.

7.4.2.1   QUESTION 2

There is no 'open answer' for Question 2 which means we are left with pure speculation as to why two of the three students chose 'lesson' rather than 'course' as their preferred Progress Bar information display. Whilst this may well be against the expected PDI (of both CAE and Hofstede) considering that the many of the matches given in *Table 7.3* involve the UAI index, perhaps this can be explained that Romanian students consider uncertainty a greater issue than authority and hierarchy. To this end they may prefer the greater level of detailed information given in a lesson progress bar than that given in a course progress bar.

The issue of *index priority* (i.e. when a user interface component involves consideration from more than one index, do certain indices take precedence) has not been examined in this thesis but would benefit from additional studies.

7.4.2.2   QUESTION 3I AND QUESTION 3II

Subject 2 is the dissenter here (in both questions), preferring a casual image for the logo rather than the expected institutional one, the open answer section given (question 3iii) here is of little use in determining why this is the case with the student stating (I = Interviewer, S2 = Subject 2):

I: How else would you otherwise prefer this?

S2: I would actually like an image of other people, more, errr, wider image.

If anything the subject's response goes to further strengthen their desire for a casual image with a wider image of more people (in this case students), but no explanation for this can be gathered from this response.

The responses from the students that match the expected result to the open answer question 3iii also give little additional information, with Subject 3 stating:

I: How else would you otherwise prefer this to be displayed?

S3: I think the important point of a logo is that it is a simple image, easy to remember not a photo something unique, I think

An important issue for any AEH logo designer but not one that addresses the issue at hand.

7.4.2.3   QUESTION 4II

Whilst all three subjects agree that the 'general' links are useful, Subject 3 dissents from the expected result in stating:

I: the page specific links, did you find them useful?

S3: not really, I don't think they have a point, I think the general ones suffice.

This does seem to go against the expected result for the ROU stereotype, especially considering the otherwise strong match with Romanian students over 'uncertainty' issues. As such this is probably worth remembering that the CAE (and Hofstede) stereotypes are just that *stereotypes* and they will not be matched with all responses from all students. If this mis-match had been connected to another index perhaps more may be made of it but as it concerns the UAI it seems reasonable to draw no further conclusions from it.

7.4.2.4   QUESTION 6

Subject 1 was the only dissenter to the expected response here, however in examining the response to the 'open answer' part of the question we can see that it is not as simple as might be expected:

I: Navigation panel again. Here you are presented with a very open hierarchy, all course items were displayed at once rather than a subset. Would you have preferred to have fewer content items displayed at once, with these … with this display changing over the course of the lesson?

S1: well it would be … it's OK that you choose this, the main problem was that they kept moving when I clicked them

So whilst the student is OK with the many items presented here their main issue concerned a software issue – that the menu items shifted a few pixels every time one of the items was clicked. Also their acceptance of this approach seems equivocal at best.

As such it may well be that the dissent to the expected response may be an artefact from the software bug that the user experienced distracting them from the focal issue. It is worth noting that neither of the other two subjects seemed concerned by this software bug.

7.4.2.5   QUESTION 10

Unfortunately Subject 3 (the only dissenter to the expected response for this question) gave very little information as to why they thought the 'See Also' links should not be also present in the main text of the content:

I: With the See Also compared to the main content panel here should the page specific links that are present in the See Also section also be present as links as text in the main content page to ensure that you notice them?

S3: I don't believe so

I: Do you that other links are necessary in the main content page?

S3: No

This is the same subject that gave an unexpected response to Question 4ii (above), indicating a general higher degree of acceptance to 'uncertain' situations – and therefore required less help than their colleagues. Once again as this concerns the UAI index no further conclusions will be drawn for the same reason stated for Question 4ii above.

7.5   SUMMARY

It is interesting to follow the degree of change in quantitative study – the results indicate that the ROU stereotype may give better learning results. As this was shown across two different groups, on two different lessons, for the same, non-adapted content, and with no particular order in being introduced to the stereotypes, it is an important result.

Some significant differences however give mixed results. For instance, the depth of the information presented (hierarchical structure) conforms to the CAE expectations. On the other hand, the response for the localised links contradicts the CAE findings, as well as Hofstede. The latter clearly needs more research to establish if this was a case of the wrong selection of localised links, or a genuine preference in contradiction with the theory.

On the other hand, the high degree of matched results in the qualitative study is encouraging. Being able to have students explain their choices was useful and gave further insight into their preferences.

These findings generally support those of the original CAE questionnaire, but more data would be needed to confirm these initial findings.

7.6   NEXT

In the next chapter, another assessment is conducted, this one to determine the appropriateness of the original CAE questionnaire. As this questionnaire was written in English, the question appears if there is in fact a bias between responses to it and responses given in the mother tongue of the respondent?

That is, is there a difference between an Indian student responding in English (their non-mother tongue) and Hindi (the Indian mother tongue example used)?

CHAPTER 8:

LOCALISED CAE

8 LOCALISED CAE

8.1 INTRODUCTION

In Chapter 3, the CAE questionnaire was introduced, along with the findings gathered from the student respondents. There were several assumptions made during the creation of this questionnaire, one of which was stated at the end of Chapter 3:

> *"It should also be noted that further tests using the CAE questionnaire remain to be performed – as one of the assumptions of this study was that, as the CAE questionnaire was written and delivered in English, that there is no significant difference between students who could read English and those who could not. For example, an Indian student's responses would be the same if the questionnaire is written in English or Hindi."*

This chapter attempts to determine if this was an appropriate assumption, through the creation of two other localized versions of the CAE questionnaire, and gathering data from their native language speakers for examination.

Let us first remind ourselves of the CAE questionnaire in its original form. A screenshot showing the first few questions can be seen in *Figure 8.1* below. Note that the entire questionnaire can be found in Appendix B.

When translating the questionnaire into another language, it is vital to use translators who are fluent in both languages, to ensure that the meaning of each question is correctly transferred from the original to the copy.

To this end, when translating the CAE questionnaire, the following approach was used:

- The text of the questionnaire was gathered and sent to the translator (who was fluent in both English and the target language).
- The translator would translate the English text and submit the new text.
- A webpage for the new CAE version was created using the translated text.
- The webpage was then checked by the translator, to ensure that their translations were correctly used.
- Finally a second person who was also fluent in both languages was brought in to double-check the work of the first translator.

Only when the translated questionnaire had been double-checked and approved, was the new webpage made available to the public.

The rest of this section details the two translations chosen for further investigation, Chinese (China) and Hindi (India), as well as the rest of the analysis of the finding from each set of respondents. These two countries were chosen due to readily available access to translators for both languages.
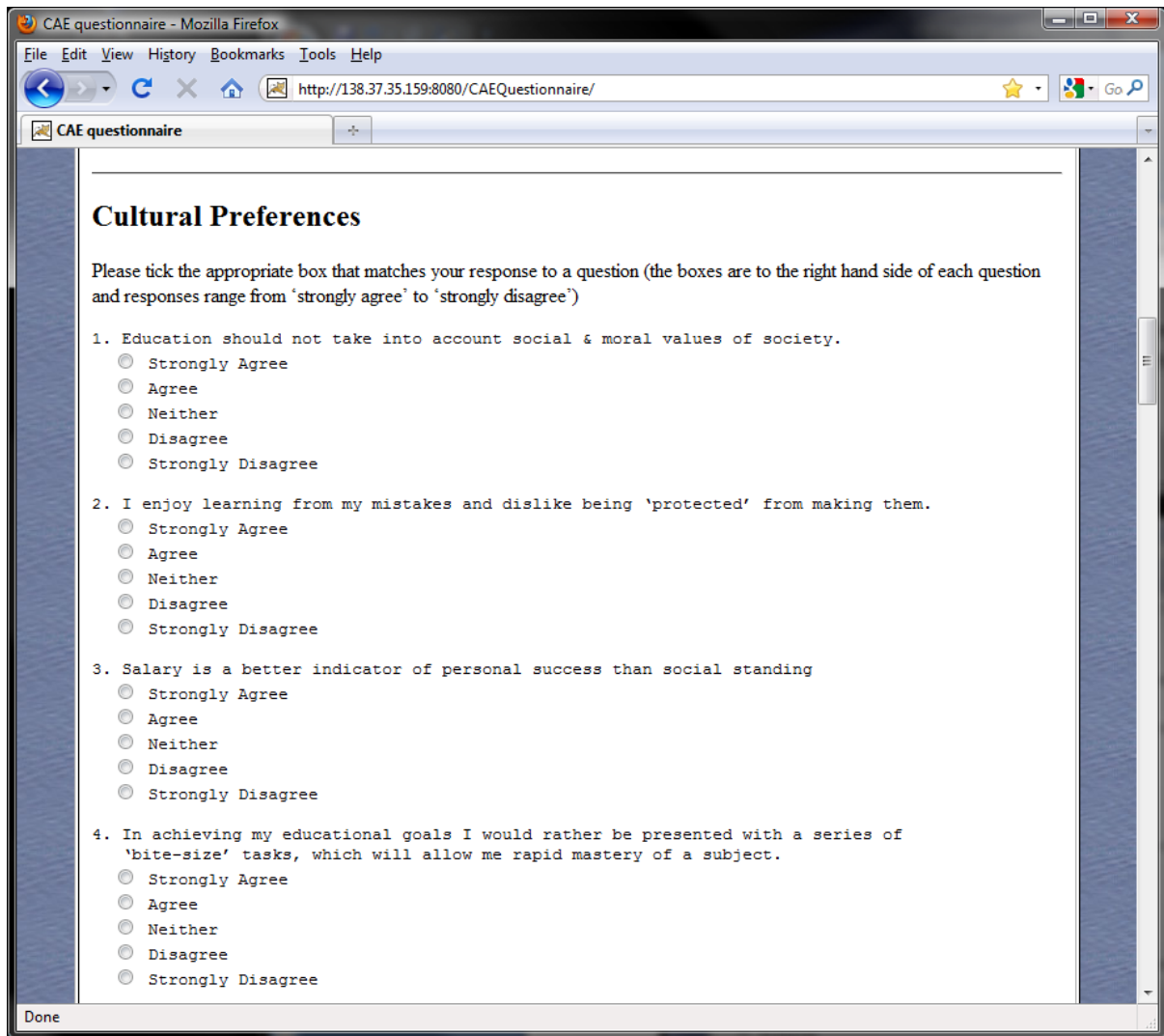
Figure 8.1: a screenshot of the English language version of the CAE questionnaire (http://138.37.35.159:8080/CAEQuestionnaire/).

8.2   CAE – CHINESE VERSION

The screenshot for the Chinese language version of the CAE questionnaire can be seen in *Figure 8.2*. As can be seen, the overall structure remains the same as in the English language version, but the rest of the text has been translated.

Using this website, respondents were sought from Chinese students, and these responses were analysed in a similar manner to the data in Chapter 4. As in the previous analysis, the respondents were all students, the numbers of respondents being analysed are given in *Table 8.1*.

Chinese CAE questionnaire	N
English	6
Chinese	8

Table 8.1: the numbers of respondents (given by 'n') from the two questionnaire language versions

By using a one-way ANOVA, the Chinese respondents from the English language questionnaire were compared with the Chinese respondents from the Chinese language questionnaire. The goal here is to determine if there is a significant difference between the two groups in their responses to each question. The 'p' value results from the Kruskal-Wallis test are given in *Table 8.2*, the test was done to investigate differences at the $p=0.1$ level.
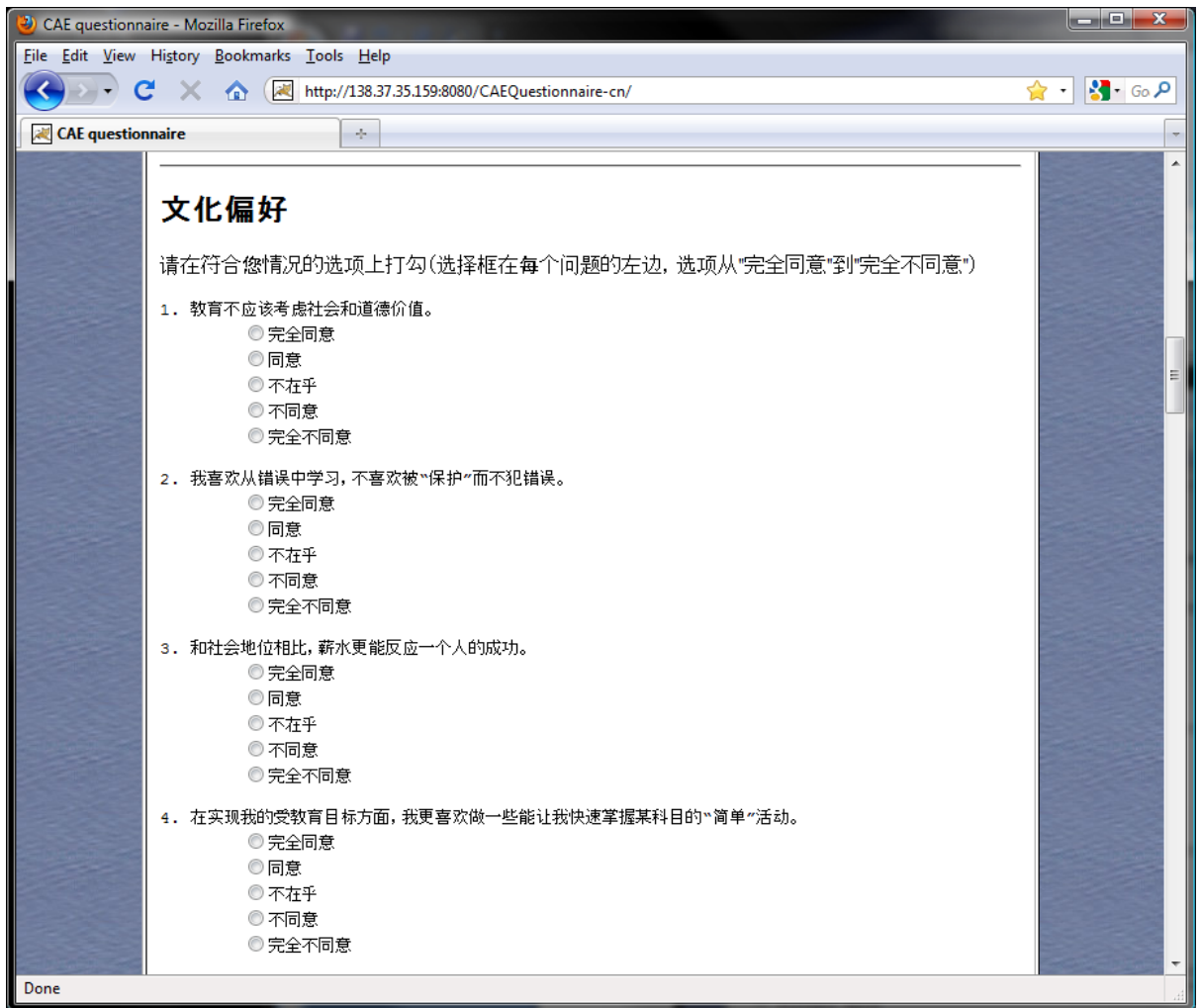
Figure 8.2: a screenshot of the Chinese language script of the CAE questionnaire (http://138.37.35.159:8080/CAEQuestionnaire-cn/).

The Null Hypothesis for analysing these data was that there is no significant difference between each of the questionnaire's respondents when it comes to answering the CAE questions.

Question	'p' value
Q1: "Education should not take into account social & moral values of society"	0.681
Q2: "I enjoy learning from my mistakes and dislike being 'protected' from making them"	0.827
Q3: "Salary is a better indicator of personal success than social standing"	0.247
Q4: "In achieving my educational goals I would rather be presented with a series of 'bite-size' tasks, which will allow me rapid mastery of a subject"	0.130
Q5: "Teachers / trainers should act as friends not gurus"	0.909
Q6: "When exploring a topic, I prefer a teacher to direct and limit my discoveries"	0.340
Q7: "When given educational information I prefer it to be presented in a tightly structured and regulated manner"	0.433
Q8: "In gaining the respect and attention of my peers I prefer non-competitive activities (such as	0.640

painting or writing poetry) rather than competitions and games"	
Q9: "I prefer to study with a teacher rather than with my peers"	0.319
Q10: "There should be as much structure and directions in a lesson as possible to ensure that there is no ambiguity"	0.408
Q11: "I prefer to reduce complexity by using smaller, limited amounts of information"	0.943
Q12: "I think that 'understanding' should be the goal of education, not the completion of 'learning tasks' and 'exams'"	0.549
Q13: "I prefer lessons that emphasise practice and practical values rather than abstract theories and 'truth'"	0.882
Q14: "Separation of the genders in education enables more effective teaching, with a teacher better able to target each group"	0.458
Q15: "Separation of the genders in education enables more effective teaching, with a teacher better able to target each group"	0.178
Q16: "I prefer to be patient and respectful of others when engaging in discussion, rather than being forward with my own point of view"	0.277
Q17: "When it comes to completing my educational goals, I prefer to work slowly and patiently, to achieve a better understanding"	0.433
Q18: "My motivation is based around personal goals and not those of my group of peers"	0.595
Q19: "I would prefer to be educated in my own language."	0.459
Q20: "Given the chance, I would prefer to be educated in another country"	0.135
Q21: "In choosing a university, the ability to practice languages other than my own is important."	0.008
Q22: "I respect the manner in which my teachers have taught me"	1.000
Q23: "I often feel constrained by the pace of my teaching"	0.925
Q24: "Different perspectives are important to me in my education."	0.116
## Q25: "I enjoy experiencing other cultures"	0.116
Q26: "I think the idea of an Adaptive Education System is a good one."	0.835
Q27: "I do **not** have concerns about the *type* of the personal data that is gathered."	0.318
Q28: "*Security* of my personal data is of utmost importance."	0.046
Q29: "I would rather that the lesson the teacher has written is not altered in any way."	0.802
Q30: "I would like to have control over the level of alteration that the Adaptive Education System makes."	0.602

Q31: "I would be very happy to receive a 'personal' education but only one approved by the teacher."	0.181
Q32: "I would prefer a personalised education even if it differs from that received by my peers."	0.595

Table 8.2: the CAE questions and the 'p' value (significance) determined from the null hypothesis when using a one-way ANOVA test on the Chinese respondents using the English and Chinese language questionnaires.

