CAMELL
Towards a Ubiquitous Multilingual e-Learning System

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Abstract: This paper describes a ubiquitous e-learning tutoring system for multiple language learning. It is a post-desktop model of human-computer interaction in which students "naturally" interact with the system in order to get used to electronically supported computer-based learning. The system presents advances in user modeling and user interface design. Furthermore, the main focus of the tutor is on the student's error diagnosis process, which is performed by the student modeling component. Whenever a student types a solution for an exercise, the system's reasoning mechanism examines the correctness of the student's answer. If the student's answer is erroneous, the system records it and attempts to diagnose the nature of the error. The system holds a student model, namely it keeps a profile of every student, and provides individualized help concerning performance and error diagnosis for three languages. In addition, the errors that originated from language confusion are a matter that is deeply examined.

1 INTRODUCTION

Learning several languages is becoming a worldwide necessity. Especially, considering the fact that some languages are not widely used, students have to learn at least two foreign languages at primary school, one of which is English (Kurata N., 2010). Furthermore, there is an increasing interest in the use of computer-assisted language instruction, especially in cases where the language to be taught is not the students' mother tongue (Kunichike et al, 1998).

The design of Intelligent Tutoring Systems (ITS) is founded on two fundamental assumptions about learning (Ferreira and Atkinson, 2009). First, individualized instruction by a competent tutor is far superior to the classroom style because both the content and the style of the instruction can be continuously adapted to best meet the needs of the situation. Secondly, students learn better in situations which more closely approximate the situations in which they will use their knowledge. Furthermore, according to Ditcharoen et al (2010), computer-assisted language learning (CALL) can better serve the individual needs and is able to capture and analyze the learner's performance during the learning process, and return feedback to the learner. Hence, students have greater opportunities to learn a foreign language, using an ITS than being in a traditional classroom. However, the need of multiple language learning is not depicted in current scientific efforts, as the scientific literature is orientated to single language learning. However, facing reality in our own country gave the authors the stimulus to conform to these developments.

In view of the above, we have developed a sophisticated tutoring system that has been based on the architecture of Intelligent Tutoring Systems (ITSs). The system combines interactivity and adaptivity to individual students needs, along with multiple language learning, that is English, French and German learning. The resulting system is called CAMELL and is an abbreviation of Computer-Assisted Multilingual E-Language Learning. CAMELL includes all the standard attributes of an ITS and complies with its architecture, which consists of the domain knowledge, the student modeler, the advice generator and the user interface (Wenger, 1987). A novelty of the system lies in the multilingual component and in the error diagnosis process, which is carried out through the languages.

The existence of three different languages is not a way of separate learning in the same system. The system provides estimation of the learner's

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proficiency in the domain as well as his/her proneness to commit errors. The facility of individualized error diagnosis is particularly important for students, who can benefit from advice tailored to their problems (Virvou et al, 2000).

2 RELATED WORK

Teaching languages through computer-assisted approaches is quite significant and a wide range of computer scientists has been attracted over the last decades. After a thorough investigation in the related scientific literature, we found a large amount of works, concerning language systems, which have large linguistic coverage, but limited error analysis procedures or vice versa.

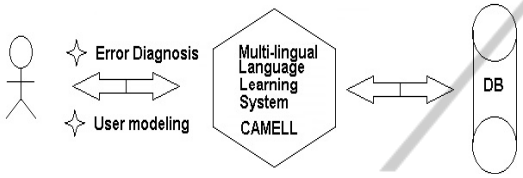

Figure 1: The CAMELL system and its basic components.

