An Advisor System for Cultural Adaptation in Instructional Design

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Abstract. In an age of globalization, it is important to consider cultural variables in the instructional design process, but as [2], [3], [7] and [16] point out, too few tools and guidelines exist to assist instructional designers in this task. Also, as pointed out by [13], professors are not always aware or even informed of the existence of cultural variables in pedagogical practices. We used a Design-based Research (DBR) iterative approach to identify cultural variables in the instructional design professional culture and we modeled knowledge regarding these variables via a formal ontology on the basis of which we created a "Cultural Diversity" knowledge base. Our "Cultural Diversity" knowledge base brings together knowledge regarding five cultures. Our advisor system, through an executable assistance process for cultural adaptation, uses this knowledge to advise the instructional designer, who then proceeds to adapt a pedagogical scenario to a culture other than his or her own. In this article, we present the executable assistance process model which enables the staging of different software agents that advise the designer, who must carry out the cultural adaptation of his or her pedagogical scenario.

Keywords: Instructional Design, Cultural Variables, Advisor System, Ontology

1 Introduction

Distance education continues to this day to gain in popularity. A number of factors can account for this reality: 1) the growing need for continuing education; 2) the exponential increase in the number of learners with Internet access; and 3) the desire on the part of universities to reach a distant clientele with time constraints and to attract an international clientele. Students no longer limit themselves to the institutions in their countries and do not hesitate to study "abroad" while remaining in the comfort of their homes. Professors also have a greater number of opportunities to give their courses to learners from a culture other than their own or than that of learners for whom their courses were originally designed.

These new contexts have given rise to new challenges. The resources used are not always adapted to the cultural realities of the learners for whom they are intended. As

pointed out by [13], professors are not always aware or even informed of the existence of cultural variables in educational practices. It is therefore important to consider cultural variables in the instructional design process, but as [2], [3], [7] and [16] point out, too few tools and guidelines exist to assist instructional designers in this task. We have identified seventeen variables that need to be considered in instructional design decisions when adapting a course (or pedagogical scenario) so that it may be offered to learners of a culture other than the one for which it was first planned.

2 Cultural Variables

In order to identify the cultural variables to consider when adapting a pedagogical scenario, we reviewed the literature and designed a web-based questionnaire that we had instructional designers from various countries complete. In all, sixty-six respondents from eleven countries have begun the questionnaire; fifty-five of them have completed it.

The literature review, conceptualization process and questionnaire response analysis allowed us to target variables that we have grouped into three major categories: Values, Common Practices and Human Interactions.

The Values category was inspired by the work of [4], [6] and [10] and consists of the following variables: relationship with authority, tolerance for uncertainty, individualism/collectivism, approach towards time. The other two categories were inspired by the work of [12]. The Common Practices category consists of the following variables: learning aims, lesson plan, rhythm of learning activities, learning situations, pedagogical communication, cooperation-collaboration, detailed feedback, summative evaluation methods, results interpretation. The Human Interactions category consists of the following: teacher's role, learner's role, reaching learning goals, available learning resources.

This work allowed us to develop a formal cultural variables ontology and a "Cultural Diversity" knowledge base, which brings together knowledge regarding five cultures: Quebec, Mauritius, France, Belgium and Gabon. To populate the knowledge base, we used the cultures for which a minimum of five respondents had completed the questionnaire.

The ontology, knowledge base and executable process were developed with the Tele-Learning Operating System (TELOS), presented by [8] and [9].

3 Tools Developed in the TELOS Environment

TELOS is a multi-agent system allowing various actors (computer engineer, technician, instructional designer, professor and learners) to interact in a homogenous environment adapted to the needs of each and covering the distance learning tools production chain. Within this chain, the designer uses the platform to design a formalized and executable pedagogical scenario and to implement all the resources that will allow the learners and the professor to apply the aforesaid scenario and to leave a product or learning trace. The central principle of TELOS is therefore the aggregation of

resources in an executable multi-agent scenario where the participants accomplish tasks by consulting and producing different types of resources.