As *Table 8.2* shows that only two questions have a significant difference in the responses (questions 21 and 28). The responses for the remaining questions match those originally discerned in the analysis of the English language version of the questionnaire and as such will not be discussed further here.

8.2.1 QUESTION 21

"In choosing a university, the ability to practice languages other than my own is important"

CAE questionnaire	Mean	StDev	Median	Interpretation
English	3.0	1.1	3	Neither
Chinese	1.6	0.5	2	Agree

Table 8.3: median scores and interpretation for Q21

Unlike the respondents from the original English CAE questionnaire, it seems that the Chinese CAE respondents have a much stronger preference in answering this question. The English CAE respondents not only had a mean of 3 (they 'neither' agreed nor disagreed with the question) but they range of responses was far greater (as can be seen by a Standard deviation of 1.1 and in the boxplot spread in *Figure 8.3*) than those for the Chinese CAE respondents (with a standard deviation of 0.5 and a much tighter spread of respondents in the boxplot).

The reason for this may be that students who have already learned English may feel that they have enough knowledge for their purposes (educational and employment opportunities) and are less concerned with practicing in it. Students who do not have such a command of a second language may feel that the opportunity to learn and practice another language is of much greater importance (again possibly for access to more academic and employment opportunities).

Figure 8.3: a boxplot showing the spread of the responses for Q21 (note CHNORI, is the label for the English questionnaire respondents and CHN is the label for the Chinese questionnaire respondents).

It should be noted that the CAE questionnaire (be it Chinese or English) also collects data on the educational background of each student. In all cases of the respondents, none of them were educated

in an English speaking country (data not shown), in fact all but one of them had only ever been educated in China.

The conclusions drawn above would indicate that when preparing an adaptive lesson for Chinese students, it is best to arrange access to additional English (or whatever the language of the online institution is) language features for them.

8.2.2 QUESTION 28

"Security of my personal data is of utmost importance"

CAE questionnaire	Mean	StDev	Median	Interpretation
English	2.2	1.2	2	Agree
Chinese	3.5	1.1	4	Disagree

Table 8.4: median scores and interpretation for Q21

In examining question 28, I found a dramatic reversal in the response from the Chinese CAE questionnaire when compared to the English CAE questionnaire. The original English version response indicates that Chinese students agree with the statement that security of their data is important to them; however the response to the Chinese CAE questionnaire shows that these students actually disagree with this statement.

As can be seen from the boxplot in *Figure 8.4* there is quite an overlap between the two response populations but the overall figures are significantly different at 'p<0.05'.

Figure 8.4: a boxplot showing the spread of the responses for Q28 (note CHNORI, is the label for the English questionnaire respondents and CHN is the label for the Chinese questionnaire respondents).

A possible explanation may be that a greater population sample size will iron out these discrepancies, but it is also possible that students who have spent their entire academic lives with China feel that they do not need to be so concerned over their personal data. This could be due to either their faith in the Chinese government being able to protect them, or their disillusionment in the fact that the Chinese government will penetrate their secrets no matter how they protect them.

The truth to this is probably a complex issue concerning the trust and relationship between the student and 'authority'. The lesson that the CAE cultural stereotypes can take away from this analysis would be that Chinese students should have a clear security statement made concerning their personal data, even if they feel it is unnecessary.

8.3 CAE – HINDI VERSION

The screenshot for the Hindi language version of the CAE questionnaire can be seen in *Figure 8.5*. As with the Chinese version of the questionnaire, the overall structure remains the same as in the English language version, but the rest of the text has been translated.
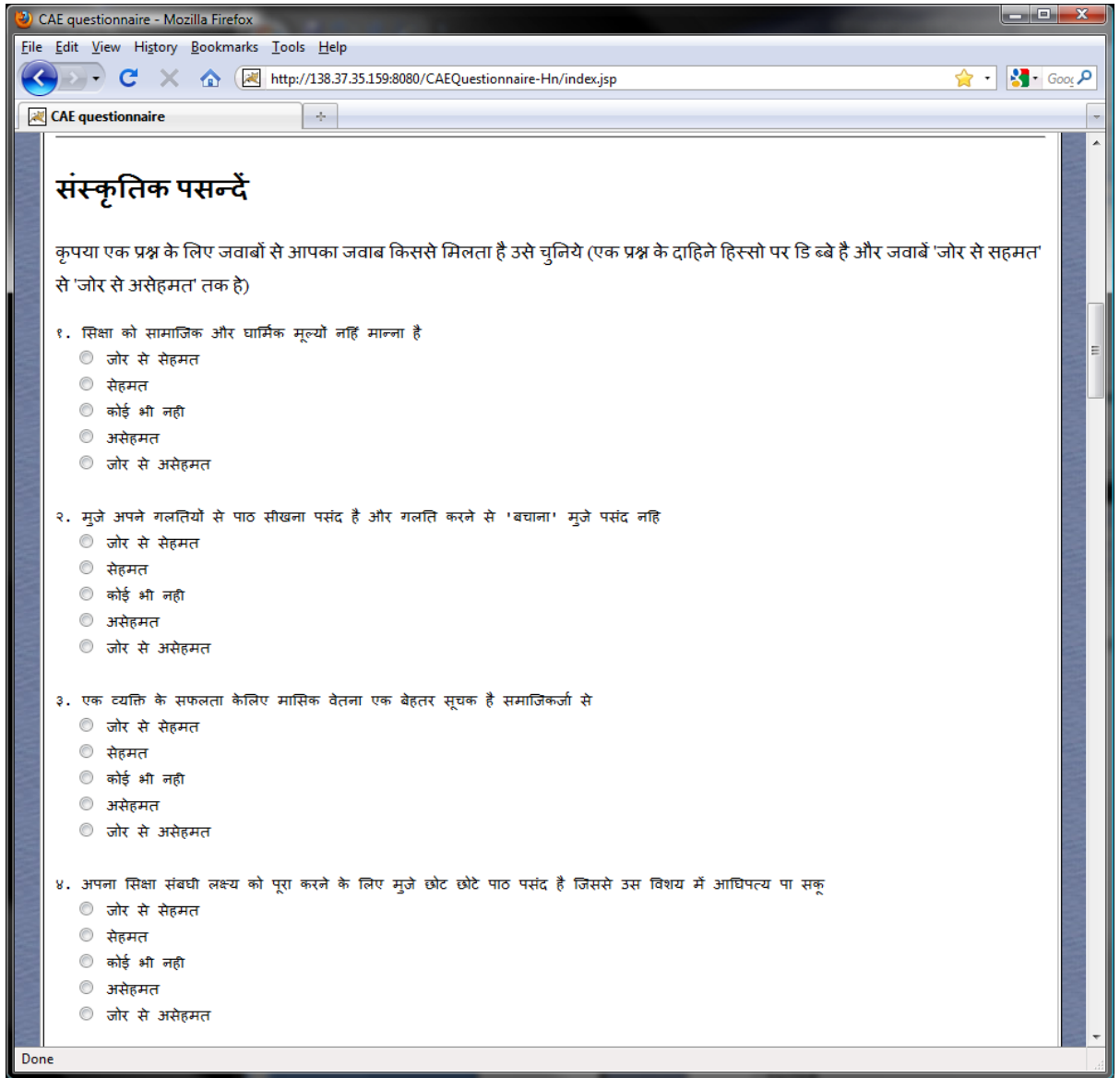
Figure 8.5: a screenshot of the Hindi language script of the CAE questionnaire
(http://138.37.35.159:8080/CAEQuestionnaire-Hn/index.jsp).

Once again responses were gathered from this questionnaire and analysed in the same manner as described above, using a one-way ANOVA to detect the differences between the two groups under investigation, the original Indian respondents to the English questionnaire and the new respondents to the Hindi language questionnaire.

The numbers of respondents being analysed are given in *Table 8.5*.

Hindi CAE questionnaire	N
English	9
Hindi	6

Table 8.5: the numbers of respondents (given by 'n') from the two questionnaire language versions

The Indian students who responded to the English language CAE questionnaire were reduced from 12 (as shown and analysed in the Chapter 4) to 9 for the purposes of this analysis so that like could be compared to like more accurately. By this it is meant that only students who had been educated in

India for their entire academic lives were to be included in this comparative analysis. Three of the twelve student respondents to the English questionnaire were in part or in full educated outside of India (this data was also gathered by the questionnaire and is not shown here). As the purpose of this comparative analysis was to investigate the effect (if any) that the language of the questionnaire has, this removes an unnecessary variable from the study.

The 'p' value results from the ANOVA are given in *Table 8.6*; the test was done to investigate differences at the p=0.1 level.

The Null Hypothesis for analysing these data was that there is no significant difference between each of the questionnaire's respondents when it comes to answering the CAE questions.

Question	'p' value
Q1: "Education should not take into account social & moral values of society"	0.808
Q2: "I enjoy learning from my mistakes and dislike being 'protected' from making them"	0.086
Q3: "Salary is a better indicator of personal success than social standing"	0.712
Q4: "In achieving my educational goals I would rather be presented with a series of 'bite-size' tasks, which will allow me rapid mastery of a subject"	0.635
Q5: "Teachers / trainers should act as friends not gurus"	0.122
Q6: "When exploring a topic, I prefer a teacher to direct and limit my discoveries"	0.412
Q7: "When given educational information I prefer it to be presented in a tightly structured and regulated manner"	0.913
Q8: "In gaining the respect and attention of my peers I prefer non-competitive activities (such as painting or writing poetry) rather than competitions and games"	0.109
Q9: "I prefer to study with a teacher rather than with my peers"	0.686
Q10: "There should be as much structure and directions in a lesson as possible to ensure that there is no ambiguity"	0.234
Q11: "I prefer to reduce complexity by using smaller, limited amounts of information"	0.268
Q12: "I think that 'understanding' should be the goal of education, not the completion of 'learning tasks' and 'exams'"	0.876
Q13: "I prefer lessons that emphasise practice and practical values rather than abstract theories and 'truth'"	0.213
Q14: "Separation of the genders in education enables more effective teaching, with a teacher better able to target each group"	0.272
Q15: "Separation of the genders in education enables more effective teaching, with a teacher better able to target each group"	0.913
Q16: "I prefer to be patient and respectful of others when engaging in discussion, rather than being forward with my own point of view"	0.510
Q17: "When it comes to completing my	0.256

educational goals, I prefer to work slowly and patiently, to achieve a better understanding"	
Q18: "My motivation is based around personal goals and not those of my group of peers"	0.653
Q19: "I would prefer to be educated in my own language."	0.495
Q20: "Given the chance, I would prefer to be educated in another country"	0.413
Q21: "In choosing a university, the ability to practice languages other than my own is important."	0.810
Q22: "I respect the manner in which my teachers have taught me"	0.290
Q23: "I often feel constrained by the pace of my teaching"	0.369
Q24: "Different perspectives are important to me in my education."	0.097
Q25: "I enjoy experiencing other cultures"	0.777
Q26: "I think the idea of an Adaptive Education System is a good one."	0.343
Q27: "I do **not** have concerns about the *type* of the personal data that is gathered."	0.670
Q28: "*Security* of my personal data is of utmost importance."	0.413
Q29: "I would rather that the lesson the teacher has written is not altered in any way."	0.640
Q30: "I would like to have control over the level of alteration that the Adaptive Education System makes."	0.258
Q31: "I would be very happy to receive a 'personal' education but only one approved by the teacher."	0.925
Q32: "I would prefer a personalised education even if it differs from that received by my peers."	0.032

Table 8.6: the CAE questions and the 'p' value (significance) determined from the null hypothesis when using a one-way ANOVA test on the Indian respondents using the Hindi and English language questionnaires.

As *Table 8.6* shows, there are three questions that have a significant difference in the responses (questions 2, 24 and 32). The responses for the remaining questions match those originally discerned in the analysis of the English language version of the questionnaire and as such will not be discussed further here.

8.3.1 QUESTION 2

"I enjoy learning from my mistakes and dislike being 'protected' from making them."

CAE questionnaire	Mean	StDev	Median	Interpretation
English	1.9	0.60	2	Agree
Hindi	2.7	1.03	2	Agree

Table 8.7: median scores and interpretation for Q2

Although there is a significant difference here (p=0.086), it seems the overall interpretation of the findings does not change, both the Hindi and English CAE respondents 'agree' with the statement. Further detail can be gathered by examining the standard deviations and the boxplot shown in *Figure 8.6*.

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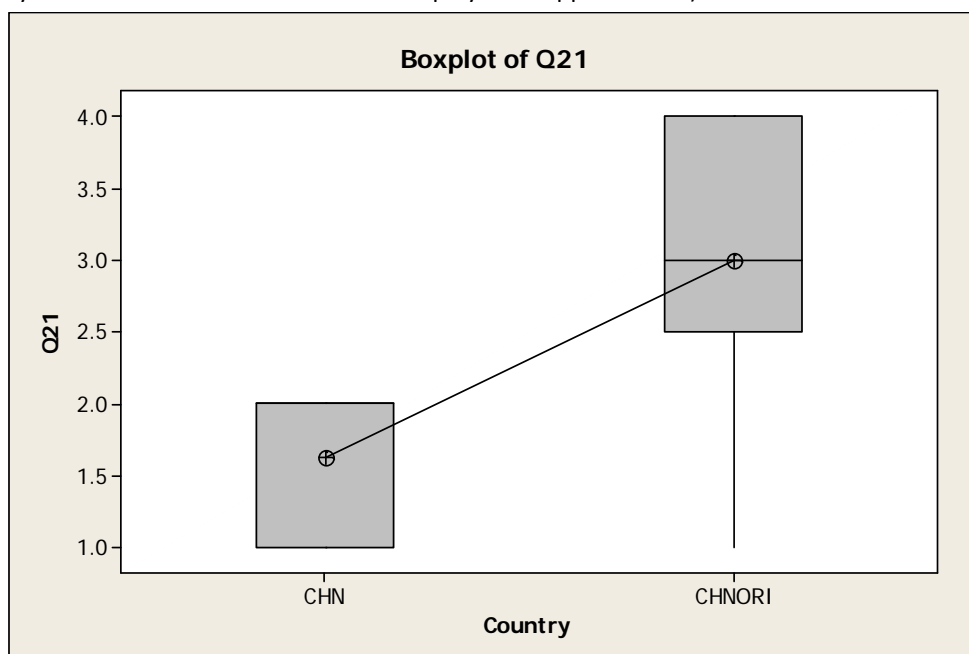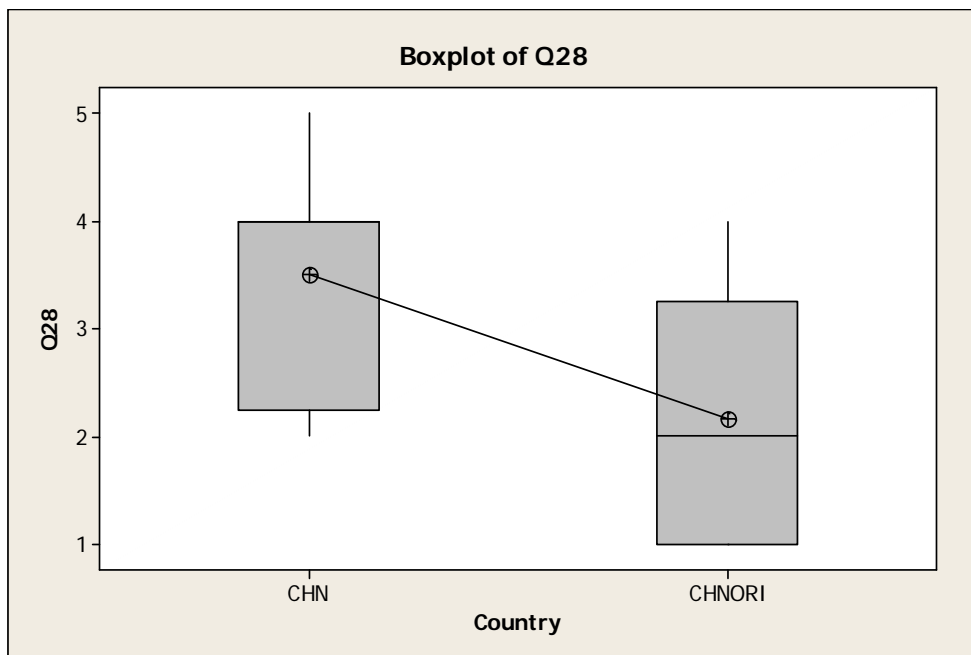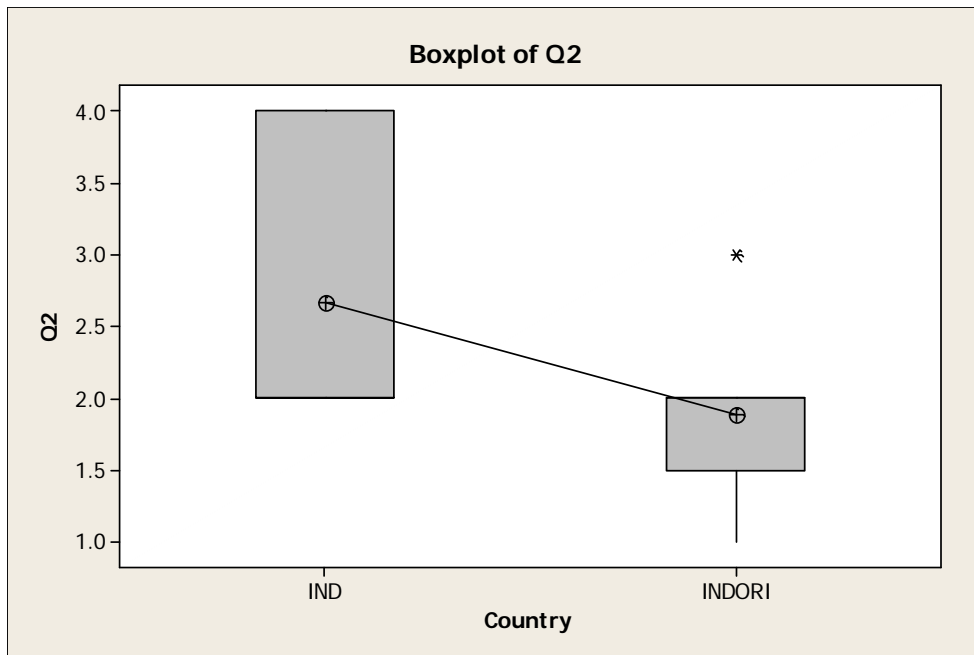*Figure 8.6: a boxplot showing the spread of the responses for Q2 (note, INDORI is the label for the English CAE respondents and IND is the label for the Hindi CAE respondents).*

In examining *Figure 8.6*, it was found that there is a far greater spread of responses for the Hindi CAE respondents than for the English CAE respondents. This is an indication that this apparently non-effective shift (both groups 'agree' with the statement) might hide a deeper shift in attitudes between the two groups.

