Design of an Intelligent Agent for Personalization of Moodle's Contents

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Abstract. This paper presents the architecture of an Intelligent Learning Management System (ILMS) applied to Moodle. In particular, we present the design and implementation of an agent that select the teaching strategy according to the student's learning style. The chosen teaching strategy is used to filter the learning objects that are displayed to the students.

Keywords: Intelligent Learning Management System, teaching strategy, learning style, personalization content.

1 Introduction

Today, it is clear that in the universities and schools has increased the use of information and communication technology in the process of teaching and learning. This has led to the creation of Intelligent Tutoring Systems (ITS). An ITS is a software system that aims to guide students in their learning and/or training process in a personalized way. To achieve its objective, the ITS should model the teaching process, the expert's knowledge, the student understanding on that domain, and achieve communication between these elements. However, most of these systems are not designed to show to the students the materials according to their preferences, and neither are designed to diagnose whether the student has developed the competences of the subject that will be taught. One exception is the architecture proposed by [1], which integrate the concept of *learning styles*, as well as *competency-based education* in the basic architecture of an ITS.

Also, there are other systems called Learning Management Systems (LMS), which are platforms where teachers can create and manage courses. However, according to [2], these systems don't allow the learner to get a personalized learning experience. Considering this problem, this paper apply the ITS architecture proposed by [1] to create an Intelligent Learning Management System (ILMS) applied to the LMS

Moodle [3]. This proposal seeks to enhance the features of Moodle and provides a personalized learning to the student. In particular, is presented the design and implementation of an intelligent agent that chooses a teaching strategy according to the student's learning style. This strategy will be used to select the content that will be displayed to the student.

This paper is structured as follows: section two describes the concepts related to learning styles. Section three presents the proposal architecture. Section four describes the design and implementation of intelligent agent. Section five presents conclusions.

2 Learning styles

According to [4], the idea that each person learns differently from others, allows to find most suitable ways to facilitate the learning, however, we must be careful of not to "label" the people, because the learning styles, although they are relatively stable, can change depending on the situation in which the person is.

In [4], defines the concept "learning style" to the fact that each person uses their own methods or strategies to learn. Although the strategies vary depending on what the person wants to learn, each person tends to develop certain preferences or global trends, trends that define their style of learning.

Table 1 shows some learning styles that have been considered in the implementation of tutoring systems to adapt their teaching environments to users.

Table 1. Learning styles implemented in ITS

Models of Learning styles	Works
Felder and Silverman model	Hernández [5], Caviedes [6], Cataldi [7]
Gardner's Multiple Intelligences	Cataldi [7]
VARK of Neil Fleming.	Araújo [8] and Peter [2]

In this work the VARK Model [9] was the learning style used and implemented in Moodle. This model is a tool to find out the preferences of persons when they process information. This model takes its name from the initials of the four learning styles that it considers: Visual, Aural, Read/Write and Kinesthetic. Table 2 shows some of the Neil Fleming's proposals for teaching-learning strategies for each learning style.

Table 2. Example of Teaching-learning strategies for the VARK model

Learning Style	Teaching-Learning Strategies
Visual	▪ Pictures, Videos and/or Posters.
Aural	▪ Discuss topics with your teachers. ▪ Explain new ideas to other people. ▪ Use a tape recorder.
Read / Write	▪ Dictionaries, Textbooks, Notes.
Kinesthetic	▪ Field tours. ▪ Applications. ▪ Trial and error.

The learning style is detected by a process that applies to the student a questionnaire to determine their dominant learning style, this process is described in [10].