AutoTutor is a system, developed by Graesser et al (2005), which simulates a human tutor by promoting the conversation and provides feedback to the learner, pumps him/her for more information, gives hints, fills missing information with assertions, identifies and corrects bad answers, answers learner's questions and summarizes answers. Scooter the Tutor, developed by Baker et al (2006), is a system which gives a gaming student supplementary exercises focused on exactly the material the student bypassed by gaming, and also expresses negative emotion to gaming students through an animated agent. Another computer-assisted language learning system is rEcho, developed by Zhou et al (2007), which can give relevance feedbacks through anatomy animation and is based on deliberate data trained recognition to give error trend relevant feedbacks. SignMT was implemented by Ditcharoen et al (2010) to translate sentences/phrases from different sources in four steps, which are word transformation, word constraint, word addiction and word ordering. Another computer-based program on second language acquisition is Diglot Reader, which was developed by Christensen et al (2007) and is used in a way that students may read a native language text with second language vocabulary and grammatical structures increasingly embedded within the text. TAGARELA is an individualized instruction program, implemented by Amaral et al (2007), which analyzes student input for different activities and provides individual feedback. Finally, VIRGE, developed by Katsionis and Virvou (2008), works as asn adventure virtual reality game but it has educational content as well and supports personalized learning based on a student modeling component.

However, after a thorough investigation in the related scientific literature, we came up with the result that teaching multiple languages through an integrated tutoring system is an approach that was not investigated before. For this reason, we implemented the CAMELL prototype system, which incorporates user modeling and error diagnosis components, while teaching three different languages, namely, English, German and French.

3 ARCHITECTURE OF THE CAMELL

The architecture of CAMELL follows the main line of Intelligent Tutoring Systems (ITS) architectures. The major functional components of an ITS architecture are the domain knowledge, the student modeler, the advice generator and the user Interface (Wenger, 1987). In this section, we will briefly describe each one of these components, except the student modeler which will be described in the next section, so as to give in detail the effective operation and interoperability of our system.

The domain knowledge of the CAMELL system consists of three languages, which are English, French and German. For each one of these languages the system follows the same logical structure. This structure includes five novice level lessons for beginner students. The first lesson is the learning of the alphabet of the corresponding language. The alphabet is given both in capital letters and in minuscules. The second lesson encompasses the learning of months and days, along with their pronunciation. The third lesson encompasses the genders and the articles, so as to render the students capable of mastering these subjects. The fourth lesson describes in detail the personal and the possessive pronouns. The final lesson familiarizes students with the verbs "to be" and "have", as main verbs. An important issue considering these lessons is that the there is a multiple-choice test for each one of the three last lessons, so that the students get evaluated and examined concerning their knowledge and comprehension of the previous lessons. If the students are not found to be adequately prepared to

go on to the next lesson, they have to study again the relative theory. We used multiple-choice exercises to evaluate their performance, as they provided us with the ability to measure the students' achievements.

Moreover, the user interface is very significant in educational applications, because it can stimulate the student's interest in learning (Virvou et al, 2000). The main goal of interaction between a human and a machine at the user interface is the effective operation and control of the machine, and the feedback from the machine, which aids the operator in making operational decisions. This goal is adequately accomplished in our system. Finally, the friendliness of the user interface of the CAMELL system is achieved by using, colors, animations and images, so that it can attract the student's interest in the subject. In section 7, we made an effort to break up this complex application into simple, discrete pieces that can be individually studied, so as to advance the readability and reusability of our system. Hence, we used UML, which offers a standard way to visualize our system's architectural blueprints.

4 OVERVIEW OF THE SYSTEM

CAMELL is a multiple language learning system, which incorporates the learning of three languages and offers "communication" between them. Entering the main page of the application, the student is asked to choose the language that s/he wants to learn. By choosing the language of his/her interest, the user has to give his/her credentials in order to log in and start the lessons.

After the successful log-in of the user, the system follows two different approaches, according to the gender of the student. Apart from the student's gender, the system holds records considering each user's interaction, such as when and at which lesson a student has exited from the educational application. Hence, when a student logs in the system, s/he can resume the lesson that s/he was taught in his/her last visit. Accordingly, a new user will have to start from the first lesson and has no right to go on to the other lessons, if s/he does not accomplish it.

The student's card, which is illustrated in Figure 2, can be checked in every lesson and for every language of our application. It constitutes a user model through which the students' performance can be monitored for all the languages and whenever the student wants.