For now however, the interpreted results indicate that there is no meaningful change to the Indian CAE stereotype that should be made because of these questionnaire findings.

8.3.2 QUESTION 24

"Different perspectives are important to me in my education"

CAE questionnaire	Mean	StDev	Median	Interpretation
English	1.4	0.53	1	Strongly Agree
Hindi	2.3	1.37	2	Agree

Table 8.8: median scores and interpretation for Q24

Although there is a significant difference here (p=0.097) it seems that all this means for the interpretation of these results is that the students who responded to the Hindi CAE questionnaire are somewhat less strident in their agreement to this statement than those who answered the English CAE questionnaire.

In examining the boxplot shown in *Figure 8.7*, it can be seen that there is a much greater spread of responses (with a large standard deviation of 1.37), so much so that there are no concrete conclusions that can be drawn. Other than to say that whilst the overall average result indicates that respondents 'agree' with the statement, there is a large degree of variety in the level of responses. This would require more data to fully determine which of the student groups were more representative of the Indian student culture.

As things stand, there is no meaningful change to the Indian CAE stereotype that should be made because of these questionnaire findings.

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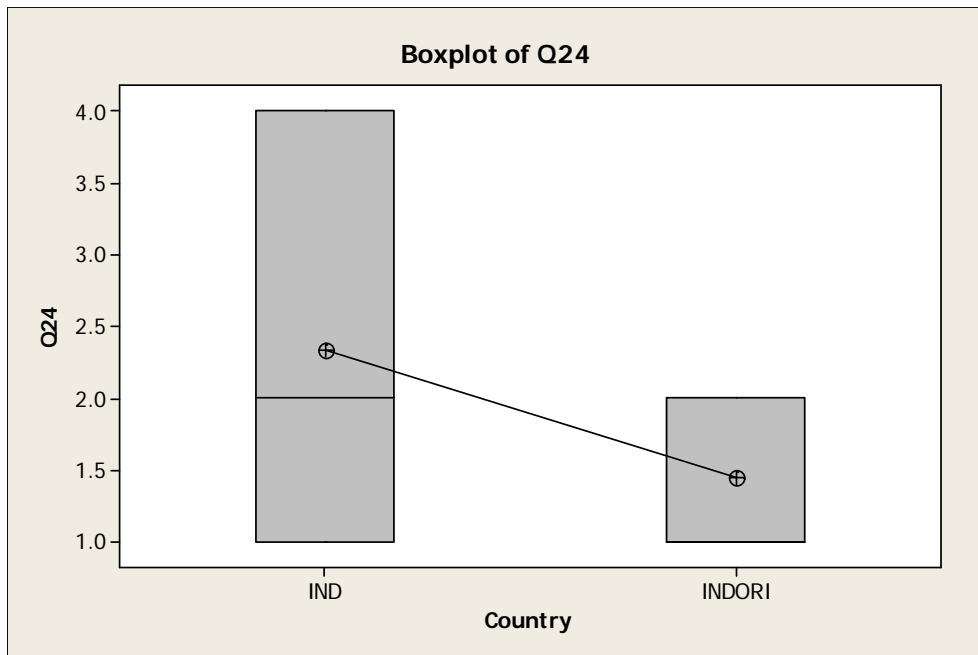
Figure 8.7: a boxplot showing the spread of the responses for Q24 (note INDORI, is the label for the English CAE respondents and IND is the label for the Hindi CAE respondents).

8.3.3   QUESTION 32

"I would prefer a personalised education even if it differs from that received by my peers"

CAE questionnaire	Mean	StDev	Median	Interpretation
English	3.0	0.76	3	Neither
Hindi	2.2	0.41	2	Agree

Table 8.9: median scores and interpretation for Q32
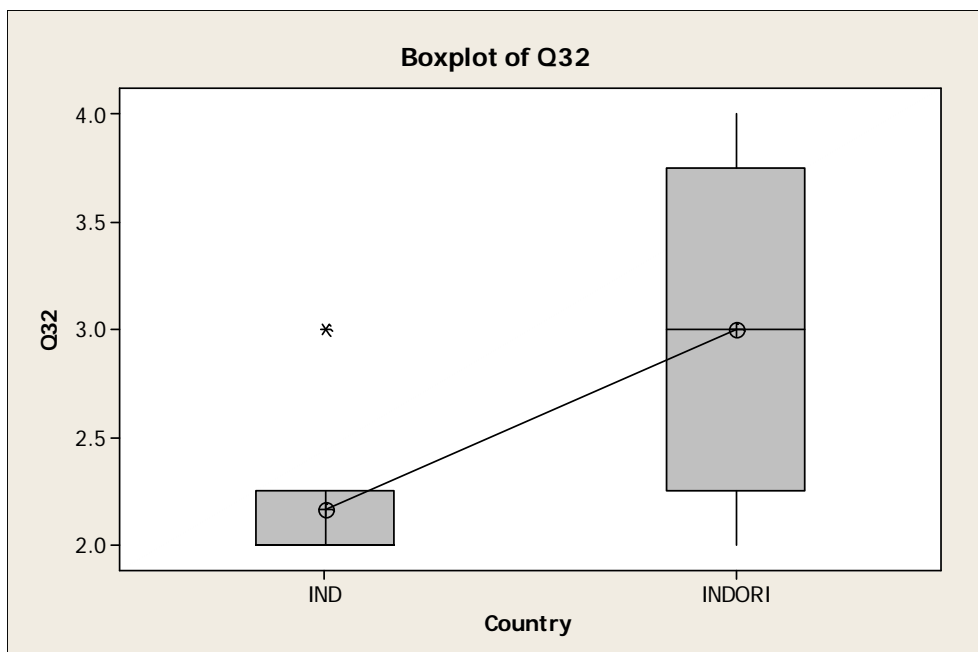
Figure 8.8: a boxplot showing the spread of the responses for Q32 (note INDORI, is the label for the English CAE respondents and IND is the label for the Hindi CAE respondents).

The results for the comparison of the Hindi and English CAE respondents to question 32 shows a reversal of the effect displayed in the previous two questions, where the spread of response widened

in the Hindi responses. Here there is a marked reduction in the spread of responses for the Hindi CAE questionnaire.

Figure 8.8 displays the boxplot that highlights this change. Also with a 'p' value of 0.032, this is a much more significant shift then the previous two questions.

Hence it seems that the Hindi questionnaire respondents agree with this statement, when compared to those respondents that answered the English CAE questionnaire. This change should be reflected in the Indian CAE stereotype.

8.4   SUMMARY

This chapter compares native language CAE questionnaires with English language CAE questionnaires in terms of the types of responses received. Two such languages/ cultures are analysed: Chinese and Hindi. Overall, there is a significant overlap between the native language responses and the English responses for the same culture. This means that, in general, it is reasonable to assume that the CAE questionnaire in English extracts similar information to one in a native language. The questions which were not overlapping were discussed, and possible reasons were explained. Moreover, consequences for the adaptive system implementing cultural personalisation for these cultures are extracted.

8.5   NEXT

In Chapter 9, the findings from the previous chapters are aggregated and discussed. The global recommendations for cultural AEH systems will be made, along with discussion for future research avenues.

CHAPTER 9:

DISCUSSION AND CONCLUSIONS

9 DISCUSSION AND CONCLUSIONS

9.1 RESEARCH AIMS REVISITED

The research presented in this thesis revolves around the initial motivation described in Chapter 1, and can be summed up by the following question:

> *With the rapid spread of technologies whose development has been rooted in the Western US (English) culture, how best can the globalisation of education through eLearning be brought back into a more cross cultural balance, so that learners receive an appropriately personalised online lesson?*

Following on from this motivation five research aims were described, these will now be readdressed to fully understand the contributions of this thesis.

9.1.1 (1) INVESTIGATE CULTURE-BASED PERSONALISATION TECHNIQUES FOR EDUCATION

Previous efforts by the AEH community have focused on the use of learner profiles that include background knowledge (normally associated by lesson or domain), learning style and educational goals. However there has been little effort to include a learner's cultural background (the clear exception to this is Blanchard's recent work [Blanchard and Mizoguchi, 2008] in Intelligent Tutoring Systems) in adaptive system user models.

9.1.2 (2) IDENTIFY THE EFFECT THAT CULTURE HAS ON A STUDENT'S EDUCATION

The research described in Chapter 3 describes the creation of the CAE questionnaire and the analysis of the data gathered from the respondents. This data was used to answer the three hypotheses:

Hypothesis 1: Hofstede's cultural dimensions apply to the educational domain. (Hofstede's cultural dimensions were extracted from data from the corporate world; can they be mapped from this domain to the educational domain?) More precisely, does the identified set of cultural adaptation features as informed by Marcus's assumptions correctly map back to Hofstede's Index? ACCEPTED

Hypothesis 2: Students desire to be taught in the manner that they have been brought up with. (Is there a cultural bias to education? Do students recognize this? Would they desire a different cultural bias to their own?) REJECTED

Hypothesis 3: There is a cultural bias in the acceptance of openly acknowledged Adaptive Educational systems. (Is there a cultural bias in the desire for AEH – do some cultures accept the teacher's viewpoint no matter how it is presented and would therefore resent that being 'changed'. Can this adaptation be hidden and therefore accepted? Do students want to conform or not?) REJECTED

These findings lead to the conclusion that:

a) Marcus and Gould's interpretation of Hofstede's work in the business domain and his conclusions can be accepted for use in the educational domain. This is of course a generalisation; in fact, the CAE ontologies have been developed via this research work, in order to better model specific features of cultural adaptation in e-learning. Hence it is more accurate to use the CAE findings for any adaptation based on culture in education. However, the Hofstede indices can be used to create 'estimated' stereotypes for countries and cultures which have not been represented in this thesis. This is an extremely powerful and useful approach, as Hofstede has categorised almost 70 countries compared to the 11 CAE stereotypes so far created. In the following, this process of stereotype extraction from the Hofstede indexes is highlighted with an example:

In the previous chapters, no CAE stereotype was created for the Mexican culture. In fact, the CAE questionnaire gathered data from two Mexicans, but as this was below the threshold used in the main research (n=>6), these two responses were not analysed. Hofstede, on the other hand, provides indices for Mexico, as follows:

PDI: 81　　　IDV: 30　　　MAS: 69　　　UAI: 82

As the research of this thesis has proven that one can in general accept these indices for use within the CAE ontologies (within the limitations and constraints discussed due to sample size issues as discussed in Chapter 3, although backed up by the interview responses in Chapter 7), this means that it is possible to (along with the findings from Hypotheses 2 and 3) create an interim CAE stereotype. The initial mappings would look similar to those seen in *Table 4.1* (in Chapter 4).

Country	PDI	UAI	IDV	MAS	LTO	CEI	AEI
Mexico (MEX)	high	High	low	high	incon	?	?

Table 9.1: the interpretation of Hofstede's indices for use in the CAE ontologies

Table 9.1 does not show the LTO result, as Hofstede does not have these results for all of the countries that he has the other four indices for. Hence in this case 'incon' is used (inconclusive) to indicate that an estimated setting must be used.

The result above can be used as is, but can be improved by further data gathering, as shown in this thesis, by using the CAE questionnaire, which can help define a more precise CAE stereotype, instead of one created purely using the original Hofstede indices.

b) Hypothesis 2 was rejected; this indicates that students do **not** necessarily desire to be taught in the manner that they have been brought up with. This suggests flexibility in their educational requirements that may seem more out of place in other arenas – imagine a politician or businessman stating that they do not desire to work in their cultural setting. Generally, it is assumed that people prefer to work in the environment they are used to.

In the case of students, results of the research showed that they in general are actually not fixed on being taught in their original culture. This is possibly due to the fact that people willing to further educate themselves at a high education level are more open to knowledge in general, and to knowledge on other cultures, in particular. For our stereotype forming, it is sufficient to state that it is therefore possible to make a generic statement concerning the Cultural Education Index (CEI). To restate from Chapter 3:

The CEI (addressing Hypothesis 2) deals with issues such as:

- The learner's acceptance of being taught in another language;
- The learner's acceptance of presence/availability to access other languages;
- Access/separation of cultures different to the learner's own.

A culture with a low CEI value represents one that is open to other cultures, and so would be accepting of being taught in another language; would prefer having access to other languages. A high CEI culture is the opposite, rebuffing learning in another language or culture.

Considering that Hypothesis 2 has been rejected, the estimated setting for the CAE ontology would be 'low'. Once again this is a generalisation, as when examining the data from the specific questions in the questionnaire to answer some of these issues, it can be seen that this is not as simple as it may at first appear. These discrepancies can be illuminated through further data gathering and analysis of the CAE questionnaire respondents. However, using this simple generalized setting allows the further CAE definition of the cultures that have not yet been stereotyped (*Table 9.2*).

Country	PDI	UAI	IDV	MAS	LTO	CEI	AEI
Mexico (MEX)	high	high	low	high	incon	low	?

Table 9.2: the CAE ontology for Mexico, with the insertion of the estimated CEI setting

c) Hypothesis 3 was also rejected; this indicates that there is **no** cultural bias in the acceptance of openly acknowledging AEH. As can be seen from the results given in Chapter 3, the actual results for the questions dealing with this hypothesis indicate that the majority of respondents are indifferent to receiving personalised education or not. The only minor exceptions are China, the Netherlands and Saudi Arabia which are the only countries that has a slight preference towards receiving lessons using Adaptive Hypermedia.

Once again it is possible to make a generic statement concerning the Adaptive Education Index (AEI). To restate from Chapter 3:

The AEI (addressing Hypothesis 3) deals with issues such as:

- Do the learners actively desire an AEH education?

- How important is the security of their data?
- Are there concerns over the type of data being collected and stored?
- Do they require access to and control over this data?
- Should an AEH lesson always be obviously teacher approved?

A high AEI culture is accepting of the principle behind AEH systems – that an adaptive learning environment delivering a personalised lesson is the best form of online learning. There are of course issues surrounding this core principle (the type and security of user data being two) and they are to be examined as well. A low AEI culture is not accepting of AEH systems, preferring instead the more limited 'one size fits all' approach common to most online learning systems today.

Considering that Hypothesis 3 has been rejected, that there is no bias for or against the use of AEH in education, the estimated setting for the AEI will be set to 'high', indicating that AEH should be used in lessons (a setting of 'high' was chosen as the estimated setting as there is a great deal of research which shows that AEH systems do in fact help the students, in this case it is a matter of the teacher/researcher knowing best and imposing this on students – of course this is only an estimated setting and can be changed as more data is gathered and analysed). Thus, using this estimated setting completes the stereotype in *Table 9.3*. Of course, with further analysis of additional CAE questionnaire results this may change.

