SHAIEX: A web-based architecture for adaptive English learning

J. Enrique Agudo[1], Héctor Sánchez[1], A. Belén Cumbreño[2] and Mercedes Rico[2]
[1] *Departament of Computer Science,* [2] *Departament of English Language*
Universidad de Extremadura, Centro Universitario de Mérida , Santa Teresa de Jornet nº 38, Mérida, SPAIN

SHAIEX, a web based Educational Adaptive Hypermedia Systems, provides adaptation of the information presented to the student according to his objectives, interests and/or knowledge [1]. The information hyperspace of SHAIEx is structured using a "tasks and rules"-based architecture [2]. It is divided in tasks that students have to complete to achieve their objective. The tasks that a student can carry out are determined by the rules that are activated depending on the student's characteristics. In the user model associated to each student, the system stores the following user characteristics: level, knowledge, language and dexterity with the mouse. Difficulty and the use of textual information are features associated to each activity that depend on knowledge and the student level. Therefore, SHAIEx enables the appropriate tasks to a student depending on what rules are activated according to the student user model. When the student selects a task, SHAIEx builds it dynamically choosing the best multimedia elements according to the student's characteristics from the pedagogical domain database. Finally, the dynamically generated task is presented to the student.

Most adaptive hypermedia systems base their content in textual information because they are addressed to adult users. In our case, the users are children (3 to 6 years). At this early age, children do not have reading and/or writing skills so the multimedia content plays a leading role and adapting it to the user's characteristics is pedagogically beneficial.

In this work we describe SHAIEx architecture, a platform for language learning that personalises both the content and the navigation to each student improving thus the learning process.

Keywords: Adaptive Hypermedia Systems, English Learning, web-based systems, preschool learning, ICTs.

1 INTRODUCTION

Based on the assumption that educational software addressed to Primary school learners must comprise a set of features to encourage children's creativity and development, factors relevant to our study could be summarized as follows:

- Educational software must be open and exploratory to increase children creativity, and to allow them to choose and control the activity until completion [3]. Educational games enhance motivation and commitment, which are closely connected to challenge, fantasy, curiosity and control [4].
- Children show a higher interest in computers when using software that responds to real time interactions [5]. Multimedia content enhances learning and commitment [6] and attracts children's attention for longer periods of time [7].
- Appropriate educational software must have the capability to adapt the instructional presentation to the characteristics and progress of each child [8]. The didactic units, the interface, the software structure and the vocabulary must be tailored to the age of the potential users [9].
- Educational software must adapt itself to the psychomotor skills of the children. Although the mouse seems to be the favourite device, [10], children should make a more effective and improved use as lessons progress. Once the mouse is controlled, further training should introduce young learners to the use of pressing buttons. Since "drag and drop" and "double click" are too complex actions at this age, they should be deferred till later stages to prevent children rejection [11].

In the light of these premises, we claim that an adaptive hypermedia system, such as the ongoing SHAIEx project, could adapt to the main features of educational software for young learners and influence the learning of a second language at early ages. In this paper we describe both the SHAIEx adaptation process and its architecture as a platform for language learning.

[1] J. Enrique Agudo. Centro Universitario de Mérida , Santa Teresa de Jornet nº 38, Mérida, SPAIN. jeagudo@unex.es. http://gexcall.unex.es

2 ADAPTATION

Our system provides adaptation [12] of the information presented to the student according to the following user's features:

- **Educational level**: Based on the curriculum for infantile education.
- **Knowledge**: The contents will adapt as the child progresses.
- **Dexterity with the mouse**: We will adapt the mouse interaction style in the activities and games to the dexterity they have using it. This feature can be assessed by examining the speed at which children execute the operation, the number of mistakes they make and how comfortable children feel while using the mouse [13].
- **Language**: We will allow the inclusion of other languages (French, Spanish, etc.) that the children can learn in the school.
- **Difficulty of the activities**: The complexity of the activities and games will be adapted.
- **Textual information**: We may, or may not, include a textual label according to their level.

These features set up the user model. It allows adaptive navigation support, adaptive presentation [1] and adaptive interaction according to the users features. The children's educational level and knowledge are used to provide adaptive navigation support and determine the right learning way. For adaptive presentation we use the language, the difficulty, the textual information and also the educational level that we will be kept in mind when presenting the contents. And last, we use the dexterity with the mouse to provide adaptive interaction, the activities they will be able to do with click, double click, drag & drop, etc. depending on the user's dexterities.