Figure 3 illustrates the categorization of the errors in the final test. The student can be evaluated and check where s/he is wrong and what type of mistake s/he has made, after s/he had filled in the gaps. The different colors indicate different type of errors. The red color in the field means error in articles or pronouns. The green color means a verb mistake. The yellow color means a spelling mistake. The blue color means confusion with the German language, while the purple means confusion with the English language. Finally, the grey color indicates an unanswered question. In the same time, the system shows grade of the student, along with the exact number of the errors in each category.

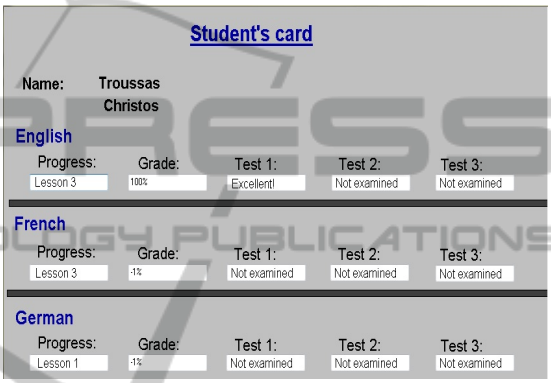

Figure 2: Student's card, which includes the student's profile.

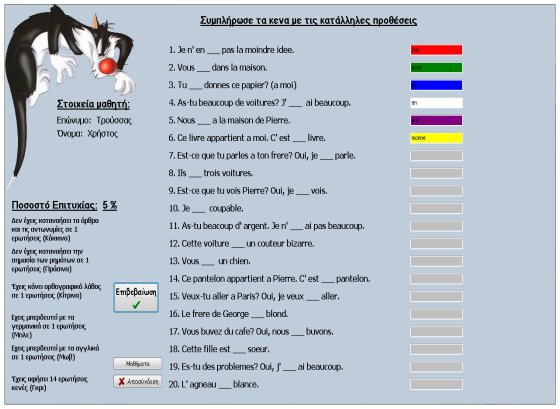

Figure 3: Error diagnosis progress in the final test.

The "communication" of the three languages of the system concerning the student's performance is quite noteworthy. Namely, the system can give advice to the user, as far as his/her performance in the other languages. This operation consists of a significant component of adaptivity, as the system can store each student's performance in the database and can give advice, when it is necessary.

5 STUDENT MODELING

Student modeling, as the model of a learner, represents the computer system's belief about the learner's knowledge. It is generally used in connection with applications computer-based instructional systems. Student modeling is crucial for an intelligent learning environment to be able to adapt to the needs and knowledge of individual students. Virvou et al (2000) support that the student modeler is responsible for preserving the system's estimation of the learner's proficiency in the domain as well as his/her proneness to commit errors.

CAMELL constructs a student model, which gives assistance to the learner, providing feedback or interprets for his/her behavior. One significant element is that before the student's starting a multiple-choice test in another language, the system informs him/her about his/her performance in the corresponding test of the lesson of the already taught language and gives him/her advice concerning the test s/he is about to do. Moreover, concerning the final test, the student modeler checks the student's answer and in case of an error and it performs error diagnosis. In this case, the system checks the complexion of the error and acts in a way that it will be described in the next section.

A matter of great importance is the existence of a long term user model for each student. The system includes also a form, which keeps information about the student's progress in the three languages, the total grade in each one of the three languages and all the results of the tests. Moreover, this form can be presented to students so that they stay aware of their advance of knowledge.

6 CONCLUSIONS

CAMELL is an educational application which combines the attractiveness and user-friendliness with individualized help that an ITS can provide. In particular, the system incorporates the student modeling component for each user and performs error diagnosis. Moreover, the system keeps each student's error history in one language that is already taught and then provides advice in the tests of the other languages. In order to perform error diagnosis, the system bears a detailed categorization of common student's mistakes. The error diagnosis process of the CAMELL system is especially focused on errors due to confusion of the other languages of the system, if the student learns more than on language at the same time. Furthermore, apart from the friendliness of the user interface, our system is oriented to offer adaptivity and dynamic individualization to each user that interacts with the application.

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