Country	PDI	UAI	IDV	MAS	LTO	CEI	AEI
Mexico (MEX)	high	high	low	high	incon	low	high

Table 9.3: the CAE ontology for Mexico, with the insertion of the unconfirmed AEI setting

Using the settings for Mexico as shown in *Table 9.3* it is possible to create an 'estimated' CAE stereotype instance, as represented in the resulting diagram for Mexico in *Figure 9.1*.
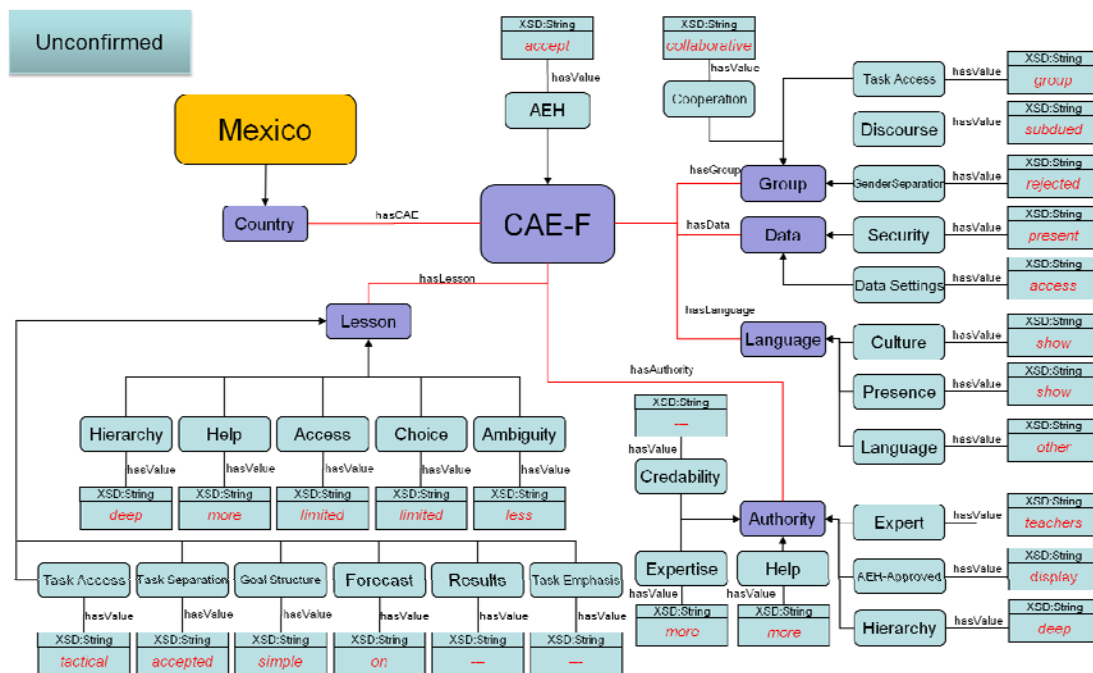
Figure 9.1: Instance Diagram of the 'estimated' CAE-F Ontology for Mexico (MEX)

This ability to directly take the Hofstede indices and use them to generate 'estimated' CAE stereotype instances is very useful, although this has not been developed further within this thesis.

Usage of these stereotypes has the additional benefit that it can simplify AEH personalization to some degree, as there is no need for additional questionnaires, so no time consuming discovery process would be required. Instead, the student would receive content in a manner appropriate to their cultural background immediately. However it is important for system designers to note that students should be able to be override these settings themselves, in order to give them a chance to rectify possible deviations from the average stereotype which better characterize them as a person.

Chapter 4 goes on to describe the creation of XML instances for each of the stereotypes (with the exception of the Mexico 'estimated' stereotype, just computed above). These instance descriptions can be accessed through the CAE-L web service, which is a product of this thesis will be shortly discussed next.

9.1.3 (3) CREATE A TEST SYSTEM THAT WILL ALLOW FOR INTERFACE PERSONALISATION OF EDUCATIONAL MATERIALS ACCORDING TO THE CULTURAL STEREOTYPES

Chapter 5 (and in Chapters 6 & 7) described the implementation efforts undertaken in this thesis, this included:

- Creating an ontology repository to store the various CAE stereotypes
- Creating a service application that will connect to the repository and return an XML file containing a specific country's stereotype.
- Creating a web service that will mediate access to and from the repository; this will accept requests for data for a specific country from any program (the typical target system however is an AEH) and return the CAE stereotype XML file.
- Prototype AEH interfaces as adapted according to each received stereotype.
- Adapting an extant AEH system (ADE) to implement the CAE-L cultural stereotypes for use in the classroom.

The focus of this process chain is to get the CAE stereotypes from the publically accessible repository to the AEH system where it can be applied as an adaptive layer. Now that the findings of the CAE study are available, the focus has shifted to formative testing of the interfaces followed by a summative testing of a full implementation in an extant AEH (ADE).

Therefore the rest of Chapter 5 went into the various implementation options available – how best should an AEH use adaptive presentation or adaptive navigation support to personalise each lesson to a specific culture?

The initial suggestions made are presented in Chapter 5 and tested in Chapters 6 & 7. However to sum up, the type of adaptation used focused on presenting different functionalities to the learner depending on their culture. For example the concept 'Lesson::choice' was used to determine the level of additional support links that a user is given, from detailed page specific only to high level course related information.

This is of course only one possible implementation interface, as it is of course possible to envisage multiple adaptation strategies all using the same basic user information. The 'Lesson::choice' example just presented could be interpreted as allowing the user access to *only* high level links (that themselves lead outside of the lesson), whereas this function allows access to page related links as well. Also the nature of an open choice system (vs. a closed choice one) could be an indication for how much access to Open Hypermedia the learner would be able to cope with. There are many different types of eLearning systems available, some are more closed than others. With the advent of the Learning Management System and adaptive system combination research (such as GALE and Moodle, as well as APeLS and Moodle) it would be possible to control the amount of didactic learning presented to each student. With 'closed' choice learners being presented a little information in a controlled manner (this obviously impinges on other CAE concepts relating to the cultures Uncertainty Avoidance Index score) compared to 'open' choice learners who may rather have their lesson presented in as open a manner as possible, even moving beyond the 'narrow' lesson structure that their teacher has prescribed.

The CAE-L ontology that this initial prototype investigation uses is also only a limited application of the larger and more complex CAE-F ontology. Once the formative CAE-L study is performed then application and adaptation possibilities for using the entire CAE-F ontology are open to be investigated and implemented. For example the CAE-L ontology does not make great use of any 'Group' level concepts. These concepts could be of great use in collaborative systems, which are becoming more widespread with the ongoing uptake of the Web2.0 technologies. Some learners do not feel comfortable being forced to work as part of a group, or if they must work in a team then they would rather be given a task and left to work on it at their own pace. The 'Group::cooperation'

concept could inform a social learning system as to how best approach learners from culture who tend to this approach. An example of adaptation to this would be task assignment, with learners from a 'collaborative' culture being able to access a variety of tasks that multiple learners can work on at once within a single project. Compare this to learners from a 'personal' culture, whilst they can still be in a group they can be given their own focused task that they can later present to the group.

These are just a few examples of facets for CAE-L and CAE-F potential adaptation features. The CAE investigation presented in this thesis has not focused on the HCI aspects of this work to a great extent, to determine if the prototypes suggested in Chapter 5 are enough to gain preliminary feedback from the two evaluation stages using a specially adapted ADE.

9.1.4 (4) THE EVALUATION OF THIS NEW LAYER OF ADAPTATION AND PERSONALISATION WILL BE UNDERTAKEN

The prototype interfaces proposed in Chapter 5 were used in Chapters 6 & 7 to initiate an evaluation into the effectiveness of using the CAE-L ontology in this type of AEH interface.

9.1.4.1 FORMATIVE EVALUATION

In Chapter 6, a questionnaire was created that presented to a student three webpage mock-ups. The student had to examine these mock-ups and their associated descriptions and answer a series of questions as well as identifying which of the screenshots they preferred (their own culture's screenshot was always included as one of the options).

The results from these questionnaires were analysed and a set of tentative conclusions were drawn. The reason that these conclusions are tentative is due to the fact that (a) there were only a limited number of respondents and (b) this was the first formative stage of an evaluation approach. However such a small scale study is extremely useful as it can highlight any possible errors or uncertainties in this approach. One such uncertainty seems to be that asking the student to distinguish between several similar looking pages (even though the differences were highlighted and explained for each instance) leads them to misidentify the page they would actually desire. This can be seen from the fact that their responses to the individual questions match the expected response much more often than when matching pages.

Overall this evaluation study identifies two interesting features:

1) the screenshot features suggested for both China and India seem to approaching the most appropriate interface for their cultures. That is not to say that they could not do with being 'tweaked', for example in the case of China, Q11 ("*Links in the main text (such as 'blogging') [should]/[should not]* be present.*"), it seems that the proposal to not include inline links may be a step too far in reducing screen information overload. This does not invalidate the CAE stereotype concept for China of 'Lesson::ambiguity' with a value of 'more' (i.e. that they are happy with greater degrees of ambiguity and require fewer redundant cues, such as inline links). Indeed this may prove that in such case as China where 'Lesson::ambiguity' is set to 'more' (fewer links) and 'Lesson::choice' is set to 'open' (more links access) that the 'choice' concept takes precedence.

This example in fact highlights an issue that has not been investigated, the issue of concept priority. Considering that there is some overlap between concept implementation possibilities (different concepts can affect the same user interface component for different reasons), how is this conflict resolved? Should this be done on a country by country basis, or are there global rules that can be accepted?

This is certainly an interesting issue and one that has lain outside of the scope of the CAE study until now, and any future work will have to take this issue into account.

2) the interpretation of the CAE stereotype for Irish students would appear to be counter intuitive for those students. The interface features that this prototype screenshot suggests for use in AEH situations for Irish students seem to be the incorrect ones. These students seem to desire more information presented to them rather than less, the links to the User data settings, the Security statement, the local links, the inline links are all desired – whereas the CAE stereotype interpretation would suggest that these should not be displayed.

Of course this may be an issue of questionnaire and question design. For example in Q5 ("*The 'Data Security' link should [always]/[never]* be available*") it should be made clear that this functionality is always available but may be hidden in more obscure locations. Therefore for students whose CAE stereotype suggests that this link is useful would always have the link available in their interface, but for the other students this link would be accessible through a help page that must be navigated to.

The results from this study, whilst limited in number, have raised several interesting issues which need to be examined in light of these findings, specifically those issues concerning the Irish CAE stereotype.

9.1.4.2 SUMMATIVE EVALUATION

In Chapter 7 the CAE-L interface proposals from Chapter 5 were implemented in the ADE AEH system (developed at the University of Warwick, with my design criteria) with the goal of performing a larger scale examination, containing both quantitative and qualitative experiments.

This evaluation was performed in the classroom with Romanian students, where each student was given access to a lesson with an interface matching their cultural stereotype and one mismatching it. In addition to this a series of structured interviews were recorded to examine the accuracy of the Romanian CAE-L stereotype.

As can be seen from Chapter 7 one of the most interesting findings is that a student whose ADE interface was created from a matched CAE stereotype actually performed better than those who had a mismatched stereotype. In addition the high degree of matched results in the qualitative study is most encouraging. Being able to have students explain their choices was useful and gave further insight into their preferences.

The results from Chapter 7 are therefore encouraging, and they confirm and support the findings from the previous chapters, specifically Chapter 3. As has been stated repeatedly the small sample size of respondents in Chapter 3 limits the strength of any conclusions drawn from this analysis. The results and conclusions drawn in Chapter 7 however all backup those initial findings – for the Romanian stereotype.

This last point is the main limitation of Chapter 7's findings, that only one CAE stereotype was examined, ideally more student populations should be examined in the same manner; as an initial examination though this is an exceedingly promising start.

9.1.5 (5) INVESTIGATE IF THERE IS A BIAS IN THE CULTURAL QUESTIONNAIRE DUE TO LANGUAGE

Chapter 8 was included in this thesis to examine the fact that there could be a bias inherent to the English language version of the CAE questionnaire.

Does this bias affect the outcomes of the CAE analysis described in Chapter 3 and used in the subsequent chapters?

Two countries were chosen (due to readily available translators), to examine this potential bias, those countries being India and China. In both cases the sample size of the populations involved was not large ('n' varied from 6 to 9) and any possible conclusions drawn from this study should bear that in mind. However it should also be noted that the majority of responses examined between the four samples (Chinese CAE vs. English [China] CAE and Hindi CAE vs. English [Indian] CAE) do indeed match each other.

Out of a possible 64 matches (32 questions in each of two studies) only 5 responses did not match, a mere 8%.

Whilst these discrepancies should indeed be investigated and further data gathered to identify if this is a meaningless artefact or indicates a deeper issue, it seems that the student responses to the CAE questionnaire are in no meaningful way altered due to the English language nature of the CAE questionnaire.

This builds upon the conclusions of Chapter 7 and gives greater emphasis to those results discovered in Chapter 3 and validates the use of those findings in Chapters 4 and 5 to create and implement a CAE stereotype that is useable by all students (no matter if they speak English or not) for each of the eleven countries under investigation.

Of course it should be noted that to be more certain of this conclusion each of the eleven countries should have their own CAE questionnaire created and investigated. Also more data needs to be gathered to investigate these results in a deeper, more meaningful way.

Finally, it should be mentioned that once again simplifications have been made in the matching of 'country', 'culture' and 'language'. In this case the obvious simplification is the use of 'Hindi' as the 'Indian' language. This is not an ideal setup as there are several major languages and cultures within India – however in this case such a comparison is valid as all respondents (either for the English [Indian] CAE or the Hindi CAE) have been from a similar source (through contacts at several related Indian universities). For further investigation of the Indian sub-cultures more data would be needed from a wider contact base, but this in no way invalidates the findings presented here.

9.2   CONTRIBUTIONS OF THE THESIS

The research presented in this thesis offers specific advancements to the state of the art of research in ICT, HCI, eLearning, Cultural Studies and Education. Specifically this thesis contributes:

1) Validation of the Marcus and Gould extension of Hofstede's Cultural Indices into the field of web design, specifically use of this extension in the Educational domain [Stewart, 2007][Stewart, 2009][Bourguet *et al*, 2006].

Meeting Objectives: O1, O3, O4 (Chapters 2 & 3)

2) The CAE questionnaire is a key contribution of this thesis, as it binds several disparate elements, HCI, Web Design, Adaptive Interfaces, eLearning and Cultural Studies. This questionnaire will bring a lasting body of research work well beyond the lifetime of this thesis and will benefit eLearning generally.

Meeting Objective: O4 (Chapter 3)

3) Creation of the CAE framework and ontology, designed to model the cultural factors of a learner that may determine the nature of educational materials given to them, specifically cultural factors affecting eLearning in Higher Education [Chandramouli *et al*, 2008] [Stewart *et al*, 2008] [Stewart, 2009]. [Chandramouli, 2008] [Stewart *et al*, 2008].

Meeting Objectives: O2, O5 (Chapters 2 & 4)

4) Creation and validation of specific cultural template for eleven countries using the CAE ontology.

Meeting Objective: O5 (Chapter 4)

5) Creation of the CAE repository (containing the eleven CAE instances), which is made freely available to all [Stewart *et al*, 2010].

Meeting Objectives: O6 (Chapter 5)

6) An adaptive cultural interface is designed, investigated and evaluated in the classroom; this study validates the proof of concept for using CAE in a real world setting.

Meeting Objectives: O6, O7, O8 (Chapters: 6, 7 & 8)

9.3   OVERALL SUMMARY

Before addressing the overall conclusions it is worth restating the initial problem motivation.

With the rapid spread of technologies whose development has been rooted in the Western (US English) culture, how best can the globalisation of education through eLearning be brought back into a more cross cultural balance, so that learners receive an appropriately personalised online lesson?

This simple statement has resulted in the body of research presented here. Issues such as:

- how to define culture (Chapter 2),
- how best to analyse and define student requirements in AEH systems at the cultural level (Chapter 3),

- how to structure this information and what do these structural concepts mean in an eLearning situation (Chapter 4),

- how should these new ontologies be stored, accessed and implemented (Chapter 5),

- finally the implications of this analysis and implementation are tested and evaluated (Chapter 6 for a formative evaluation, Chapter 7 for a summative classroom based evaluation and Chapter 8 for localised CAE analysis testing)

Obviously, the problem statement addresses more than just creating an adaptive layer for cultural differences, but as was indicated in the related work (Chapter 2) this is an important area of research that was yet to be fully targeted before the work presented in this thesis. There are some works in creating a limited cultural model in ITS systems (which can themselves cause issues due to their high authoring load as well as fixed structures) but the analysis, ontologies and implementations presented in this thesis are of a much more flexible and general nature.

As the research presented here builds on the research performed by Hofstede, and expands and adapts it for use in an educational milieu, the possibilities for novel adaptive structures in current AEH systems and user models are extremely widespread and varied. Current AEH systems have so far focused on a learner's background knowledge, their learning style (and in some cases their cognitive style), their aims and goals; but never their cultural background. This was mainly due to the complexity of such a problem. Thus, this thesis has tackled this important challenge. The CAE-L, and ultimately CAE-F, ontologies created here offer that information, so that AEH systems may now be expanded to adapt to this important personal trait and in so doing, not only allow the learner to study more efficiently, but also to reduce some of the barriers to communication between different cultures within the same class.

Reducing these barriers will create a more equitable and efficient learning environment for all concerned, which is vital considering the expanding use of the Web in learning scenarios. Although this thesis has focused on students from Higher Education, the findings are not limited to use solely in this area. Cultural diversity in the classroom is also on the increase and a culturally sensitive AEH as well as a series of rules and guidelines based on the CAE stereotypes could also be useful here. Moreover, cultural diversity becomes an even greater concern in the context of the future society relying more and more on life-long learning, where differences in backgrounds are more the norm than the exception.

9.4 FUTURE WORK

The research presented in this thesis is of an open ended nature. In fact the previous sections, as well as the 'summary' sections in each chapter, have often suggested ideas for future research efforts. Some of these will be further pursued by me, some I'd be happy to explore in collaboration with others, and some are avenues for further research open for the research community at large.

As the study continues beyond the lifetime of this thesis there are several core areas that require further work, they are:

1. More data. This is vital as with more data it will be possible to identify the educational values of more cultures and be more certain of our conclusions. As was stated early in this thesis, there are 47 cultures that have responded to the CAE questionnaire, only 11 of which have passed the chosen n>=6 barrier. Ideally, this sample size limit should be increased, and more cultures should be examined, however many more responses are needed before this can happen. More data is also required for the evaluation stages of this work, specifically students from cultures other than Romania need to be examined using the methodology presented in Chapter 7.