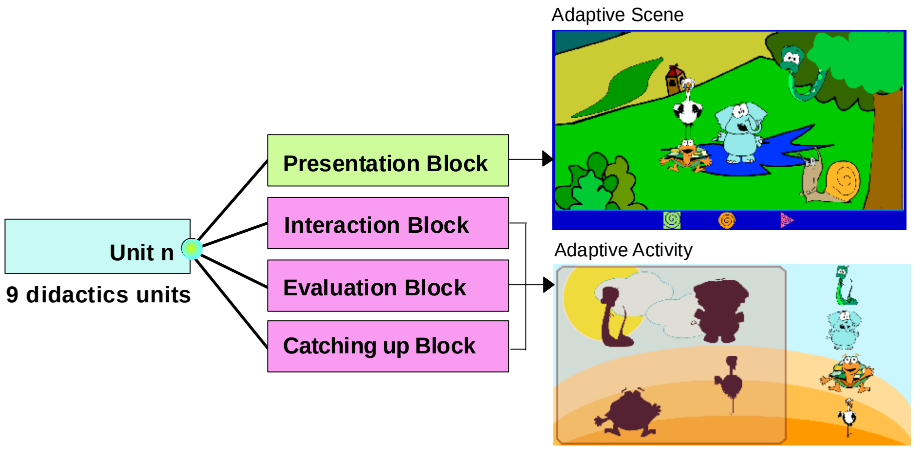

Fig. 1. Pedagogic domain structure

We implement the adaptation throw the adaptive scenes, adaptive activities and structure rules [14]. By means of the structure rules we divide the pedagogic domain in didactics units, each didactic unit includes four blocks of activities: presentation, interaction, evaluation and catching up (Figure 1).

- The first block is aimed at familiarizing learners with word association and vocabulary acquisition by interactive means.
- The second block is designed to consolidate concepts and linguistic content by means of interactive games.
- The third part evaluates the acquired knowledge. The teaching blocks are orderly presented to the user according to specific teaching rules. So, before accessing the evaluation block, input and interaction blocks should have been successfully achieved.
- The fourth block will be presented to the student only when the evaluation block has not been achieved or for revision purposes.

Each block includes one or more activity scenes (tasks), which are educational games that children must complete and/or pass. We use adaptive scenes and adaptive activities to implement these tasks. The adaptive scenes will present the content depending on the educational level of each child and the target language used. As you can see in figure 2, the appearance or not of the different characters, the textual information and the associated dialogues are described in the table shown. For level 1 character 1 and 2 will appear saying only their names. For level 2 characters1, 2 and 3 will appear and saying this time their names and the animal type they are. Finally, in level 3 all the characters will appear telling us their names and nationalities. The textual information only appears for level 3.

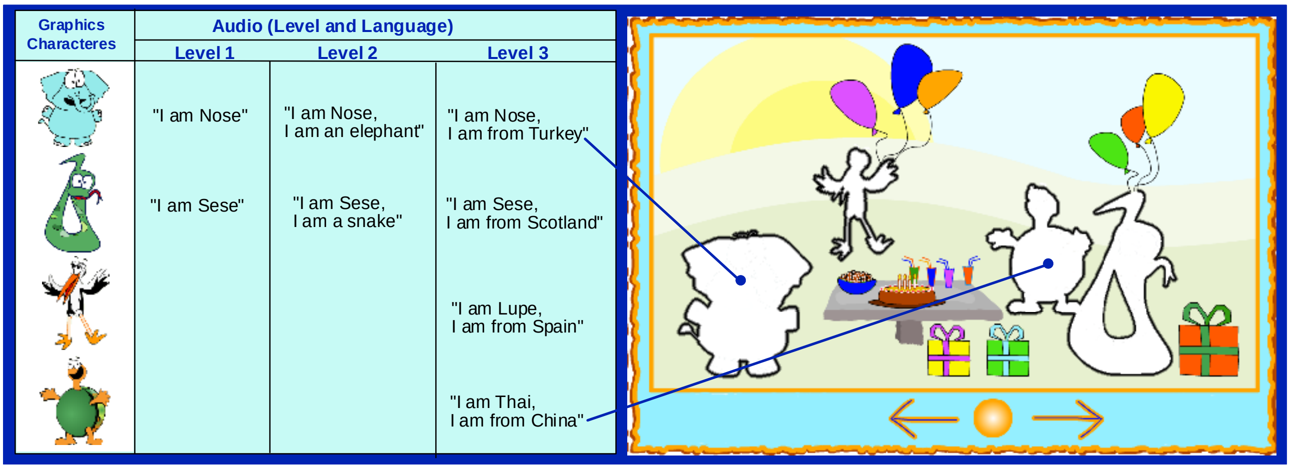

Fig. 2. Adaptive scene.

The adaptive activities, on the other hand, take into account the educational level, the interaction level (that is, the interaction with the Mouse), and the target language.

The difficulty and the mouse interaction style of the activities will be adapted to the educational level and psychomotor skills. The location of the multimedia elements inside these activities is randomly determined to produce different variations. In the activity shown in figure 3, the child is asked to place the character in the corresponding shadow after listening to information and descriptive hints.

	Level 1	Level 2	Level 3
Mouse interaction style	One Click	Click move click	Drag and drop
Number of elements (difficulty)	Identify Characters	Identify Animals	Identify Countries
Objetives	3	4	5
Language	English	English	English
Text information	No	No	Yes

Fig. 3. Adaptive activity.

Likewise, the adaptation will be carried out according to different parameters: the number of characters, the audio information related to each character, showing the text information or not and the mouse interaction style.