3 Architecture

This section presents an Intelligent Learning Management System (ILMS) applied to the LMS Moodle based on the integration of the concept of *learning styles* and *competency-based education* in the basic architecture of an ITS (see Figure 1). The concept of learning style is implemented in the process called selector agent of teaching-learning strategies and the concept of competencies in the process called diagnostic of competencies. Both processes were integrated in the *tutor module*.
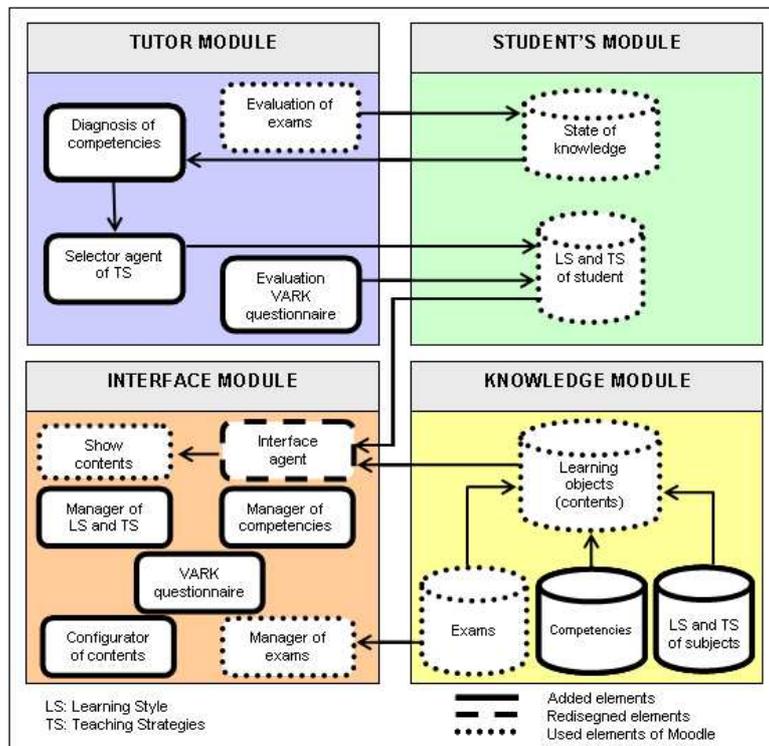

Figure 1. Architecture of an Intelligent Learning Management System

The modules of the architecture are related as follows, the *knowledge module* stores the contents to be taught, which are displayed via the *interface module*. The *interface module* displays the contents designed according to the learning style and the current teaching strategy for student, this information is consulted in the *student module*. The student module is updated by the tutor module, which is responsible for evaluating the performance of the student and to diagnosing the competencies that

students possess. If the student receives a diagnosis of unsatisfactory competence, the *tutor module* updates the teaching strategy and/or if necessary also the student's learning style, stored in *student module*, through the selector agent.

The execution of the selector agent depends on the result obtained by the process of diagnosis of competencies. That is, when a student does not meet the standard of competence established, the diagnostic process will execute selector agent. The purpose of the selector agent is to reinforce student learning, by selecting a teaching strategy that goes according to the current learning style of the student. When the teaching strategy is chosen, the interface agent uses this strategy to filter the learning objects developed for the current learning style and teaching strategy of the student that will be show. This paper only describes the design and implementation the selector agent.

4 Design and implementation of the selector agent in Moodle

The selector agent is responsible for selecting the teaching strategy according to the current learning style of the student, so that it is used to filter the learning objects that will be displayed to him. In the case where all teaching strategies related to the current learning style of the student have been used, the selector agent will be able to change the student's current style.

This change is performed according to the scores obtained by the student in the VARK questionnaire, choosing the next predominant learning style. When this action is performed on different occasions, there will present the case where all learning styles have been used, then the selector agent will assign as current learning style, the style with the highest score. After changing the current student's learning style, the agent chooses learning style according to it, assigning it as the current teaching strategy (see Figure 2).
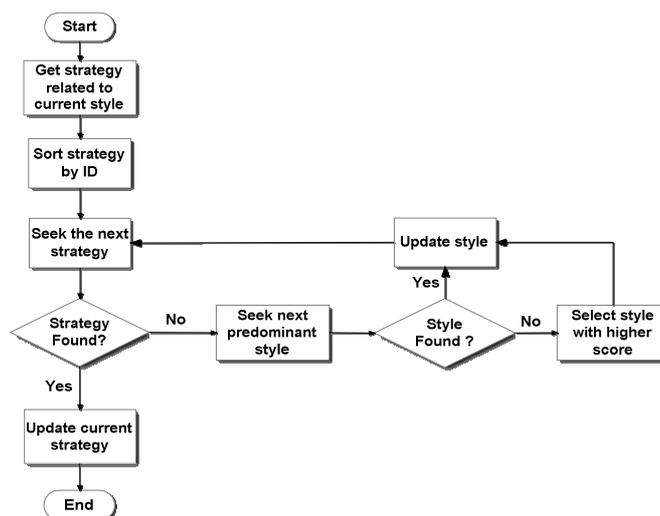
Figure 2. *Flowchart of the selector agent*