2. More 'estimated' & 'confirmed' instances. With more data comes the possibility of creating 'confirmed' CAE instances. This means that whilst the overall results of Hofstede's research can be adopted to create 'estimated' CAE stereotypes, they should be investigated and confirmed using the process described in Chapter 3 as soon as enough data is available. Also, those instances that have been created should be re-investigated as soon as a significant amount of new data is added. The proposed boundaries for this investigation would be n=6,

100 and 384[6]. As the data responses for each country pass these levels, the CAE results should be reanalysed.

3. Temporal variations. With the rapid spread of global eLearning, many cultural boundaries are breaking down. Another interesting study would be to analyse the CAE questionnaire results across time as well as country.

4. Culture not country! The assumption that culture equated to country was a necessary one, but with additional data it would be important to acknowledge that this is not always the case. The CAE questionnaire collects the respondents 'ethnicity' as well as their nationality, but the variations this may cause have not been investigated within this thesis due to scarcity of the data.

5. Study concept priority. As stated previously, this factor in assigning adaptive functionality which can be influenced by different CAE concepts needs to be prioritised. It is expected that different cultures would have different priority lists; another study needs to be made into determining these lists and evaluating their performance.

6. Study implementation variations. In Chapter 5, a single implementation variation was presented (and subsequently implemented and examined in ADE, Chapter 7). With the feedback from the results in Chapters 6 & 7 it would be possible to subtly change this implementation proposal to better reflect each cultures requirement. However, other more dramatic changes could be proposed for different learning environments, such as problem based learning, discursive based learning etc … rather than the more didactic based learning that the Chapter 5 proposal uses.

7. CAE-F. The focus of Chapters 5, 6 and 7 is on implementing and evaluating the CAE-L ontology, which was done for practical reasons. But with the results and expertise gained in doing this for CAE-L it is possible and desirable to use the entire CAE-F ontology. This would also make the potential types of adaptation and adaptive scenarios much more varied and interesting.

8. Further AEH implementations. In Chapter 7 ADE was modified to deliver cultural adaptation using the CAE-L stereotypes, the findings from this implementation and classroom usage were very positive. The ADE implementation should be expanded to implement the CAE-F stereotype as well as enable flexible examination of different cultural adaptive scenarios. Not only this but ideally this layer should be added to multiple systems so that the effect that this has on system development issues could be evaluated.

9. Different student milieus (primary, higher, lifelong). The focus of this research has been in the sector of higher education; however, how this work should be used and would be received in other education sectors is unknown. As such, once an AEH system has an adaptive layer implemented, this could be used to investigate this issue. For example, this could be explored in multi-cultural schools in the UK, where the same lesson can be offered to different students within the *same* classroom. This would allow testing to quickly explore the effects of cultural personalization on the same lesson, and thus evaluation of the quantity of information passed along, and quality of the lesson.

10. When is stereotype not a stereotype? As has been stated in this thesis, cultural stereotypes are in no way meant to override the use of a more focused individualised user model - it is important to remember that they are an excellent starting point and can enhance the use of other more traditional forms of adaptation. A very interesting research question for further investigation would be where does the boundary lie between a stereotype user model (such as an Indian student logging into ADE for the first time) and a traditional individual user model (such as the same student using ADE for several years - with subsequent changes in adaptation)? When does a stereotype stop being a stereotype?

11. Correspondence with devices. The focus in this thesis has been on adaptive interfaces for higher educational cultures, what are the HCI issues and requirements that arise if different devices contexts are used in this milieu? For example Irish students, learning in Saudi Arabia,

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[6] This number allows for statistically significant extrapolations up to a population of the size of a country's higher education student body, as previously explained in chapter 3.

using both their PC as well as their smart phone. Is there a difference in the types of adaptive interfaces required and are there cultural commonalities?

12. Culture of practice vs. culture of nation. Nation has been used within this research as the grouping variable for determining how different cultures behave, their cultural stereotypes and their subsequent interface requirements. What changes would be required, which user variables would be commonalities and which ontology concepts would be constant if the study was to progress to different forms of 'culture', such as cultures of practice?

Finally, there are other areas in which this research could be used to contribute to the eLearning field. Moreover, these stereotypes could also be used beyond eLearning in non-educational adaptive hypermedia and ITS systems. Facets of this work could also be applied to non-adaptive systems, such as traditional learning management systems. Indeed it is the very shareable nature of this research which makes it attractive. Many can benefit from work into how best to provide learning and information to specific cultures. This indicates where funding for these projects might arise: within cultures interested in improving access to material available to the wider world.

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APPENDICIES

URL: http://138.37.35.159:8080/CAEQuestionnaire/

This questionnaire has been developed to study the effect that culture (and nationality) has upon a person's educational preferences and requirements. By completing this form you will be part of my research project that will improve the delivery of education across the web and beyond.

The questionnaire should take 10 minutes to complete and the information gathered is anonymous and will only be used for research purposes.

The data collected will *not* be used for any other purposes other than the research goals stated above, nor will anyone other than myself have access to this data. This research is supported by the University of Nottingham, UK

If you need to contact me to discuss any issues please feel free. Contact: Craig Stewart

Personal Information

Age:

Nationality (e.g. British, Chinese):

Ethnic Background (e.g. Indian, Chinese):

Primary Language:

Gender (please select):
- Male
- Female

Educational Status: Full time student
if 'Other', please specify:

Which countries have you been educated in (including your home country) and for how long?
a.   ,   years,   months.
b.   ,   years,   months.
c.   ,   years,   months.
d.   ,   years,   months.
e.   ,   years,   months.

If you are interested in receiving the results of your analysis then please give your email address:

Cultural Preferences

Please tick the appropriate box that matches your response to a question (the boxes are to the right hand side of each question and responses range from 'strongly agree' to 'strongly disagree')

1. Education should not take into account social & moral values of society.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

2. I enjoy learning from my mistakes and dislike being 'protected' from making them.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

3. Salary is a better indicator of personal success than social standing
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

4. In achieving my educational goals I would rather be presented with a series of 'bite-size' tasks, which will allow me rapid mastery of a subject.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

5. Teachers / trainers should act as friends not gurus.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

6. When exploring a topic, I prefer a teacher to direct and limit my discoveries.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

7. When given educational information I prefer it to be presented in a tightly structured and regulated manner.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

8. In gaining the respect and attention of my peers I prefer non-competitive activities (such as painting or writing poetry) rather than competitions and games.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

9. I prefer to study with a teacher rather than with my peers
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

10. There should be as much structure and directions in a lesson as possible to ensure that there is no ambiguity.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

11. I prefer to reduce complexity by using smaller, limited amounts of information.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

12. I think that 'understanding' should be the goal of education, not the completion of 'learning tasks' and 'exams'.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

13. I prefer lessons that emphasise practice and practical values rather than abstract theories and 'truth'.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

14. Separation of the genders in education enables more effective teaching, with a teacher better able to target each group.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

15. I concentrate on each educational task separately and require immediate results to gauge my success.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

16. I prefer to be patient and respectful of others when engaging in discussion, rather than being forward with my own point of view.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

17. When it comes to completing my educational goals, I prefer to work slowly and patiently, to achieve a better understanding.
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

18. My motivation is based around personal goals and not those of my group of peers.
   - Strongly Agree

- Agree
- Neither
- Disagree
- Strongly Disagree

Educational Experiences

19. I would prefer to be educated in my own language.
- Strongly Agree
- Agree
- Neither
- Disagree
- Strongly Disagree

20. Given the chance, I would prefer to be educated in another country
- Strongly Agree
- Agree
- Neither
- Disagree
- Strongly Disagree

21. In choosing a university, the ability to practice languages other than my own is important
- Strongly Agree
- Agree
- Neither
- Disagree
- Strongly Disagree

22. I respect the manner in which my teachers have taught me
- Strongly Agree
- Agree
- Neither
- Disagree
- Strongly Disagree

23. I often feel constrained by the pace of my teaching
- Strongly Agree
- Agree
- Neither
- Disagree
- Strongly Disagree

24. Different perspectives are important to me in my education
- Strongly Agree
- Agree
- Neither
- Disagree
- Strongly Disagree

25. I enjoy experiencing other cultures
- Strongly Agree
- Agree
- Neither
- Disagree
- Strongly Disagree

Adaptive Education

"Adaptive Education System is a on-line system that will measure your personal behaviours and preferences, store them and use these to alter the nature of the education given to you. The aim is to deliver a personalised and unique education to you - and in so doing give you the best education you can receive."

26. I think the idea of an Adaptive Education System is a good one.
  ○ Strongly Agree
  ○ Agree
  ○ Neither
  ○ Disagree
  ○ Strongly Disagree

27. I do **not** have concerns about the *type* of the personal data that is gathered.
  ○ Strongly Agree
  ○ Agree
  ○ Neither
  ○ Disagree
  ○ Strongly Disagree

28. *Security* of my personal data is of utmost importance.
  ○ Strongly Agree
  ○ Agree
  ○ Neither
  ○ Disagree
  ○ Strongly Disagree

29. I would rather that the lesson the teacher has written is not altered in any way
  ○ Strongly Agree
  ○ Agree
  ○ Neither
  ○ Disagree
  ○ Strongly Disagree

30. I would like to have control over the level of alteration that the Adaptive
    Education System makes.
  ○ Strongly Agree
  ○ Agree
  ○ Neither
  ○ Disagree
  ○ Strongly Disagree

31. I would be very happy to receive a 'personal' education but only one approved by the teacher
  ○ Strongly Agree
  ○ Agree
  ○ Neither
  ○ Disagree
  ○ Strongly Disagree

32. I would prefer a personalised education even if it differs from that received by my peers
  ○ Strongly Agree
  ○ Agree
  ○ Neither
  ○ Disagree
  ○ Strongly Disagree

[Submit Answers]   [Reset]

Many thanks for your time and effort!

11.2 CAE QUESTIONNAIRE - CHN

URL: http://138.37.35.159:8080/CAEQuestionnaire-cn/

本问卷旨在研究文化对于个人在接受教育时的偏好和要求的作用。

通过完成此问卷, 您将成为我的研究项目中的一员, 为提高网络教育效果做出贡献。

本问卷需时10分钟, 所收集的信息采用匿名的形式, 仅用于研究目的。

所收集的数据不会用于非上述目的以外的用途, 除了本研究人员之外不会再有任何人员接触到这些数据。

本研究由英国诺丁汉大学支持完成。

欢迎您就任何问题和我进行讨论, 联系人 : Craig Stewart

个人信息

年龄 :

国籍 (例如:英国, 中国) :

民族 (例如:印度, 中国) :

母语 :

性别 (请选择) :
　　　○ 男
　　　○ 女

受教育情况 :　　全日制学生

如果选择 "其它", 请注明 :

受教育国家(包括本国)及时间?

1. _____ ,　　　　　_____ 年,　　　　　_____ 月
2. _____ ,　　　　　_____ 年,　　　　　_____ 月
3. _____ ,　　　　　_____ 年,　　　　　_____ 月

4. _____ , _____ 年, _____ 月
5. _____ , _____ 年, _____ 月

如果您希望接收您的分析结果, 请留下您的电子邮件地址

_____

文化偏好

请在符合您情况的选项上打勾(选择框在每个问题的左边, 选项从"完全同意"到"完全不同意")

1. 教育不应该考虑社会和道德价值。
   - ○ 完全同意
   - ○ 同意
   - ○ 不在乎
   - ○ 不同意
   - ○ 完全不同意

2. 我喜欢从错误中学习, 不喜欢被"保护"而不犯错误。
   - ○ 完全同意
   - ○ 同意
   - ○ 不在乎
   - ○ 不同意
   - ○ 完全不同意

3. 和社会地位相比, 薪水更能反应一个人的成功。
   - ○ 完全同意
   - ○ 同意
   - ○ 不在乎
   - ○ 不同意
   - ○ 完全不同意

4. 在实现我的受教育目标方面, 我更喜欢做一些能让我快速掌握某科目的"简单"活动。
   - ○ 完全同意
   - ○ 同意
   - ○ 不在乎
   - ○ 不同意
   - ○ 完全不同意

5. 教师应当像朋友而非领导。
   - ○ 完全同意
   - ○ 同意
   - ○ 不在乎
   - ○ 不同意
   - ○ 完全不同意

6. 当研究某个题目的时候, 我希望有个老师能指导和限制我的发现。
   - ○ 完全同意
   - ○ 同意
   - ◉ 不在乎

　　　　　　　　不同意
　　　　　　　　完全不同意

7．在了解教育信息时，我希望所有的信息能够以密集化结构、系统化方式呈现。
　　　　　　　　完全同意
　　　　　　　　同意
　　　　　　　　不在乎
　　　　　　　　不同意
　　　　　　　　完全不同意

8．我希望通过非竞争性的活动(例如绘画、写诗)，而非竞争性的活动或者游戏来获得同龄人的尊敬和注意。
　　　　　　　　完全同意
　　　　　　　　同意
　　　　　　　　不在乎
　　　　　　　　不同意
　　　　　　　　完全不同意

9．我希望和老师而非同龄人一起学习。
　　　　　　　　完全同意
　　　　　　　　同意
　　　　　　　　不在乎
　　　　　　　　不同意
　　　　　　　　完全不同意

10．课堂的结构和指导应当清晰，以保证没有不清楚的地方。
　　　　　　　　完全同意
　　　　　　　　同意
　　　　　　　　不在乎
　　　　　　　　不同意
　　　　　　　　完全不同意

11．我更喜欢信息内容少一点，降低课程的复杂程度。
　　　　　　　　完全同意
　　　　　　　　同意
　　　　　　　　不在乎
　　　　　　　　不同意
　　　　　　　　完全不同意

12．我认为教育的目标应当是"理解"，而非完成"学习任务"或是"考试"。
　　　　　　　　完全同意
　　　　　　　　同意
　　　　　　　　不在乎
　　　　　　　　不同意
　　　　　　　　完全不同意

13．我喜欢强调实践和实际价值而非抽象理论或者所谓的"真理"的课堂。
　　　　　　　　完全同意
　　　　　　　　同意
　　　　　　　　不在乎
　　　　　　　　不同意
　　　　　　　　完全不同意

14．分性别的教育可以使教学更加有效，因为老师可以充分注意到每一个群体。
　　　　　　　　完全同意
　　　　　　　　同意
　　　　　　　　不在乎

○ 不同意
○ 完全不同意

15． 我非常注意每一个教育任务，并且要求得到即刻的结果来评价我的成功与否。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
○ 完全不同意

16． 在讨论中，我会有耐心、对他人尊重，而不是直接给出我自己的观点。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
○ 完全不同意

17． 当涉及我的教育目标时，我更希望慢一点、有耐心地学习，以达到更好的理解。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
○ 完全不同意

18． 我的目标是基于我自己的个人目标，而非同组其他人的目标。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
○ 完全不同意

教育经历

19． 我更喜欢接受以母语为授课语言的教育。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
○ 完全不同意

20． 如果有机会，我愿意到另外一个国家接受教育。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
○ 完全不同意

21． 在选择大学时，锻炼外语能力是非常重要的。
○ 完全同意
◉ 同意

○ 不在乎
○ 不同意
○ 完全不同意

22．我尊重我的老师们的教学方法。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
○ 完全不同意

23．我常常因为所受教育的进度而觉得受到束缚。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
○ 完全不同意

24．在教育中，不同的观点对我而言非常重要。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
○ 完全不同意

25．我喜欢经历其它文化。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
○ 完全不同意

适应性教育

"适应性教育系统是一个在线系统，用以检测你的个人行为和喜欢，将它们存储起来，并使用它们来改变给你提供教育的性质。该系统的目标是给你提供个性化、独特的教育从而使你接受到最好的教育。"

26．我认为适应性教育系统这个想法很好。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
○ 完全不同意

27．我并不关心所收集到的个人信息。
○ 完全同意
○ 同意
○ 不在乎
○ 不同意
◉ 完全不同意

28. 我个人信息的安全性并不是最重要的。
- 完全同意
- 同意
- 不在乎
- 不同意
- 完全不同意

29. 我更希望老师所撰写的课程没有任何改变。
- 完全同意
- 同意
- 不在乎
- 不同意
- 完全不同意

30. 我希望可以控制适应性教育系统所做改变的程度。
- 完全同意
- 同意
- 不在乎
- 不同意
- 完全不同意

31. 我非常愿意接受一个被老师认可的"个人"教育。
- 完全同意
- 同意
- 不在乎
- 不同意
- 完全不同意

32. 我愿意接受个性化教育，即使它和我的同伴们接受的教育不同。
- 完全同意
- 同意
- 不在乎
- 不同意
- 完全不同意

提交答案　重新填写

非常感谢您的合作！

URL: http://138.37.35.159:8080/CAEQuestionnaire-Hn/index.jsp

एक व्यक्ति के सिक्षा पसंदे और जरूरतों में एक सथ्थता (और राष्ट) किस प्रकार पबावित करता है जानन के लिए यह प्रश्रावली तैयार की गयी.

इस प्रक्षावली को पूरा कर्ने से आप मेरे कोज परियोजना में भाग लेंगे और इस्से वे मूल (दुरा) सिक्श्रा प्रदान कर्ने मैं उन्नती हो सक्ता है.

यह कोज को नाटिंगम विश्रविघालय यूके प्रोत्साह कर रही है

अगर आप को अधिक जान्कारि चाहिए कृपया मुजे संपर्क कीजिए. संपर्क – क्रैंग स्टीवर्ट. Craig Stewart

अप्ना जान्कारी

उमर

राष्ट्रीयता (मातृ भूमि) :

थर्मे या भाषा का विरासत के संबंघ :

मातृ भाषा :

जाति (लिंग) :
- पुरुष
- स्री

सिक्षा के पद (दर्जा) :   सम्पूर्ण समय विघार्थी

अगर अन्य कृपया नाम दीजिए

आप किन देशों में पढ़े है (मातृ भूमि को मिला कर) और कित्ने साल पढ़े है?

a.	,	साल,	मास.
b.	,	साल,	मास.
c.	,	साल,	मास.
d.	,	साल,	मास.
e.	,	साल,	मास.