The audio attached to each character depends on the language and educational level he/she has. For level 1 the character's name will be identified; for level two the animal type will be chosen and for level 3 the information to be identified is the character's origin. The textual information only appears for level 3. Finally, the way of carrying out the activity for each level of dexterity with the mouse will be also adapted (one click, click move click, drag and drop).

3 SHAIEx ARQUITECTURE

SHAIEx architecture (Figure 4) is divided into three different levels:

- The interface with the client which is executed in the web browser client
- The intelligent tutoring system which is executed in the Server
- The database which stores data (user's features, the unit and content, etc.) in the Server.

The user's interface is being implemented in Macromedia Flash, and is shown by a web browser. The system provides the adaptation in the server by means of Servlets that decide the best task that a student can carry out according to his/her user model. Finally, the tutor sends back the associated content to this task. The communication between the interface and the tutoring system is made by a XML file, which stores the activity and all the configuration variables.

The Intelligent Tutor is divided in four parts (Figure 4): Navigation Control, Task and Rules management, Student management and Content management. The Navigation Control allows the User interface to connect with the Intelligent tutor. The Task and Rules management consult the task and rules database to decide the next task to do according to the rules. The Student management handles the user model that stores the student's characteristics. Finally, the Content management builds the next activity and looks up in the pedagogic domain where the information about each task is stored.

The database stores task and rules, user model and pedagogic domain. The task and rules database stores the structure of the knowledge divided in different tasks. These tasks are linked by means of rules that describe the different ways for each student. The user model database stores the student features and the progress of the children. Lastly, the pedagogic domain stores the content of the didactics units.

Now we will describe the process of adaptation. When the student finishes an adaptive activity, the interface sends to the intelligent tutor the student identification and the results of this activity. The navigation control sends this information to the student management to stores it in the user model.

Then the navigation control asks for the next task to the task and rules management. This module looks the user model up through the student management and the task and rules database to decide which task or tasks are most appropriate according to the student features and knowledge structure. Finally, the task and rules management returns the next task that the user must complete. The navigation control asks the content management for the content of this task and looks for it in the pedagogic domain and builds dynamically the activity with the content and interaction style according to this task and student features.

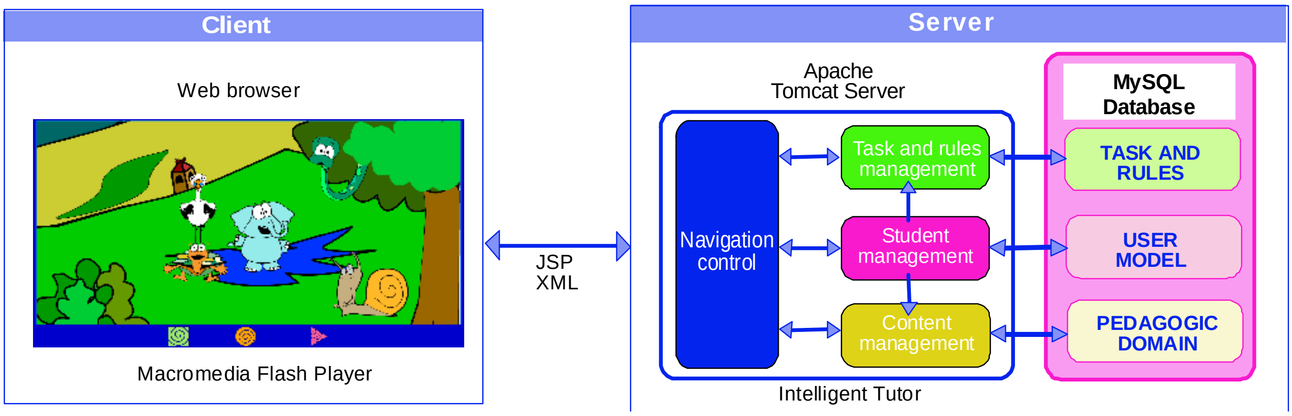

Fig. 4. SHAIEx Arquitecture

If the task and rules management returns more than one tasks, the navigation control builds a scene with a menu with the possible task that the student can face. Once the student chooses one, the navigation control consults the content of this task with the content management and returns the corresponding activity.

4 CONCLUSIONS

Based on the potential advantages derived from the positive attitude children show to learning foreign languages, SHAIEx aims to design and develop a web-based educational AHS to enhance language learning at early ages by means of individualised tasks and the potential of its multisensorial richness. SHAIEx can provide adaptation in different areas: knowledge, educational level and dexterity with the mouse, consequently achieving the adaptation and necessary motivation so that the preschool children can get the highest benefits from the learning process.

Regarding the web-based architecture of SHAIEx it is divided into three different levels: the interface with the client, which is executed in the web browser client, the tutoring system, which is executed in the Server, and finally the database, which stores data (user's features, the unit and content, etc.). This architecture allows SHAIEx to scale to others educational levels and centralize the adaptation process. Also it makes it possible to analyze the learning process, the uses of ICTs at early ages and the power of SHAIEx as an educational tool.

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