TELOS consists of graphics or text editors developed in order to construct particular models: knowledge model, ontological model, scenario model (executable processes), competence editor. These different editors are based on a web interface and on the use and production of XML files. In this way, interoperability between the editors is ensured, and it is possible to make reference to an ontology or a competence referential in a scenario (executable processes) edited in TELOS. The TELOS ontology editor allows for XML files that meet OWL-DL international specifications to be imported and exported.

In TELOS, we first developed the cultural variables ontology on the basis of the variables that we identified and presented in Savard, Bourdeau and Paquette (2013). We then developed a formalized and executable assistance process for cultural adaptation (a TELOS scenario) intended for instructional designers who need to adapt their pedagogical scenario for learners from a new culture. This assistance process offers instructional designers various tasks that allow them to produce a pedagogical scenario adapted to the new culture. It encompasses different software agents that provide adaptation advice to the designer at predetermined times. These agents use the knowledge represented in the "Cultural Diversity" knowledge base, which is constructed on the basis of the cultural variables ontology. Figure 1 illustrates these tasks and the relationships between them.

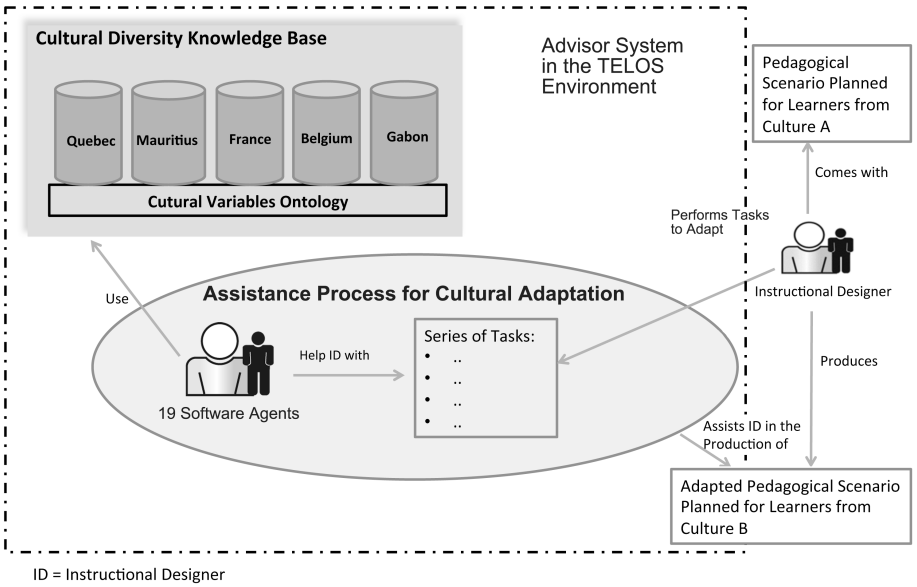

Fig. 1. The Assistance Process for Cultural Adaptation in the Advisor System in the TELOS Environment

In the following sections, we describe in greater detail each of these developments: the cultural variables ontology, the "Cultural Diversity" knowledge base, the assistance process for cultural adaptation tasks and the software agents.

4 Cultural Variables Ontology and "Cultural Diversity" Knowledge Base

The engineering work on the formal ontology alternated with the questionnaire design, the questionnaire response analysis and the variable identification. Following the identification and stabilization of the various concepts and their relationships, a more technical task consisted in making the ontology computer-interpretable by formalizing it as an OWL-DL domain ontology. This modeling work was validated on three occasions by a modeling expert.

All of the seventeen variables enumerated in Section 2 are represented in the formal ontology. As illustrated in Figure 1, it is on the basis of this ontology that the knowledge about each of the cultures is organized. All of the knowledge represented in this manner constitutes the "Cultural Diversity" knowledge base.

For each of the cultural variables rendered in the ontology, we depicted the possible values via instances, and we established a relationship with each of the cultures represented on the basis of the responses obtained in the web-based questionnaire. Figure 2 presents an example for the variable "learner's role", which we have limited to a comparison between two cultures: Mauritius and France. Of course, the data for the five cultures are always represented in the knowledge base.