अगर आप को इस प्रश्रावली के परिणाम के बारेम अधिक भाहिय कृपया आपका इलेक्ट्रॉनिक मेल पूरा कीजिए

पता

संस्कृतिक पसन्दें

कृपया एक प्रश्र के लिए जवाबों से आपका जवाब किससे मिलता है उसे चुनिये (एक प्रश्र के दाहिने हिस्सो पर डि ब्बे है और जवाबों 'जोर से सहमत से 'जोर से असेहमत' तक है)

१. सिक्षा को सामाजिक और धार्मिक मूल्यों नहिं मान्ना है
- जोर से सेहमत
- सेहमत
- कोई भी नही
- असेहमत
- जोर से असेहमत

२. मुजे अपने गलतियों से पाठ सीखना पसंद है और गलति करने से 'बचाना' मुजे पसंद नहि
- जोर से सेहमत
- सेहमत
- कोई भी नही
- असेहमत
- जोर से असेहमत

३. एक व्यक्ति के सफलता केलिए मासिक वेतना एक बेहतर सूचक है समाजिकर्जा से
- जोर से सेहमत
- सेहमत
- कोई भी नही
- असेहमत
- जोर से असेहमत

४. अपना सिक्षा संबघी लक्ष्य को पूरा करने के लिए मुजे छोट छोटे पाठ पसंद है जिससे उस विशय में आधिपत्य पा सकू
- जोर से सेहमत
- सेहमत
- कोई भी नही
- असेहमत
- जोर से असेहमत

५. अध्यापकों/सिक्षकों को तरह व्यक्हार कर्ना है बल्कि गुरू की तरह नही
- जोर से सेहमत
- सेहमत
- कोई भी नही
- असेहमत
- जोर से असेहमत

६. एक विषय को कोजना पर मै अपना सिक्षक मुजे रास्ता दिरवाना और सीमा में बाघना पसंद कर्ता हूँ
- जोर से सेहमत
- सेहमत
- कोई भी नही
- असेहमत
- जोर से असेहमत

७. मुजे सिक्षा उज्ञान को एक कर्म और विनयमीति तरह से प्रस्तुत करना पसंद करता हूँ
- जोर से सेहमत
- सेहमत
- कोई भी नही
- असेहमत
- जोर से असेहमत

८. मैं अप्नौ दोस्तों और सायियों के साम्ने इज्ज कमाने केलिए कीमतेतर प्रतियोगिता (कवि लिखना, चित्र लिखना) पसंद करता हूँ बल्कि होढ और खेलो से
- जोर से सेहमत
- सेहमत
- कोई भी नही
- असेहमत

○ जोर से असेहमत

९. मुजे दोस्तों से गुरु / अघयापक से सिक्षा सीखना पसंद हूँ
  ○ जोर से सेहमत
  ○ सेहमत
  ○ कोई भी नही
  ○ असेहमत
  ○ जोर से असेहमत

१०. सिक्षा मैं अस्पषृता दूर कर्ने के लिए पाठो मैं बहुत सारे क्रम और दिया होना जरूरी है
  ○ जोर से सेहमत
  ○ सेहमत
  ○ कोई भी नही
  ○ असेहमत
  ○ जोर से असेहमत

११. पाठ मैं कठिनयी कम कर्ने केलिए छोटा कम सीमित अंग विशय पसंद करूँगा
  ○ जोर से सेहमत
  ○ सेहमत
  ○ कोई भी नही
  ○ असेहमत
  ○ जोर से असेहमत

१२. मैं सिक्षा के लक्ष्य "समज्ना" मानता हूँ बल्की "सीक्ना" और परीक्षा लिख-कर करना नहि
  ○ जोर से सेहमत
  ○ सेहमत
  ○ कोई भी नही
  ○ असेहमत
  ○ जोर से असेहमत

१३. मुजे मेरे पाठो को व्यक्हारिक पर जोर देना पसंद करता हूँ बल्कि सिघ्दातो एवं सच्चाईयों से.
  ○ जोर से सेहमत
  ○ सेहमत
  ○ कोई भी नही
  ○ असेहमत
  ○ जोर से असेहमत

१४. अगर हम स्त्री और पुरूष को अलग कर्के सिखा सखें, अध्यापक बेहतर सिखा सकते हैं
  ○ जोर से सेहमत
  ○ सेहमत
  ○ कोई भी नही
  ○ असेहमत
  ○ जोर से असेहमत

१५. अपना सफलता को जानने के लिए मैं अपना सिक्षा पाठ को अलग और तुरन्त परिणाम पर ध्यान देना पसंद करता हूँ
  ○ जोर से सेहमत
  ○ सेहमत
  ○ कोई भी नही
  ○ असेहमत
  ○ जोर से असेहमत

१६. एक चर्चा समूह मे शात और दूसरों को इज्जत कर्ना बहतर मानता हूँ बल्कि अप्ना राय दूसरों पर दबाव डालने से बेहतर
  ○ जोर से सेहमत
  ○ सेहमत

      ° कोई भी नही
      ° असेहमत
      ° जोर से असेहमत

१७. जब मेरा सिक्षा ध्येय पूरा कर्ना है, मै अप्ना काम मंदगतिसे और धीरे कर्ना पसंद कर्ता हूँ, बेहतर समजदारी के लिए
      ° जोर से सेहमत
      ° सेहमत
      ° कोई भी नही
      ° असेहमत
      ° जोर से असेहमत

१८. मेरा अभिप्रेरणा अप्ने व्यक्तिवाचक लक्षस पर होंगें बल्कि मेरे मित्र समूह पर नही
      ° जोर से सेहमत
      ° सेहमत
      ° कोई भी नही
      ° असेहमत
      ° जोर से असेहमत

सिक्षा संबंघी अनुभूतियाँ

१९. मैं अप्ना मातृ भाषा मैं पढ्ना पसंद कर्रुँगा
      ° जोर से सेहमत
      ° सेहमत
      ° कोई भी नही
      ° असेहमत
      ° जोर से असेहमत

२०. अगर मुजे अक्सर मिले मैं अन्य देश मैं पढ्ना पसंद कर्रुँगा
      ° जोर से सेहमत
      ° सेहमत
      ° कोई भी नही
      ° असेहमत
      ° जोर से असेहमत

२१. मै अक्सर मेरे शिक्षण की गति से बाधा लगता है
      ° जोर से सेहमत
      ° सेहमत
      ° कोई भी नही
      ° असेहमत
      ° जोर से असेहमत

२२. मैं गुरू के सिखलाना रीति को इज्जत कर्ता हूँ
      ° जोर से सेहमत
      ° सेहमत
      ° कोई भी नही
      ° असेहमत
      ° जोर से असेहमत

२३. मैं सिक्षण की पग से कृत्रिम होता हूँ
      ° जोर से सेहमत
      ◉ सेहमत

ᵒ कोई भी नही
ᵒ असेहमत
ᵒ जोर से असेहमत

२४. मेरे सिक्षा मैं अन्य राय और अधिक दृष्टि आवश्यक हे
ᵒ जोर से सेहमत
ᵒ सेहमत
ᵒ कोई भी नही
ᵒ असेहमत
ᵒ जोर से असेहमत

२५. मैं अन्य सभ्यतावों को अनुभव करना पसंद कर्ता हूँ
ᵒ जोर से सेहमत
ᵒ Agree
ᵒ कोई भी नही
ᵒ असेहमत
ᵒ जोर से असेहमत

अनुकूली सिक्षा

अनुकूली सिक्षा विधान एक वेब द्वारा प्रदान की जानेवाली सिक्षा जिस्के व्यक्ति के व्यक्तिगत बर्तावो और पसन्दो को जान्कर और उसे समेठ कर और उस्के द्वारा सिक्षा प्रदान कर्ने मै बदलाव ला सक्ता है. एक अनोकी और व्यक्तिगत सिक्षा प्रदान कर्ना ही इसका लक्ष्य है - और इसके द्वारा आप बेहतर सिक्षा पा सर्कें

२६. मेरे अनुसार अनुकूली सिक्षा व्यवस्या एक बेहतर विचार है
ᵒ जोर से सेहमत
ᵒ सेहमत
ᵒ कोई भी नही
ᵒ असेहमत
ᵒ जोर से असेहमत

२७. मुजे कोई भी दिलचस्पी **नही ह**ॅ, किस तरह के व्यक्तिगत जानकारी लिये जा रही है
ᵒ जोर से सेहमत
ᵒ सेहमत
ᵒ कोई भी नही
ᵒ असेहमत
ᵒ जोर से असेहमत

२८. मेरे व्यक्तिगत जान्कारी सुरक्षित रहना ही बहुत जरूरी ह
ᵒ जोर से सेहमत
ᵒ सेहमत
ᵒ कोई भी नही
ᵒ असेहमत
ᵒ जोर से असेहमत

२९. अध्यापक के लिखें हुए सिक्षा रीतियाँ किसी तरह से बदलनी मैं नही चाहता
ᵒ जोर से सेहमत
ᵒ सेहमत
ᵒ कोई भी नही
ᵒ असेहमत
◉ जोर से असेहमत

३०. अनुकूली सिक्षा मैं हो रहें बदलावों को मैं अपने अधिकार मैं रहना ही पसन्द करूँगा
- ⦿ जोर से सेहमत
- ⦿ सेहमत
- ⦿ कोई भी नही
- ⦿ असेहमत
- ⦿ जोर से असेहमत

३१. मैं अपना "व्यक्तिगत" सिक्षा पाना पसन्द कर्ता हूँ मगर उसे एक अध्यापक मान्ना चाहिए
- ⦿ जोर से सेहमत
- ⦿ सेहमत
- ⦿ कोई भी नही
- ⦿ असेहमत
- ⦿ जोर से असेहमत

३२. मैं अप्नेलिए एक व्यक्तिगत विघा ही पसन्द करूँगा जो मेरे सायियों विघा से अलग भी है
- ⦿ Strongly Agree
- ⦿ सेहमत
- ⦿ कोई भी नही
- ⦿ असेहमत
- ⦿ जोर से असेहमत

[जवाब पेश कर्ना]   [फिर से लिखना]

बहुत बहुत धन्यवादें आपके समय और परि श्रम के लिए

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12 APPENDIX B: CAE-L XML INSTANCES

12.1 CAE-L – AUT

```
<?xml version="1.0"?><!DOCTYPE cael []>
<cael version="1.0" aeh="reject"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation="caels.xsd">

      <countryCode name="Austria" threela="AUT" twola="AT"
numeric="040"/>
      <authority help="more" expert="teachers" aehApproved="hide"/>
      <group genderseparation="rejected"/>
      <language presence="show" culture="show"/>
      <lesson hierarchy="deep" help="more" access="limited"
            choice="limited" ambiguity="less"/>
      <data security="absent"/>
      <comment>Comment text for Austria's CAE-L description</comment>

</cael>
```

12.2 CAE-L – CHN

```
<?xml version="1.0"?><!DOCTYPE cael []>
<cael version="1.0" aeh="accept"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation="caels.xsd">

      <countryCode name="China" threela="CHN" twola="CN"
numeric="156"/>
      <authority help="more" expert="teachers"
aehApproved="display"/>
      <group genderseparation="rejected"/>
      <language presence="show" culture="show"/>
      <lesson hierarchy="deep" help="less" access="limited"
choice="open"
            ambiguity="more"/>
      <data security="present"/>
      <comment>Comment text for China's CAE-L description</comment>

</cael>
```

12.3 CAE-L – DEU

```
<?xml version="1.0"?><!DOCTYPE cael []>
<cael version="1.0" aeh="reject"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation="caels.xsd">

      <countryCode name="Germany" threela="DEU" twola="DE"
numeric="276"/>
      <authority help="less" expert="peers" aehApproved="hide"/>
      <group genderseparation="rejected"/>
      <language presence="show" culture="show"/>
      <lesson hierarchy="shallow" help="more" access="open"
```

```
        choice="limited" ambiguity="less"/>
        <data security="absent"/>
        <comment>Comment text for Germany's CAE-L description</comment>

</cael>
```

12.4 CAE-L – FRA

```
<?xml version="1.0"?><!DOCTYPE cael []>
<cael version="1.0" aeh="reject"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation="caels.xsd">

      <countryCode name="France" threela="FRA" twola="FR"
numeric="250"/>
      <authority help="more" expert="teachers" aehApproved="hide"/>
      <group genderseparation="rejected"/>
      <language presence="show" culture="show"/>
      <lesson hierarchy="deep" help="less" access="limited"
choice="open"
            ambiguity="more"/>
      <data security="absent"/>
      <comment>Comment text for France's CAE-L description</comment>

</cael>
```

12.5 CAE-L – GBR

```
<?xml version="1.0"?><!DOCTYPE cael []>
<cael version="1.0" aeh=""
xmlns:xsi="http://www.w3.org/2001/XMLSchema-
      instance" xsi:noNamespaceSchemaLocation="caels.xsd">

      <countryCode name="United Kingdom" threela="GBR" twola="GB"
            numeric="826"/>
      <authority help="more" expert="teachers" aehApproved=""/>
      <group genderseparation="rejected"/>
      <language presence="hide" culture="hide"/>
      <lesson hierarchy="deep" help="less" access="limited"
choice="open"
            ambiguity="more"/>
      <data security=""/>
      <comment>Comment text for the UK's CAE-L description</comment>

</cael>
```

12.6 CAE-L – GRC

```
<?xml version="1.0"?><!DOCTYPE cael []>
<cael version="1.0" aeh=""
xmlns:xsi="http://www.w3.org/2001/XMLSchema-
      instance" xsi:noNamespaceSchemaLocation="caels.xsd">
```

```
      <countryCode name="Greece" threela="GRC" twola="GR"
numeric="300"/>
      <authority help="more" expert="teachers" aehApproved=""/>
      <group genderseparation="rejected"/>
      <language presence="show" culture="show"/>
      <lesson hierarchy="deep" help="more" access="limited"
            choice="limited" ambiguity="less"/>
      <data security=""/>
      <comment>Comment text for Greece's CAE-L description</comment>

</cael>
```

12.7 CAE-L — IND

```
<?xml version="1.0"?><!DOCTYPE cael []>
<cael version="1.0" aeh="reject"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation="caels.xsd">

      <countryCode name="India" threela="IND" twola="IN"
numeric="356"/>
      <authority help="more" expert="teachers" aehApproved="hide"/>
      <group genderseparation="rejected"/>
      <language presence="show" culture="show"/>
      <lesson hierarchy="deep" help="less" access="limited"
choice="open"
            ambiguity="more"/>
      <data security="absent"/>
      <comment>Comment text for India's CAE-L description</comment>

</cael>
```

12.8 CAE-L — IRL

```
<?xml version="1.0"?><!DOCTYPE cael []>
<cael version="1.0" aeh=""
xmlns:xsi="http://www.w3.org/2001/XMLSchema-
      instance" xsi:noNamespaceSchemaLocation="caels.xsd">

      <countryCode name="Ireland" threela="IRL" twola="IE"
numeric="372"/>
      <authority help="more" expert="teachers" aehApproved=""/>
      <group genderseparation="rejected"/>
      <language presence="hide" culture="show"/>
      <lesson hierarchy="deep" help="less" access="limited"
choice="open"
            ambiguity="more"/>
      <data security=""/>
      <comment>Comment text for Ireland's CAE-L description</comment>

</cael>
```

12.9 CAE-L — NLD

```
<?xml version="1.0"?><!DOCTYPE cael []>
```

```
<cael version="1.0" aeh=""
xmlns:xsi="http://www.w3.org/2001/XMLSchema-
     instance" xsi:noNamespaceSchemaLocation="caels.xsd">

     <countryCode name="Netherlands" threela="NLD" twola="NL"
          numeric="528"/>
     <authority help="less" expert="peers" aehApproved=""/>
     <group genderseparation="rejected"/>
     <language presence="show" culture="show"/>
     <lesson hierarchy="shallow" help="more" access="open"
          choice="limited" ambiguity="more"/>
     <data security=""/>
     <comment>Comment text for Netherlands' CAE-L
description</comment>

</cael>
```

12.10 CAE-L – ROU

```
<?xml version="1.0"?><!DOCTYPE cael []>
<cael version="1.0" aeh="reject"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="caels.xsd">
     <countryCode name="Austria" threela="ROU" twola="RO"
numeric="642"/>
     <authority help="more" expert="teachers" aehApproved="hide"/>
     <group genderseparation="rejected"/>
     <language presence="show" culture="show"/>
     <lesson hierarchy="deep" help="more" access="limited"
choice="limited" ambiguity="less"/>
     <data security="absent"/>
     <comment>Comment text for Romania's CAE-L description</comment>
</cael>
```