Below is presented the implementation of the selection agent in Moodle:

1. When the selector agent is executed, the first step is to perform a query to the database to get all teaching strategies that are related to the current learning style of the student. The current learning style of the student is loaded into memory in the object *$USER->Estiloactual*. When the query is performing, the strategies are ordered according to their identifier (see *Figure 3*).

```
$rs_Estrategia = get_recordset_sql("SELECT Distinct msee.EstrategiaId
                          FROM mdl_Scorms_ee msee, mdl_Estrategias me
                          WHERE (msee.EstrategiaId = me.Id) and
                                msee.CursoId = $Curso and
                                msee.EstiloId = $USER->Estiloactual
                          ORDER BY msee.EstrategiaId");
```

Figure 3. *Query to get teaching strategies*

2. Once obtained the strategies associated with student's current style, choose the strategy that has an ID greater than the ID of the current strategy. The current strategy ID is loaded into memory in the object *$USER->EstrategiaActual*. When a strategy satisfies this condition, it is set as the current strategy (see Figure 4).

```
while ($row = rs_fetch_next_record($rs_Estrategia)) {

    if ($USER->EstrategiaActual < $row->EstrategiaId){
        $estrategia_id = $row->EstrategiaId;
        $Encontrado = 1;

        break;
    }
}

rs_close($rs_Estrategia);
```

Figure 4. *Code to search the new teaching strategy.*

3. When a strategy that satisfies the condition is not found, means that all strategies have been used. So, the selector agent will be able to change the current learning style of the student, according to the scores obtained by the student in the VARK questionnaire, choosing the learning style that has the following lower score compared with the current style score.

4. Subsequent to the selection of the new style, we proceed to select the ID of the first strategy associated with the new style, which must being associated with some materials (see *Figure 5*). This strategy will be set as the current.

```
$estrategia_id = get_field_sql("SELECT Distinct msee.EstrategiaId
                               FROM mdl_Scorms_ee msee, mdl_Estrategias me
                               WHERE (msee.EstrategiaId = me.Id) and
                                       msee.CursoId = $Curso and
                                       msee.EstiloId = $estilo_id
                               ORDER BY msee.EstrategiaId");
```

Figure 5. *Code to select a teaching strategy related with the new learning style.*

5. After the selector agent made the change of learning style and/or teaching strategy, this information is updated in three different places: 1) in the *EstiloActual* and *EstrategiaActual* fields contained in the *mdl_user_info_data* table, 2) in the *mdl_historial_agenteselector* table which stores the history of changes realized by the selector agent in the style and strategy and 3) in memory the attributes *EstrategiaActual* and *EstiloActual* of the *$USER* object are updated.

With these three updates, ends the selector agent function, now, the next process is filtering the contents showing to the student through of the interface agent, considering that contents are designed for the current style and strategy for the student.

5. Conclusions

This paper describes the modifications made to basic architecture of an ITS incorporating the concept of learning styles and competency-based education. This architecture is applied to the LMS Moodle in order to create an Intelligent Learning Management System (ILMS).

In particular, we describe the design and implementation of the processing performed by the selector agent to choose a teaching strategy according to the student's learning style. Supporting with it the idea expressed in [3], which states that when students are taught according to their learning style, they learn more effectively.

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