Human Interactions (manifestation scheme)			
Variable	**Object**	**Attribute**	**Value**
Learner's Role	Mauritius Learner	Has role	Work in class Ask questions Discuss Suggest resources
	France Learner	Has role	Listen passively Work in class Discuss

Fig. 2. Example of an Object, Attribute and Value for the Variable "Learner's Role" from the Human Interactions Category

Figure 2 shows that differences exist between the roles of learners in Mauritius and those of learners in France. In Mauritius, learners are in the habit of asking questions and suggesting resources, whereas this is not the case in France. Furthermore, in France, learners are used to listening passively to their professor's lecture, unlike learners in Mauritius. The following sections explain how software agents are put to use in the cultural adaptation assistance process in order to highlight these differences and advise the designer on the adaptation strategies to adopt.

5 The Executable Assistance Process for Cultural Adaptation

In the assistance process for cultural adaptation that we have developed, the designer interacts with different software agents, including one specialized agent for each of the variables identified, which are the concepts of the ontology. The specialized agent advises the designer who needs to adapt to a new culture.

This process involves steps 2 to 5 in the method for cultural variable processing presented by [14], which consists of a total of seven steps:

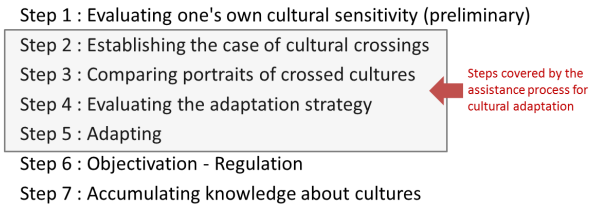

Fig. 3. Steps of the Cultural Adaptation Method Covered by the Assistance Process

Step 1 is considered as preliminary to the treatment of cultural variables and is completed for the time being with a questionnaire (external to the assistance process), adapted from the work of [11]. Steps 6 and 7 may be added to the system once we have implemented the prototype with a clientele of instructional designers in authentic situations. For the time being, the assistance process has been implemented in TELOS and has been tested on numerous occasions for steps 2 to 5.

The assistance process begins with an analysis phase during which the designer establishes a case of cultural crossing, compares the portraits of crossed cultures, outlines the scenario, if a pedagogical scenario is to be reused, and finally, evaluates the adaptation complexity of the scenario to be reused. By the end of the analysis, the designer will have received advice on the technical complexity and the pedagogical adaptation complexity from the software agents. For each of the two completed evaluation grids, technical and pedagogical, one of the following global adaptation strategies is suggested to the designer: translation-localization, contextualization, modularization or creation of a new pedagogical scenario (adapted from [2]). On the basis of this advice and the comparison of the portraits of the crossed cultures, the designer must decide whether to reuse the pedagogical scenario as is, adapt it or create a new one. Reusing a scenario as is represents the simplest use case, since it leads the designer directly to the end of the assistance process. Adaptation (Adapt) is the most complex case (Step 5 in the method presented in Figure 3). The creation (Create) of a new scenario may also prove to be complex if major differences exist between the two cultures. Creation and adaptation may both lead to the indexation (Index) of a scenario, which consists in describing the properties of the new scenario or the new version of the scenario modified on the basis of the cultural characteristics. Indexation is tied to the seventh and final step of the method illustrated in Figure 3.

All the comparisons (between the designer's culture and that of the learners whom the designer wishes to address, and between the portrait of the pedagogical scenario to

be reused and the culture of the learners to be addressed) are based on the concepts of the ontology (identified variables).

Figure 4 presents the interface offered by TELOS to the instructional designer or the professor (who is in the process of adapting a pedagogical scenario and who follows the designed executable assistance process).

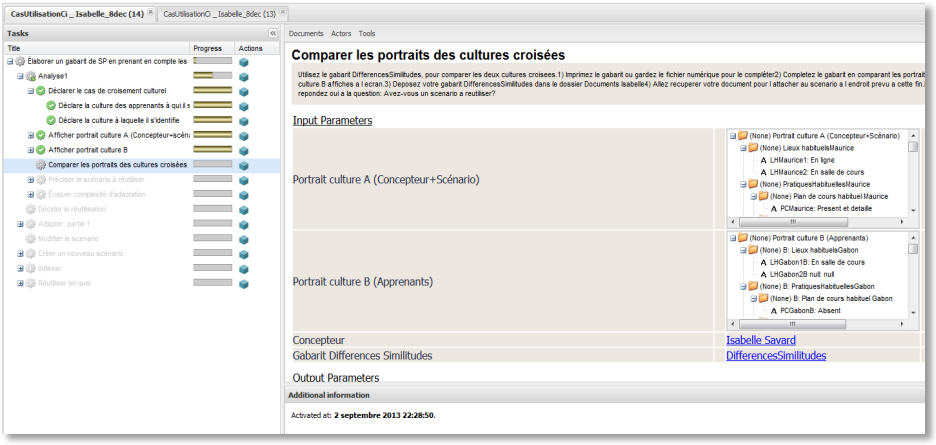

Fig. 4. Interface of the Instructional Designer in the Assistance Process for Cultural Adaptation in the TELOS Environment

The list of tasks that make up the assistance process and the progress bar for each of the tasks are given on the left-hand side of the screen. The bar indicates whether a task has been started, has been completed or is in the process of being competed. An example of a task that leads the designer to compare the portraits of the cultures involved is given on the right. The system uses the knowledge from the "Cultural Diversity" knowledge base to present the two portraits to the designer (Portrait A – designer's culture and Portrait B – learners' culture) so that he or she may compare them. The designer may highlight the similarities and differences in a comparison template provided to him or her. This information makes it possible for the designer to evaluate the adaptation complexity.

6 The Software Agents

Software agents capable of advising the designer are placed in strategic locations in the assistance process. All the software agents have specific responsibilities tied to each of the identified variables or to the evaluation of the pedagogical or technical adaptation complexity. Figure 5 illustrates one part of the assistance process for cultural adaptation in which collaboration between the designer and a software agent (here, the one who is responsible for adapting the summative evaluation methods) takes place in order to accomplish the task "Develop the adaptation strategy for the summative evaluation methods". This results in the associated adaptation strategy as the product, which marks the end of this part of the assistance process.

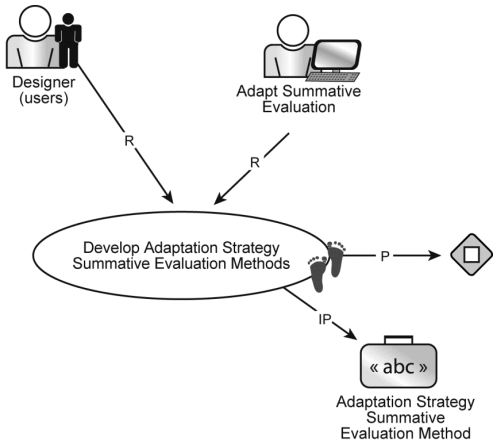

Fig. 5[1]**.** Collaboration between the Instructional Designer and the Software Agent Named "AdaptSummativeEvaluation"

Rules such as the ones presented in the table below, which concern the variable "responsibility for available resources", define each of these software agents. This variable is interested in the fact that in some cultures, learners are responsible for providing relevant resources (e.g., articles, videos, images, etc.), whereas in other cultures, this responsibility lies entirely with the professor, and the learners may be considered as relatively passive consumers.

[1] Figure 5 was designed using the TELOS scenario graphics language editor. The suitcase with the "abc" icon symbolizes a string (here, strategies adopted for the adaptation of the summative evaluation methods). The human figure icon symbolizes a human intervener (here, the designer) and the computer icon symbolizes a software agent (here, the one who is responsible for the summative evaluation methods). The oval shape symbolizes a process. An oval shape marked with small feet symbolizes an elementary human action.

Table 1. Example of Rules behind the Software Agent "Responsibility-Available Resources"

Use Case: Adapt: Adapting Human Interactions		
Agent: AdaptResponsibilities AvailableResources		
Name of the Rule	**If…**	**Then display…:**
AddResponsibili-tiesResources-Learner	ScenarioResponsibili-tiesForResources==Professor imposes a selection AND CultureBResponsibili-tiesForResources==Learner suggests resources	The learners whom you wish to address are in the habit of suggesting resources that they deem interesting or useful. We advise you to: 1) find out about the roles and responsibilities of professors and learners from colleagues who work there, 2) reflect on the advantages and disadvantages of allowing the learners to suggest resources and try to reach a compromise, 3) try allowing the learners to suggest resources that you can validate. You can let the learners know that you are not used to this practice, but that you are prepared to give it a try. If you insist on imposing your selection, clearly explain why you deem it to be indispensable.
DecreaseRespon-sibilitiesRe-sourcesLearner	ScenarioResponsibili-tiesForResources==Learner must contribute AND Role1LearnerCultureB!=Sug gest resources AND Role2LearnerCultureB!=Sug gest resources AND Role3LearnerCultureB!=Sug gest resources AND Role4LearnerCultureB!=Sug gest resources AND Role5LearnerCultureB	The learners whom you wish to address are not normally required to suggest resources, so you propose a scenario where they are required to do so. We advise you to make sure that they know how and where to look. If they do not, it is preferable to teach this first. If you do not have time to teach the basics of research, direct the students to resources that will assist them in developing these skills. You can go slowly and ask for fewer resources in the beginning and later increase the level of involvement on the part of the students. You can also begin by suggesting a variety of resources to them and asking them to select the most useful ones for them from your suggestions.

In all, there are nineteen software agents totaling over one hundred rules, such as those given in Table 1. Various pieces of advice may be displayed to the instructional designer according to the rule or rules applied and on the basis of the variables identified as requiring adaptation during the evaluation phase of the adaptation process. Figure 6 presents an example of advice displayed for the designer.

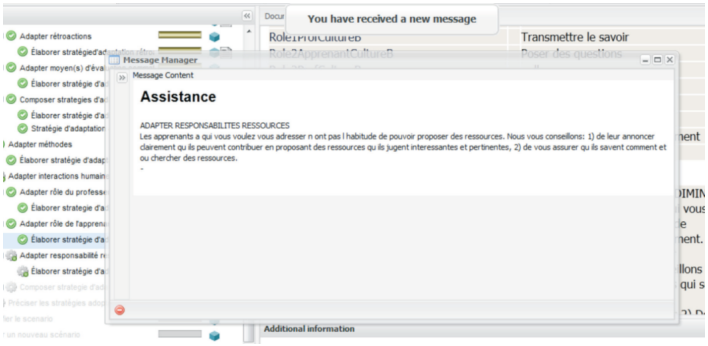

Fig. 6. Advice Displayed by a Software Agent in TELOS

The designer must then decide whether to accept the advice, reject it or complete it. This decision must take the form of a character string placed in the space provided for this purpose in the TELOS environment. All the adopted adaptation strategies (characters strings) are compiled by the system to form a collection: the detailed and adopted strategies. This collection is then made available to the designer who uses it to modify his or her scenario.

Once the adapted scenario has been completed, the system requests that the designers store their adapted scenario in a resource repository. Finally, the designers must decide whether or not to index their adapted pedagogical scenario on the basis of the new cultural parameters. Indexing the scenarios on the basis of the cultural variables could facilitate the reuse of teaching and learning resources.

7 Conclusion

The variable identification is the outcome of a long and thorough reflective process that is well anchored in the literature, our review of which served for both the questionnaire design and the final selection of the variables. Countries were selected where the French language is spoken to better isolate cultural factors without adding linguistic differences. Genericity by superimposing the two factors would be the subject of another project. The limited number of questionnaire respondents made it impossible for us to establish clear and reliable portraits of the five represented cultures, but our response analysis allowed us to select certain variables and leave others out. We have therefore successfully targeted important variables. In a DBR approach, there is an assessment loop at each stage, not only at the end as in a sequential process. Thus, the different results (ontology, assistance process, etc.) of the thesis presented by [15] have been assessed. Other assessments may be considered with designers in authentic situations since we consider this prototype of an advisor system to be promising with modeling that could prove to be very useful to the designer who must adapt a pedagogical scenario to the needs of learners from another culture.

It could also be improved by relating it to work such as that of [1], which deals with a high-level ontology of culture, as well as that of [5], which examines an ontology of teaching and learning theories. Indeed, it could be interesting to develop specialized agents with the task of evaluating coherence in the scenarios. At this time, the agents that have been developed concentrate on cultural variables in instructional design and do not verify pedagogical coherence. As such, an entirely incoherent scenario could be developed without the designer's being warned. For example, an agent could intervene and comment on the incoherence of a scenario where the learner is required to be constantly active, but where the sole teaching method planned is the lecture.

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