12.11 CAE-L – SAU

```
<?xml version="1.0"?><!DOCTYPE cael []>
<cael version="1.0" aeh="reject"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:noNamespaceSchemaLocation="caels.xsd">

     <countryCode name="Saudi Arabia" threela="SAU" twola="SA"
          numeric="682"/>
     <authority help="more" expert="teachers" aehApproved="hide"/>
     <group genderseparation="accepted"/>
     <language presence="show" culture="show"/>
     <lesson hierarchy="deep" help="more" access="limited"
          choice="limited" ambiguity="less"/>
     <data security="absent"/>
     <comment>Comment text for Saudi Arabia's CAE-L
description</comment>

</cael>
```

```xml
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
elementFormDefault="qualified">
      <xs:element name="cael">
            <xs:complexType>
                  <xs:sequence>
                        <xs:element ref="countryCode" minOccurs="1"
maxOccurs="1"/>
                        <xs:element ref="authority" minOccurs="1"
maxOccurs="1"/>
                        <xs:element ref="group" minOccurs="1"
maxOccurs="1"/>
                        <xs:element ref="language" maxOccurs="1"
minOccurs="1"/>
                        <xs:element ref="lesson" maxOccurs="1"
minOccurs="1"/>
                        <xs:element ref="data" maxOccurs="1"
minOccurs="1"/>
                        <xs:element ref="comment" maxOccurs="0"
minOccurs="1"/>
                  </xs:sequence>
                  <xs:attribute name="aeh" use="required" type="c-
aeh"/>
                  <xs:attribute name="version" use="required"
type="xs:decimal"/>
            </xs:complexType>
      </xs:element>
      <xs:element name="countryCode">
            <xs:complexType>
                  <xs:attribute name="name" use="required" type="c-
name"/>
                  <xs:attribute name="numeric" use="optional"
type="c-numeric"/>
                  <xs:attribute name="threela" use="optional"
type="c-threela"/>
                  <xs:attribute name="twola" use="optional" type="c-
twola"/>
            </xs:complexType>
      </xs:element>
      <xs:element name="authority">
            <xs:complexType>
                  <xs:attribute name="aehApproved" use="required"
type="c-aehApproved"/>
                  <xs:attribute name="expert" use="required" type="c-
expert"/>
                  <xs:attribute name="help" use="required" type="c-
authority-help"/>
            </xs:complexType>
      </xs:element>
      <xs:element name="group">
            <xs:complexType>
                  <xs:attribute name="genderseparation"
use="required" type="c-genderseparation"/>
            </xs:complexType>
      </xs:element>
      <xs:element name="language">
            <xs:complexType>
```

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```xml
                    <xs:attribute name="culture" use="required"
type="c-culture"/>
                    <xs:attribute name="presence" use="required"
type="c-presence"/>
            </xs:complexType>
        </xs:element>
        <xs:element name="lesson">
            <xs:complexType>
                    <xs:attribute name="access" use="required" type="c-
access"/>
                    <xs:attribute name="ambiguity" use="required"
type="c-ambiguity"/>
                    <xs:attribute name="choice" use="required" type="c-
choice"/>
                    <xs:attribute name="help" use="required" type="c-
lesson-help"/>
                    <xs:attribute name="hierarchy" use="required"
type="c-hierarchy"/>
            </xs:complexType>
        </xs:element>
        <xs:element name="data">
            <xs:complexType>
                    <xs:attribute name="security" use="required"
type="c-security"/>
            </xs:complexType>
        </xs:element>
        <xs:element name="comment" type="xs:string"/>

        <xs:simpleType name="c-aeh">
            <xs:restriction base="xs:string">
                    <xs:enumeration value="accept"/>
                    <xs:enumeration value="reject"/>
                    <xs:enumeration value=""/>
            </xs:restriction>
        </xs:simpleType>

        <xs:simpleType name="c-name">
            <xs:restriction base="xs:string">
                    <xs:pattern value="([a-zA-Z])+"/>
            </xs:restriction>
        </xs:simpleType>

        <xs:simpleType name="c-numeric">
            <xs:restriction base="xs:positiveInteger">
                    <xs:maxInclusive value="999"/>
                    <xs:totalDigits value="3"/>
            </xs:restriction>
        </xs:simpleType>

        <xs:simpleType name="c-threela">
            <xs:restriction base="xs:string">
                    <xs:pattern value="[a-zA-Z][a-zA-Z][a-zA-Z]"/>
            </xs:restriction>
        </xs:simpleType>

        <xs:simpleType name="c-twola">
            <xs:restriction base="xs:string">
                    <xs:pattern value="[a-zA-Z][a-zA-Z]"/>
                    <xs:length fixed="true" value="2"/>
            </xs:restriction>
        </xs:simpleType>
```

```xml
<xs:simpleType name="c-aehApproved">
      <xs:restriction base="xs:string">
            <xs:enumeration value="display"/>
            <xs:enumeration value="hide"/>
            <xs:enumeration value=""/>
      </xs:restriction>
</xs:simpleType>

<xs:simpleType name="c-expert">
      <xs:restriction base="xs:string">
            <xs:enumeration value="peers"/>
            <xs:enumeration value="teachers"/>
      </xs:restriction>
</xs:simpleType>

<xs:simpleType name="c-authority-help">
      <xs:restriction base="xs:string">
            <xs:enumeration value="less"/>
            <xs:enumeration value="more"/>
      </xs:restriction>
</xs:simpleType>

<xs:simpleType name="c-genderseparation">
      <xs:restriction base="xs:string">
            <xs:enumeration value="accepted"/>
            <xs:enumeration value="rejected"/>
      </xs:restriction>
</xs:simpleType>

<xs:simpleType name="c-culture">
      <xs:restriction base="xs:string">
            <xs:enumeration value="show"/>
            <xs:enumeration value="hide"/>
      </xs:restriction>
</xs:simpleType>

<xs:simpleType name="c-presence">
      <xs:restriction base="xs:string">
            <xs:enumeration value="show"/>
            <xs:enumeration value="hide"/>
      </xs:restriction>
</xs:simpleType>

<xs:simpleType name="c-access">
      <xs:restriction base="xs:string">
            <xs:enumeration value="limited"/>
            <xs:enumeration value="open"/>
      </xs:restriction>
</xs:simpleType>

<xs:simpleType name="c-ambiguity">
      <xs:restriction base="xs:string">
            <xs:enumeration value="less"/>
            <xs:enumeration value="more"/>
      </xs:restriction>
</xs:simpleType>

<xs:simpleType name="c-choice">
      <xs:restriction base="xs:string">
            <xs:enumeration value="limited"/>
```

```
                        <xs:enumeration value="open"/>
                </xs:restriction>
        </xs:simpleType>

        <xs:simpleType name="c-lesson-help">
                <xs:restriction base="xs:string">
                        <xs:enumeration value="less"/>
                        <xs:enumeration value="more"/>
                </xs:restriction>
        </xs:simpleType>

        <xs:simpleType name="c-hierarchy">
                <xs:restriction base="xs:string">
                        <xs:enumeration value="deep"/>
                        <xs:enumeration value="shallow"/>
                </xs:restriction>
        </xs:simpleType>

        <xs:simpleType name="c-security">
                <xs:restriction base="xs:string">
                        <xs:enumeration value="present"/>
                        <xs:enumeration value="absent"/>
                        <xs:enumeration value=""/>
                </xs:restriction>
        </xs:simpleType>
</xs:schema>
```

```
<?xml version="1.0"?>
<wsdl:definitions name="caelWebService"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
targetNamespace="http://www.act-course.co.uk/cael/caelService.wsdl"
                 xmlns:cael="http://www.act-
course.co.uk/cael/caelService.wsdl"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
xmlns:http="http://schemas.xmlsoap.org/wsdl/http/">
     <wsdl:documentation>CAE-L web service
definition</wsdl:documentation>

     <wsdl:message name="whichCountryRequest">
           <wsdl:part name="countryCode" type="xsd:string"/>
     </wsdl:message>
     <wsdl:message name="whichCountryResponse">
           <wsdl:part name="countryData" element="cael"/>
     </wsdl:message>

     <wsdl:portType name="caelPort">

           <wsdl:operation name="getCAEL">

                 <wsdl:input message="cael:whichCountryRequest"/>

                 <wsdl:output message="cael:whichCountryResponse"/>
           </wsdl:operation>
     </wsdl:portType>

     <wsdl:binding name="caelBinding" type="cael:caelPort">

           <soap:binding
transport="http://schemas.xmlsoap.org/soap/http" style="rpc"/>

           <wsdl:operation name="getCAEL">

                 <soap:operation soapAction="getCAEL"/>

                 <wsdl:input>

                       <soap:body use="encoded"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:cael"/>
                 </wsdl:input>

                 <wsdl:output>

                       <soap:body use="encoded"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:cael"/>
                 </wsdl:output>
           </wsdl:operation>
     </wsdl:binding>

     <wsdl:service name="caelService">

           <wsdl:documentation>WSDL file for CAE-L web
service</wsdl:documentation>
```

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```
            <wsdl:port name="caelPort" binding="cael:caelBinding">
                <soap:address location="http://www.act-
course.co.uk/cael/"/>
            </wsdl:port>
        </wsdl:service>

        <wsdl:types>

            <xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">
                <xsd:element name="cael">
                    <xsd:complexType>
                        <xsd:sequence>
                            <xsd:element ref="countryCode"
minOccurs="1" maxOccurs="1"/>
                            <xsd:element ref="authority"
minOccurs="1" maxOccurs="1"/>
                            <xsd:element ref="group"
minOccurs="1" maxOccurs="1"/>
                            <xsd:element ref="language"
maxOccurs="1" minOccurs="1"/>
                            <xsd:element ref="lesson"
maxOccurs="1" minOccurs="1"/>
                            <xsd:element ref="data"
maxOccurs="1" minOccurs="1"/>
                            <xsd:element ref="comment"
maxOccurs="1" minOccurs="1"/>
                        </xsd:sequence>
                        <xsd:attribute name="aeh"
use="optional" type="xsd:string"/>
                        <xsd:attribute name="version"
use="required" type="xsd:decimal"/>
                    </xsd:complexType>
                </xsd:element>
                <xsd:element name="countryCode">
                    <xsd:complexType>
                        <xsd:attribute name="name"
use="required" type="xsd:string"/>
                        <xsd:attribute name="numeric"
use="optional" type="xsd:integer"/>
                        <xsd:attribute name="threela"
use="required" type="xsd:string"/>
                        <xsd:attribute name="twola"
use="optional" type="xsd:string"/>
                    </xsd:complexType>
                </xsd:element>
                <xsd:element name="authority">
                    <xsd:complexType>
                        <xsd:attribute name="aehApproved"
use="optional" type="xsd:string"/>
                        <xsd:attribute name="expert"
use="required" type="xsd:string"/>
                        <xsd:attribute name="help"
use="required" type="xsd:string"/>
                    </xsd:complexType>
                </xsd:element>
                <xsd:element name="group">
                    <xsd:complexType>
                        <xsd:attribute name="genderseparation"
use="required" type="xsd:string"/>
                    </xsd:complexType>
```

```
                </xsd:element>
                <xsd:element name="language">
                    <xsd:complexType>
                        <xsd:attribute name="culture"
use="required" type="xsd:string"/>
                        <xsd:attribute name="presence"
use="required" type="xsd:string"/>
                    </xsd:complexType>
                </xsd:element>
                <xsd:element name="lesson">
                    <xsd:complexType>
                        <xsd:attribute name="access"
use="required" type="xsd:string"/>
                        <xsd:attribute name="ambiguity"
use="required" type="xsd:string"/>
                        <xsd:attribute name="choice"
use="required" type="xsd:string"/>
                        <xsd:attribute name="help"
use="required" type="xsd:string"/>
                        <xsd:attribute name="hierarchy"
use="required" type="xsd:string"/>
                    </xsd:complexType>
                </xsd:element>
                <xsd:element name="data">
                    <xsd:complexType>
                        <xsd:attribute name="security"
use="optional" type="xsd:string"/>
                    </xsd:complexType>
                </xsd:element>
                <xsd:element name="comment" type="xsd:string"/>
            </xsd:schema>
        </wsdl:types>
</wsdl:definitions>
```

My Nationality is …

1) [interviewer points at the progress bar] This bar showed you your progress throughout the lesson,

 i) did you notice this? {yes, no}

 ii) did you find it useful? {yes, no}

 iii) how else would you otherwise prefer this? {open answer}

2) [again pointing at the progress bar] Which would you prefer, progress shown throughout a single lesson or over an entire module of lessons? {single lesson, series of lessons}

3) [interviewer points at the logo]

 i) Do you think this logo is appropriate for the eLearning course? {yes, no}

 ii) Which would you prefer, an institutional logo or a more casual one (such as a group of happy students at graduation)? {institutional, casual}

 iii) how else would you otherwise prefer this? {open answer}

4) [interviewer points out the 'See Also' panel]

 i) This panel was designed to give you access to additional information. As you can see, there are two levels of additional links. Did you find the 'general' links useful? {yes, no}

 ii) Did you find the 'page specific' links useful? {yes, no}

 iii) what other links would you like to see here? {open answer}

5) [interviewer points out the navigational panel] Here you were presented with a very flat hierarchy (all siblings were given at the same level) detailing the rest of the lesson contents. Were you happy to receive all of the course contents in this manner? {yes, no}, how else would you otherwise prefer this? {open answer}

6) [interviewer points out the navigational panel] Here you were presented with a very open hierarchy (all course contents were displayed at once). Would you have preferred to have fewer content items displayed at once, with these display changing over the course of the lesson? {yes, no} how else would you otherwise prefer this? {open answer}

7) [Interviewer points to lower centre of the screen] In some versions of the interface a 'What's On?' link is displayed here. This button would take you to a page with local and international information not directly related to the course, such as local football teams, tourist sites and academic information. Would you want such a button to be displayed? {yes, no} what other information would you like to see in such a link? {open answer}

8) [Interviewer will go to the 'PHP' page and point out the 'Help' button] This button links to page specific information when appropriate. Do you consider this a useful function? {yes, no}

9) [Again pointing at the 'Help' button] Should the 'Help' button be used only as appropriate (by the teacher)? {yes, no} Is there any other help functionality you'd like to see? {open answer}

10) [Interviewer points out 'See Also' section and the main content panel] Should the page specific links that are present in the 'See Also' section also be present as links in the text of the main content page to ensure that you notice them? {yes, no} Do you feel that other links are necessary in the main content page? {open answer}

11) [Interviewer points out the 'Next Recommendation' link] The Navigation bar contains a link to the Next Recommended page (as specified by the teacher). This allows you to progress through the lesson in a linear manner. Do you think that such a link is useful? {yes, no}

12) In your own words, what are your favourite aspects of this interface (name at most three)? {open answer}

13) In your own words, what are your least favourite aspects of this interface (name at most three)? {open answer}

14) In your own words, do you have any other comments on the interface? {open answer}

16.1 STUDENT 1 (S1) / INTERVIEWER (I)

[Student1 is told to log in to the system, they have to complete a short pre-quiz which is not marked and has no bearing on the outcome of this interview]

I: The progress bar in the top right corner, this bar showed you your progress throughout the lesson, did you notice it?

S1: Umm, not during the … umm …

I: OK, now it has been pointed out to you do you find, would you find it useful?

S1: Yeah, I guess it would be useful.

I: How else would you prefer this to be presented?

S1: [inaudible]

I: Again on the progress bar, which would you prefer, progress shown throughout a single lesson, or over an entire module of lessons?

S1: I guess both would be useful

I: If it had to be one or the other what would you say?

S1: I would say lesson progress

I: The logo, do you think this logo is appropriate for an elearning course?

S1: Not really

I: which would you prefer, an institutional logo or a more casual one, such as a group of happy students at graduation?

S1: Institutional

I: How else would you prefer this? What other kinds of logos would be appropriate?

S1: I'm not really sure

I: the See Also area here, this panel was designed to give you access to additional information, as you can see there are two levels of additional links, do you find the General links useful?

S1: Can I test them?

I: of course, feel free to click on them if you like

S1: [inaudible] … show the same thing all the time?

I: Yes, these are always ready at hand and as approved by the teacher

S1: Ok, I guess yes

I: the page specific links, so again as assigned by the teacher, are they useful?

S1: yes

I: What other links would you like to see

S1: I not really sure …

I: It's Ok, right … if they don't need anything else. Right the navigation bar, here you are presented with a very flat hierarchy, all siblings are at the same level, detailing the rest of the lesson contents, were you happy to receive all of the course contents in this manner?

S1: yes. I have taken sort of online courses before and it's kind of normal

I: So you prefer this? As that was the next thing – how else would you prefer this?

I: Navigation panel again. Here you are presented with a very open hierarchy, all course items were displayed at once rather than a subset. Would you have preferred to have fewer content items displayed at once, with these … with this display changing over the course of the lesson?

S1: well it would be … it's OK that you choose this, the main problem was that they kept moving when I clicked them

I: so you are fine with it as it is

S1: I think also what would be useful would be a small arrow that fixed to just click for the 'next'

I: Actually have … so here is the What's On button, in some versions of the interface the What's On link is displayed here. This button will take you to a page with local and international information not directly related to the course. Such as local football teams, tourist sites and academic information, would you want such a button to be displayed?

S1: I don't know, I don't think it's very useful, it's basically a [inaudible]

I: OK, so that would be a 'no' and so what other information would you like to see in such a link – you are not concerned about the link – would that be accurate?

S1: Yes, I don't know I just don't think … I'm reading a course I'm not concerned about this other information.

I: Sure, sure

I: Right let me take you to the PHP page. This button here links to page specific information when appropriate – do you consider this a useful function? Yes or No

S1: Yeah

I: same button, should the Help button be on every page or only as appropriate, as suggested by the teacher?

S1: I think as suggested by the teacher

I: Is there any other Help functionality that you would like to see?

S1: Not really

I: OK, the See Also section again as opposed to the main content panel. Should the page specific links, such as these, that are present in the See Also section also be present as links in the text of the main content page to ensure that you notice them?

S1: Yes

I: Do you feel that other links are necessary in the main content page?

S1: Not really

I: Getting there. The Next Recommendation link, this navigation bar contains a link to the next recommended page as specified by the teacher, this allows you to progress through the lesson in a linear manner. Do you think that such a link is useful?

S1: Yes

I: OK, in your own words, it's not a good microphone so lean into the microphone, In your own words what are your most favourite aspects of this interface, name at most three, one or nought is fine.

S1: Errmm … I guess it's nice that it's a pretty good colour, it's not very tiring, urrmm … I don't know it's actually pretty good like that.

I: OK, In your own words what are your least favourite aspects of this interface, up to three.

S1: The whole, this thing, the … how do you call it?

I: navigation bar?

S1: Yes the navigational bar, that was a bit stressful …

I: In what way?

S1: it … when it moved it kind of detracted from concentrating on the content of the lesson. Also I had … I didn't really notice what was going on the right side of the screen and I guess that's about it.

I: Ok, thank you, finally in your own words do you have any other comments on the interface?

S1: No

I: Thank you very much.

16.2 STUDENT 2 (S2) / INTERVIEWER (I)

[Student2 is told to log in to the system, they have to complete a short pre-quiz which is not marked and has no bearing on the outcome of this interview]

I: The Progress bar up in this top corner, this bar showed you your progress through the lesson, one, did you notice this?

S2: Yes

I: Two, did you find it useful?

S2: yes, of course.

I: And three, how else would you other prefer this information to be presented?

S2: errmm … the information about the lesson progress?

I: [grunts in acknowledgement]

S2: I think it's OK like that. It's useful that it's right there in the right side as here I can read all the text in the course and there I can watch at a certain time the lesson progress.

I: Same with the lesson plan, which would you prefer, progress shown throughout a single lesson or over an entire module of lessons?

S2: Single lesson.

I: The logo, do you think this logo is appropriate for the elearning course?

S2: yes of course

I: Which would you prefer an institutional logo or a more casual one, such as a group of happy students.

S2: A casual one

I: How else otherwise would you prefer this?

S2: I would actually like an image of other people, more, errr, wider image.

I: OK, the See Also panel here, this panel was designed to give you access to additional information, as you can see there are two levels of additional links, did you find the general links useful?

S2: Yes

I: Did you find the page specific links useful?

S2: Yes

I: What other links would you like to see here?

S2: Errmm … well we have the general, the page specific, I think that's about it. I think that covers everything.

I: Right, the Navigation panel, here you are presented with a very flat hierarchy, all siblings are at the same level detailing the rest of the lesson contents. Were you happy to receive all of the course contents in this manner?

S2: Yes it's perfect like this.

I: How else would you prefer this? If you did?

S2: If I did … err … actually, just a title for certain part of the lesson and after that we can open it like we did with PHP and have those smaller bit sized course.

I: Next, again is the Navigational Panel, here you are presented with a very open hierarchy, ie all course contents are displayed at once. Would you prefer to have fewer content items displayed at once with the display changing over the course of the lesson?

S2: Yes

I: How else would you otherwise prefer this?

S2: No other way.

I: Down here, in some versions of the interface the 'What's On?' link is displayed here. This button would take you to a page with local and international information not directly related to the course, such as local football teams, tourist sites and academic information. Would you want to see such a button displayed?

S2: If it's related to the course then yes, otherwise no.

I: So as described it is not related to the course so no?

S2: Yes.

I: What other information would you like to see in such a link?

S2: No … errmm, nothing.

I: This button links to page specific information when appropriate, do you consider this a useful function?

S2: yes, because it helps me.

I: Again with the button, should the Help button be on every page or only as defined as appropriate?

S2: Only as appropriate as set by the teacher.

I: Is there any other Help functionality that you would like to see?

S2: Errmmm … well when we have source code and we want to … we have to use it for our own web pages, then it is useful to have a Help button because then we can actually see how it works when it goes to another web site of something where it shows me actually how it should work and if I have an error I can see where I went wrong.

I: With the See Also compared to the main content panel here should the page specific links that are present in the See Also section also be present as links as text in the main content page to ensure that you notice them?

S2: Yes

I: Do you that other links are necessary in the main content page?

S2: Errmmm … yes

I: Such as ?

S2: Links that take me to PHP where I can actually download the software and tutorials that show how to install it, I don't know how to install it.

I: The Next Recommended Link here, the Navigation bar contains a link to the next recommended page as specified by the teacher this allows you to progress through the lesson in a linear manner. Do you think such a link is useful?

S2: Yes, yes it is better like this, because I think that we can actually learn better usually if I am able to… if I can decide what to learn next, I skip some pages and it's not good.

I: Now the open questions, in your own words what are your favourite aspects of this interface? Name at most three.

S2: Errrmmm … what are my favourite aspects of this? Well first of all the lesson progress and the See Also and of course the Navigation Bar. Of course with, I would have preferred the navigation Bar to be a little more compact but it's OK, I like it either way. Everything is quite clear and well organised and I really like it.

I: In your own words what are your least favourite aspects of this interface? Name at most three.

S2: At most three … I only have an issue with the navigation bar and that's it.

I: And finally, in your own words do you have any other comments on the interface?

S2: other comments … well no, it's really OK by me

16.3 STUDENT 3 (S3) / INTERVIEWER (I)

[Student3 is told to log in to the system, they have to complete a short pre-quiz which is not marked and has no bearing on the outcome of this interview]

I: The Progress bar up in this top corner, this bar showed you your progress through the lesson, one, did you notice this?

S3: Not really

I: Now that it has been pointed out to you, do you think it would be useful?

S3: it points out the fact that one might find themselves missing parts of the lesson so I guess it does have its uses.

I: How else would you prefer this information to be presented?

S3: Are you referring to the course itself or …

I: This is still the progress bar.

S3: I say it would be easier if it were moved onto the left side with the whole menu navigation … concentrate the focus on two sides rather than three.

I: Again with the progress bar, which would you prefer, progress shown throughout a single lesson or over an entire module of lessons?

S3: Both I guess

I: If you had to choose?

S3: If I had to choose between them I guess I would have to choose the module.

I: The logo here … Do you think this logo is appropriate for an eLearning course?

S3: not really, it's … personally I would prefer something that people can identify with

I: which would you prefer, an institutional logo or a more casual one such as a group of happy students at graduation?

S3: I'd go for institutional

I: How else would you otherwise prefer this to be displayed?

S3: I think the important point of a logo is that it is a simple image, easy to remember not a photo something unique, I think

I: The see also panel here … this panel is designed to give you access to additional information, as you can see there are two levels of additional links, did you find the general links useful?

S3: I think all of them could have been included on a separate page on the navigation pane, again I don't really see the use of the rightmost panel

I: OK, but other than the position the actual links being present?

S3: yes they are useful

I: the page specific links, did you find them useful?

S3: not really, I don't think they have a point, I think the general ones suffice.

I: what other links would you like to see here, if any?

S3: I link to a page with examples would be nice.

I: the navigation bar here, here you are presented with a very flat hierarchy, with all the siblings given at the same level detailing the rest of the lesson contents. Were you happy to receive all of the course contents in this manner?

S3: Yes

I: How else would you prefer this? If you did?

S3: I enjoy using a hierarchy model

I: here you are presented with a very open hierarchy, ie all course contents are displayed at once. Would you prefer to have fewer content items displayed at once with the display changing over the course of the lesson?

S3: It would have been interesting yes

I: How else would you otherwise prefer this?

S3: I believe the sheer volume of list items is a wee bit overwhelming I guess, the option to only display a few at a time would have been welcome.

I: Down here, in some versions of the interface the 'What's On?' link is displayed here. This button would take you to a page with local and international information not directly related to the course, such as local football teams, tourist sites and academic information. Would you want to see such a button displayed?

S3: No I don't believe so

I: What other information would you like to see in such a link?

S3: I don't want the link, I don't think it is relevant

I: This button links to page specific information when appropriate, do you consider this a useful function? Information on this specific piece of text.

S3: yes

I: Again with the button, should the Help button be on every page or only as appropriate by the teacher … as established by the teacher?

S3: I believe it is not necessary for it to be on every page

I: Is there any other Help functionality that you would like to see?

S3: I don't think so, what I have seen so far seems to suffice

I: With the See Also compared to the main content panel here should the page specific links that are present in the See Also section also be present as links as text in the main content page to ensure that you notice them?

S3: I don't believe so

I: Do you that other links are necessary in the main content page?

S3: No

I: the Navigation bar contains a link to the next recommended page as specified by the teacher this allows you to progress through the lesson in a linear manner. Do you think such a link is useful?

S3: yes

I: Finally, in your own words what are your favourite aspects of this interface? Name at most three.

S3: Personally I like the hierarchy panel on the left, its rather useful and I'm used to using one. The splitting the page into zones (again I completely disagree with the third part) … splitting the page into areas, the hierarchy on the left, or right alternatively, and the actual display page, is in my opinion highly intuitive and useful, it's easy to have list of subjects right in front of you, you don't have to head back or otherwise look up a list and come back to a page and look another subject up – its simply easier this way.

I: In your own words what are your least favourite aspects of this interface? Name at most three.

S3: I say the third panel I don't really see its point

I: And finally, in your own words do you have any other comments on the interface?

S3: Don't think so.

17.1 PHP QUIZ

Question #1: What does PHP stand for?

ANS:

      Preprocessed Hypertext Page
      Hypertext Markup Language
*   PHP: Hypertext Preprocessor
      Hypertext Transfer Protocol

Question #2: PHP server scripts are surrounded by delimiters, which?

ANS:
*   <?php…?>
      <&>...</&>
      <script>...</script>
      <?php>...</?>

Question #3: All variables in PHP start with which symbol?

ANS:

      !
      &
* $

Question #4: What is the correct way to end a PHP statement?

ANS:
*   ;
      .
      New line
      </php>

Question #5: The PHP syntax is most similar to:

ANS:

      VBScript
*   Perl and C
      JavaScript

Question #6: How do you get information from a form that is submitted using the "get" method?

ANS:

      Request.Form;
      Request.QueryString;
* $_GET[];

Question #7: When using the POST method, variables are displayed in the URL:

ANS:

       True
*   False

Question #8: In PHP you can use both single quotes (' ') and double quotes (" ") for strings:

ANS:

       False
*   True

Question #9: What is the correct way to create a function in PHP?

ANS:

       new_function myFunction()
*   function myFunction()
       create myFunction()

Question #10: What is the correct way to open the file "time.txt" as readable?

ANS:

       fopen("time.txt","r+");
       open("time.txt");
       open("time.txt","read");
*   fopen("time.txt","r");

Question #11: PHP allows you to send emails directly from a script

ANS:
*   True
       False

Question #12: What is the correct way to add 1 to the $count variable?

ANS:
* $count++;
       ++count
       count++;
       $count =+1

Question #13: What will be printed by the code below?

```php
<?php
  FUNCTION TEST()
  {
    ECHO "HELLO WORLD!\n";
```

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```
    }
    test();
?>
```

ANS:
*   HELLO WORLD!
        nothing
        its a compiler error, the code won't run
        hello world!

Question #14: Which of the following is the way to create comments in PHP?

ANS:
        // commented code to end of line
        /* commented code here */
        # commented code to end of line
*   all of the above

Question #15: What gets printed?

```
$var = 'false';
if ($var) {
   echo 'true';
} else {
   echo 'false';
}
```

ANS:
*   true
        false

Question #16: What will be the value of $var?

```
$var = 1 / 2;
```

ANS:
        0
*   0.5
        1

Question #17: How do we access the value of 'd' later?

```
$a = array(
   'a',
   3 => 'b',
   1 => 'c',
   'd'
);
```

ANS:
        $a[0]
        $a[1]
        $a[2]

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```
        $a[3]
*       $a[4]
```

Question #18: What will be printed?

```
$a = array();
if ($a == null) {
 echo 'true';
} else {
 echo 'false';
}
```

ANS:
```
*       true
        false
```

Question #19: What will be printed?

```
if ('2' == '02') {
 echo 'true';
} else {
 echo 'false';
}
```

ANS:
```
*       true
        false
```

Question #20: Which of the following is NOT a valid PHP comparison operator?

ANS:
```
        !=
        >=
*       <=>
        <>
        ===
```

Question #21: What will be printed?

```
$var = 'a';
$VAR = 'b';
echo "$var$VAR";
```

ANS:
```
        aa
        bb
*       ab
```

Question #1: When you're pattern matching, you describe the pattern using:

ANS:

A string in double quotes

A MySQL select statement

* A regular expression

A template

Question #2: Perl is:

ANS:

A type of interactive web page

* A programming language

An application program

A relational database

Question #3: The statement open (FH,"abc.txt");

ANS:

opens the file abc.txt for overwriting

* opens the file abc.txt for reading

contains an error, so won't compile

opens the file abc.txt for appending

Question #4: When you create a variable, you may assume it starts off containing:

ANS:

1

You may not make any assumption

The boolean value "false"

* A null string (or 0 arithmetically)

Question #5: Which of the following tests if the string held in $qn includes the word "perl"?

ANS:

if ($qn =~ /perl/) .....

* if ($qn == "perl") ....

if ($qn = "perl") .....

if ($qn eq "perl") .....

Question #6: Which of the following is NOT a comment line in a Perl program?

ANS:
This is a comment
#/
##
* //

Question #7: What is a File Handle used for?

ANS:
* Reading binary data from a file into a scalar variable
Finding where a file is on the disc
Accessing a disc file or other input/output stream
Deleting, moving or renaming a file

Question #8: The "%" operator returns:

ANS:
The larger of two numbers e.g. 200 % 20 would return 200
A percentage of a number e.g. 200 % 20 would return 40
* The remainder when one number is divided by another
The remainder when one number is divided by another e.g. 18 % 7 would return 5

Question #9: What is Perl?

ANS:
* Practical Extraction and Report Language
Practice for Exclusive and Report Language
Practical Extraction and Report Learning
Practical Exclusive and Report Language

Question #10: The getdir command

ANS:
Reads a single file name from an open directory handle.
Reads the rest of the file names from an open directory handle.
Only works after anopendir command.
* Is not a perl command.

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Question #11: The value of the expression $yards += 10

ANS:
is 10.
is true.
* cannot be determined from the information given.
relies on which command line arguments were used.

Question #12: Which of the following commands will turn a scalar ($str)into an array of characters?

ANS:
@a = split($str).
@a = split(/\s/, $str).
* This task can be done in Perl but none of the above commands do it.
@a = split(/./, $str).

Question #13: What will be printed by the code below?

my @a = (0, 1, 2);
my $b = @a;

print $b;

ANS:
        0
        1
        2
*   3
        0 1 2

Question #14: What gets printed by the following program?

my ($x) = foo();
print "$x\n";

sub foo {
  return wantarray ? 'list context' : 'scalar context';
}

ANS:
*   list context

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scalar context
          nothing

Question #15: What will be the value of $keys after execution of the following code?

my $var;

if (exists $var->{key1}->{key2}) {
   $var->{key1}->{key2} = 1;
}

my $keys = keys(%{$var});

ANS:
          undef
          0
*   1
          2
          code will fail

Question #16: What gets printed?

my $str = 'a\\b\n';

print $str;

ANS:
          ab(newline)
          a\b(newline)
*   a\b\n
          a\\b(newline)
          a\\b\n

Question #17: What gets printed?

my $a = 123;
my $b = 0123;

if ($a == $b) {
   print "same";
} else {
   print "different";
}

ANS:
        same
*   different
        the code is ill-formed

Question #18: What gets printed?

my $a = '123';
my $b = '0123';

if ($a == $b) {
   print "same";
} else {
   print "different";
}

ANS:
*   same
        different
        the code is ill-formed

Question #19: What will the @b array consist of?

my @a = (10, 5, 1);

my @b = sort @a;

ANS:
        (1, 5, 10)
        (10, 5, 1)
*   (1, 10, 5)
        (5, 10, 1)
        ()

Question #20: What will be printed?

my @a = (0, 1,);

print scalar(@a), "\n";

ANS:
        0

1
*   2
        3
        the code will fail

Question #21: How many key-value pairs will the hash contain?

my %hash = (
 [1, 2] => 1,
 [1, 2] => 2
);

ANS:
        1
*   2
        3
        4
        the code will fail

Question #22: Which of the following erases all entries in the %h hash?

ANS:
        undef %h;
        delete %h;
        %h = {};
*   %h = ();
        delete keys(%h);

My Nationality is: _____

1) The progress bar was informative.

Strongly Agree		Agree		Neither		Disagree		Strongly Disagree	

2) The progress bar should display progress over a series of lessons not just one.

Strongly Agree		Agree		Neither		Disagree		Strongly Disagree	

3) I liked the logo in the top left corner of the lesson.

Strongly Agree		Agree		Neither		Disagree		Strongly Disagree	

4) The 'See Also' panel contained enough useful information.

Strongly Agree		Agree		Neither		Disagree		Strongly Disagree	

5) The hierarchical structure of the Navigation menu was clear and easy to use.

Strongly Agree		Agree		Neither		Disagree		Strongly Disagree	

6) The hierarchical structure of the Navigation menu should be displayed has too many links (I prefer having the overview structure only, and navigating down from there myself).

Strongly Agree		Agree		Neither		Disagree		Strongly Disagree	

7) The link displaying information about local events is not needed.

Strongly Agree		Agree		Neither		Disagree		Strongly Disagree	

8) The 'Help' link (often found in the lower right corner of the content panel) is valuable.

Strongly Agree		Agree		Neither		Disagree		Strongly Disagree	

9) The 'Help' link (in the content panel) should be active on every page.

Strongly Agree		Agree		Neither		Disagree		Strongly Disagree	

10) Links to additional information should be present in the main text of the content panel (center). (I.e., I would like to see not only plain text, but also text with links in it).

Strongly Agree		Agree		Neither		Disagree		Strongly Disagree	

Comments:

12) My favourite aspects of this interface were (name at most three):

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                                          242
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13) My least favourite aspects of this interface were (name at most three):

14) Any other comments on the interface: