From MITO to SAMO: Evolution of an Educational Game for Spanish Orthography

Cristina Carmona, David Bueno
Universidad de Málaga, Departamento de Lenguajes y Ciencias de la Computación, Málaga, Spain
{cristina, bueno}@lcc.uma.es,

***Abstract*— An educational game is a recreational activity designed to teach people (typically children) about a certain subject, or to help them learn a skill as they play. These games are usually successful in capturing pupils' interest but sometimes fail to trigger learning. This paper briefly explains MITO, an educational game to teach Spanish orthography. The game is evaluated and authors look at the implications of the results of this evaluation in the design of SAMO, a second version of the same game which tries to overcome the main deficiencies identified in the evaluation process.**

***Index Terms*— Educational Games, Adaptive Systems, WWW.**

I. Introduction

Electronic educational games are learning and recreational environments that try to increase learner motivation by embedding pedagogical activities in highly enjoyable interactions. In [1], a review of the literature on the effectiveness of games versus traditional classroom instruction is made. By analyzing 68 studies from 1963-1991 in social sciences, mathematics, language arts, logic, physics and biology, it was determined that games were more effective in the domains of language, arts and mathematics. The reason is that, in these fields, contents are more specific and more effective use of computers created a clear advantage for the exercises over traditional teaching methods. Furthermore, greater retention was shown in games, and students reported greater interest in these activities than in more conventional classroom instruction. However, there is little empirical evidence that electronic educational games can promote learning unless the interaction is led by teachers and integrated with other instructional activities [2]. One possible reason for this limitation is that learning how to play does not necessarily imply learning the domain [3].

Another important point that must be taken into account is that the educational game should adapt the proposed activities to the learner's cognitive stage. Probably one of the most accurate and commonly used definitions of children cognitive stages is that defined by Piaget's theory of cognitive development [4][5]. The cognitive abilities that Piaget studied are important when teaching young students, as they help to determine how much and in what way students will understand the topic being taught.

II. Related work

Examples of educational systems designed for children and based on Piagetian stages of cognitive development are not easily found in research. One interesting work in this field is presented in [6]: an Intelligent Tutoring System (ITS) of Mixed numbers, fractions and decimals. In this ITS, intelligent hinting is used to try to help users by giving them only the information they need, according to their knowledge and Piaget stage.

Later on, the same authors presented in [7] an independent, adaptive, and easy-to-integrate web-based component to evaluate a student's cognitive development, which can be used as the pre-test to initialize the student model in any ITS This component was constructed by including existing test items [6] into the web-based adaptive testing system, SIETTE [8].

Nowadays, game developers are producing new games with some kind of instructional goal. For example, the "Big Brain Academy" or the "English Training" for Nintendo DS, or the "Spb Brain Evolution" for Pocket PC try to entertain and engage the user, but at the same time improve their capacities and skills, i.e., training the brain or learning English. Another interesting area of research is Epistemic Games [16], which as it says on their web page "develop computer games that can help students learn to think like engineers, urban planners, journalists, architects, and other innovative professionals, giving them the tools they need to survive in a changing world".

III. First Prototype: MITO

MITO[1] (which stands for Multimedia Intelligent Tutor of Orthography) is a stand-alone application focused on helping children aged between 8 and 12 years learn Spanish orthography [9]. The Orthography domain was chosen mainly for three reasons: a) correct writing is an essential ability during education and in many aspects of

[1] MITO is a tool designed with educational and non-commercial purposes. Installation files and instructions are accessible at http://www.lcc.uma.es/~cristina/mito.

working life; b) teaching orthography is challenging, because students usually find it very boring; and c) the existence of rules for Spanish orthography, make it suitable for being encoded into a computer system.

According to the American Heritage dictionary, the definition of the word orthography is:

- The art or study of correct spelling according to established usage.
- The aspect of language study concerned with letters and their sequences in words.
- A method of representing a language or the sounds of language by written symbols (spelling).

But in the case of Spanish, the word "orthography" has a different meaning. The definition of the "Real Academia de la Lengua Española" dictionary could be translated as follows:

- A set of rules that determine the writing of a language.

The most significant difference between English and Spanish orthography, is that, in the case of Spanish, there are rules that determine how words are spelt. Fortunately for our purposes, from the nearly 600 existing rules, there are only a few that are widely applicable, i.e. that cover many words and have few exceptions (for example, rules for accents).

In spite of the existence of these rules, learning Spanish orthography is not based on learning them, but in a mixture of exercising the visual memory and the fact that, unlike English, Spanish is a phonetic language (i.e., most words are pronounced as they are written) [14]. In MITO, orthography rules are not a learning goal in themselves, but provide support to users learning to spell words correctly. More specifically, rules are used in our system to group the exercises to be posed to the student.

As Fig. 1 shows, the contents in MITO are divided into four modules that aim to teach words corresponding to different sets of rules: a) Written accent rules; b) H, G and J rules; c) B, V, C, Z, D and Q rules; and d) M, N, Y, LL, R and RR rules. .

Fig. 1 Screenshot of the main menu

For each learner, MITO creates and maintains a simple student model which keeps a record of the number of correctly solved exercises for each module. At any time, the user can see his/her student model just by pressing the "*Ver resultados*" button. In order to achieve the learning goals established, MITO presents a series of features that have been designed to take good practice in educational games into account. Such good practice was identified in a literature review (for details see [9]), and it is represented here by keywords. Below is the list of the important features of MITO, together with the keywords that describe the good practices they intend to promote.

- At any time, the user can choose a different module (NAVIGATIONAL FREEDOM, INTERACTIVITY).
- Each exercise is explained briefly, but a more complete explanation can be shown on the request of the user (SIMPLICITY, ACCESSIBILITY).
- The user's answers are checked immediately (IMMEDIACY).
- Each group is divided into several different exercises (VARIETY) which become progressively more complicated (i.e., more difficult rules are applied) as the user correctly completes them (CHALLENGING). In order to demonstrate learning, the user must show knowledge of about between 90% and 100% of the module content (either by recalling the visual memory, or by direct application of the corresponding rules) to successfully finish it (LEARNING EFFECTIVENESS).
- The system has a help mechanism that explains the rules accurately and clearly. This help is context dependant and can be shown in response to the user request (SIMPLICITY, SUPPORT).

- Feedback is provided immediately (for both correct and incorrect answers) and is clear and brief. Orthography rules are used as the basis for explanations. (SUPPORT, IMMEDIACY).
- There are many multimedia elements (childish sounds, attractive pictures, etc.), in order to keep the user engaged. (MOTIVATION).
- As the user goes on with the game, his/her knowledge about the topic increases, and the system adaptively selects more difficult exercises. (ADAPTATION, CHALLENGING, WELL-STRUCTURED)
- The system keeps a simple student model which is updated immediately after solving each exercise. (OUTCOMES)
- At any moment, the user can see his/her student model. (OUTCOMES, ORIENTATION)
- Each time the user correctly solves an exercise, some points are awarded (REINFORCEMENT).
- MITO keeps record of a ranking, showing the score obtained by its registered users, which is available at any time. In this way, competition is used to keep children engaged and to motivate them. (MOTIVATION)

Fig. 2 shows a sample exercise in MITO. The relevant elements are (from left to right and from top to bottom): user name, exercise stem, points reached, motivational feedback, window of the exercise, motivational goal (in this case, Pluto must reach Mickey and each correct answer will move him one position forward), number of correct and incorrect answers and four buttons: main menu, show results, help, and how to play (this includes an extended game description). When the student selects a word in the exercise, the background is changed to green or red depending on the correctness of the answer, and a childish voice congratulates or scolds the action, while appropriate feedback is shown.

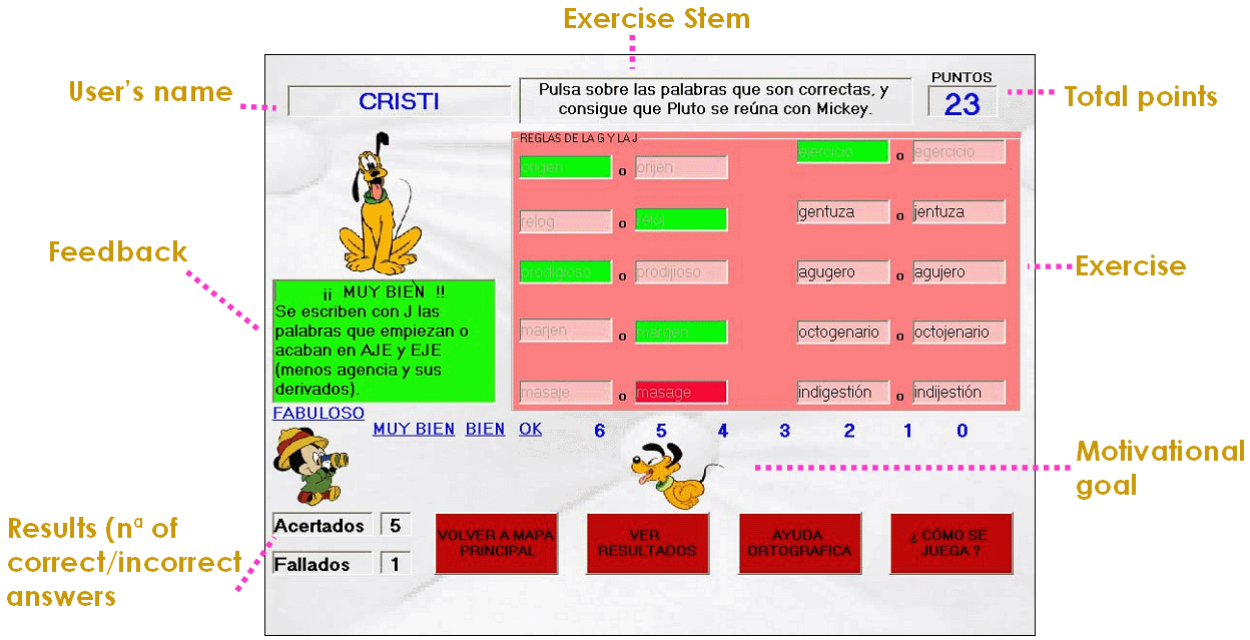

Fig. 2 Screenshot of an exercise

IV. EVALUATION OF MITO

An initial formative evaluation of the MITO system has been performed. This evaluation had two main goals: a) to determine the degree of acceptance of the game among the users it was aimed at, identifying relevant aspects that could improve learner motivation and b) to study the effectiveness of the game in helping children to learn orthography, identifying possible ways to improve the design and behavior of the system from an educational point of view.

Sixteen children from the school "CEIP Ricardo León" in Málaga took part in the experiment. The children were from 5th grade (10 years old) and used the game for 15 minutes. Before starting, they had to take a pre-test and after the game, the children answered a post-test. The tests are almost identical, both have 40 items that are grouped according to the rules applied: 5 items for the B, V rule; 5 items for de C, Z, D, Qu rule; 5 items for the I, Y, LL rule; 5 items for the M, N rule; 5 items for the R, RR rule; 5 items for the written accent rules; 5 items for the H rule; and 5 items for the G, J rule. Each item is a partially written word, and the student has to complete the missing letter. The post-test also has four questions (free text) about the game: a) Did you like the game?; b) Did you ask for help?; c) What did you like most?; and d) What did you like least?

While the children were playing, a human tutor observed their behaviour and assisted them when necessary (children had differentdegrees of computer literacy, so some of them needed more support than

others, though in general we found that the system was very easy to use and children only needed assistance at the very beginning).

Evaluation results can be summarized as follows (see [10] for details):

- Regarding the motivational aspects, the initial results have been very encouraging. Children really did become very engaged with the game. The features of the system that they liked best were the multimedia aspects, i.e., Disney©[2] characters and childish sounds (which fully fulfilled their goal of capturing children's attention). The fact that they could help their favorite character to reach a goal was also appreciated. But the most successful feature regarding motivation was the ranking, as the children did not want to stop playing until their name was the first on the list. However, sometimes this high engagement interfered with learning, as children wanted to play as quickly as possible and consequently only paid attention in order to obtain the points needed.
- Regarding the effectiveness of the game, Fig. 3 shows the number of mistakes made by the students in the pre and post-tests. As can be seen, after playing with the system, 8 students do better, 4 do worse and 4 stay the same, the mean rate of improvement/impairment being 5.3% and 5.6% respectively. Therefore, results suggest that 50% of the students learn, while the rest either do not learn (25%) or 'unlearn' (25%).

Learner ID	Pre-test	Post-test
1	13	14
2	7	10
3	10	10
4	13	11
5	6	5
6	8	10
7	11	11
8	11	11
9	15	12
10	7	5
11	7	6
12	10	13
13	2	2
14	18	14
15	7	6
16	14	12

Fig. 3 Nº of mistakes in the pre-test and post-test

However, we must recognize the limitations of this evaluation. One important factor in MITO is the shortness of the learning session, which makes it clearly insufficient to promote significant learning. However, this first evaluation has allowed us to clearly detect some areas for improvement, which will guide the design and implementation of a better prototype. We consider this step to be necessary before including the computer sessions in the regular lessons children receive, and before having the children use it more often and for longer periods.

V. Detecting Deficiencies in MITO

As previously mentioned, the results of the evaluation seem to show that, all together, students learn in the same measure that they 'unlearn'. In our opinion, the most plausible explanations for this are: a) the session was too short to change student's knowledge; and b) students did not show much interest when answering either the pre-tests or the post-tests (a fact which we had already learned from direct observation during the experiment).

The evaluation also showed some weaknesses of the system:

- Some of the exercises of MITO consist of students choosing between the correctly and incorrectly written words. Therefore, MITO shows incorrectly written words to students, and this has been shown to interfere with learning orthography as visual recall is an important factor in learning to spell correctly [14]. In this sense, exercises based on identifying orthographical mistakes must be given only to advanced students, because they may be inappropriate for students who still do not have correct visual representations of the words in their minds.
- The design of the system does not sufficiently encourage students to use feedback and help, both of which are designed to stimulate learning. We have learned that these facilities need to be redesigned so that they interfere as little as possible with the actual playing of the game. In this sense, we plan to use helping agents as in [11]. In the evaluation, the human tutor played this role with satisfactory results, which encourages us to pursue this approach.
- The architecture and the user modeling techniques used are too simple and therefore the adaptive capabilities need to be improved. Currently the system only stores the student score (number of correct words) in each game. The solution is clearly to implement a better user model. Based on this user model, students will be classified into categories and the adaptive capabilities will be improved, so for example exercises for identifying incorrectly spelt words will only be shown to advanced students.
- Finally, another important issue is that the evaluation plan needs to be redesigned so we can obtain significant conclusions in the summative evaluation. In order to obtain a more reliable assessment of the learning obtained, children need to take part in pre and post tests. One possible way to their cooperation is to include motivational aspects. To this end, both the pre and post-test will be incorporated into the game, and each correct answer will give the child points for the ranking, which in the evaluation was shown to be one of the main sources of motivation.

[2] Disney characters were taken from http://clipart.disneysites.com and are used in our application with no commercial purposes.

VI. PRESENT WORK: SAMO

A Introduction

The proposed exercises in MITO are similar to the exercises in the classroom: "apply the rules to write words correctly", but the daily work in the classroom shows that knowing the rules does not imply writing correctly. In [12], authors did a study with a basic vocabulary consisting of 674 words (those that students usually write incorrectly) to determine how many of them were covered by at least one of the aforementioned 600 existing rules, and they found that there were only 48 words out of the 674 covered. This confirms the fact that simply knowing the rules is not enough.

On the other hand, it is known that there is a very close relationship between orthography and visual memory. The study presented in [13] states that, in orthography, 83% is learnt visually, 11% is learnt by hearing, and only 6% is learnt using other senses.

So our view of how orthography should be taught is not based on learning the rules, but rather it is based on the ideas presented in [14], which we briefly explain below. For our purposes, orthography will be used as a synonym for "correctly spelling the words". Therefore our main goal will be to teach the strategies applied by good spellers. Solving exercises is not effective if the mental strategy is wrong, so it is fundamental to teach a mental process, which can be described as follows: when in doubt, good writers mentally search for the image of the word and try to visualize it. Good writing becomes then recalling the image of the word, previously stored in the mind. This visual recall of the word might be good enough to be sure of its correctness, but in some cases good writers clarify doubts by writing the word in different ways.

SAMO (which stands for Multimedia Adaptive System to teach Orthography, in Spanish: *Sistema Adaptativo Multimedia para la enseñanza de Ortografía*) is a new system that tries to apply these ideas and to fix the errors detected in the evaluation of MITO. To improve its availability, SAMO is being designed as an adaptive web-based game. Also, the new implementation will make SAMO *adaptable*, because the presentation of the exercises will be adapted to user preferences, and *adaptive*, because the content will be adapted to the user's knowledge (this will be dynamically inferred from the interaction of the system).

B. Teaching Methodology

When teaching orthography, the main goal is that students can correctly write every word they normally use and that they can correctly write new words they will learn in the future. This goal can be divided in several sub-goals, which are:

- Students must write according to established rules.
- Students must improve their memory, especially visual memory.
- Student must be able to generalize.

In order to learn Spanish orthography, the student must satisfy some conditions:

- Be advanced in Piaget's operational stage, (which is reached at about eight years old),
- Be able to write and read at a reasonable speed,
- Be aware of the existence of rules and exceptions,
- Be motivated to improve.

Until approximately 8 years of age, children write according to the sound of the word. Between 8 and 12 years old, children are able to store the vocabulary they normally use, but they cannot assimilate abstract knowledge (some rules and grammatical aspects), so it is recommended to teach only more general rules, i.e., those with no exceptions. From 12 years old, children can increase their vocabulary and also learn grammatical aspects that are directly related to orthography, for example: to distinguish "*de*" (preposition) from "*dé*" (verb).

SAMO organizes exercises in levels, and within each level from the easiest to the most difficult. Presentation is also adapted to student performance, so one student might finish the game faster than another, that is, some students may need more exercises than others to reach the same goal. In any case, all of them should reach the knowledge required for their level.

With respect to the learning goals, SAMO is intended to teach:

- *Visual strategies*, using exercises that are not specific to orthography, but help to improve visual memory.
- *Basic orthographic skills*, using those words that statistically generate a higher number of mistakes. In the follow sections, we will call the set of these words the *basic vocabulary*. In our case, the basic vocabulary includes 1000 words that will be incrementally added to the successive levels.
- *Basic rules*, studying only those rules that have many words and few exceptions.

Fig. 4 shows the goals for each level in SAMO. To incrementally build learning, each level can include exercises from previous levels.

Level 1:
- To practice writing and reading
- To improve the visual memory
- To begin with capital letters

Level 2:
- Using capital letters (after a full stop and in proper nouns)
- To practice the basic rules: C/Qu, G/Gu, R/RR, Z/C, M before B and P
- 50 words from the basic vocabulary

Level 3:
- Using capital letters: at the beginning of a writing, places, trademarks, and titles
- B+ consonant, words ending with ILLO/ILLA
- Written accent rules
- Words ending with T, D, Z and their plurals

- 100 new words from the basic vocabulary

Level 4:

- *Haber* (verb), ending imperfect preterit with ABA
- Families of words
- To split words according their syllables
- To split words with diphthong
- HUE/HIE
- HECHO/ECHO
- PORQUE/POR QUÉ/POR QUE
- EH/HE/E
- AH/HA/A
- 200 new words from the basic vocabulary

Level 5:

- Syllables with and without stress
- Diphthong and triphthong
- Written accent in words with final syllable stress, with second-to-last syllable stress and with third-to-last syllable stress
- Written accent in *qué*, *cuál*, *quién*, *dónde*, *cuándo*, *cuánto*, *adónde*
- Written accent in adverbs ending with MENTE
- Written accent in *sí*, *tú*, *mí*, *él*
- 300 new words from the basic vocabulary.

Level 6:

- Diacritical mark
- Homophonic words
- Abbreviations and acronyms
- 350 new words from the basic vocabulary

Fig. 4 Goals for each level

Fig. 4 shows the initial content for SAMO, but it will also include an authoring tool to allow the inclusion of new contents (words, rules or exercises) by parents and/or teachers. This authoring tool can be very useful if the teacher wants to add specific words in some domain, for example, for geometry we might want to add *polígono* (polygon), *hexágono* (hexagon), etc. These words will be used as the basic vocabulary.

As previously said, SAMO is a game, so exercises are disguised as missions the player must overcome to keep on playing. In this game, users can choose their level at the beginning:

- *Training level*, which will show visual memory exercises that will give the user some extra points.
- *Beginner level*, which will show exercises from levels 1 and 2.
- *Intermediate level*, which will show exercises from levels 3 and 4 (and include some from previous levels).
- *Advanced level*, which will show exercises from levels 5 and 6 (and include some from previous levels).

At the end of each level, the user must complete a final test, in order to complete the mission.

Although this teaching methodology is not very different from traditional methods, the distinctive feature is the way that SAMO teaches correct writing: the goal is not that students learn the rules by heart and then apply them to words, but to work with visual representations of words, storing them in the mind. By learning how to write words from the basic vocabulary, students reduce the number of mistakes. As explained in [15], there are five words that produce 10% of orthographic mistakes, so if students learn to write these 5 words correctly, they will improve by 10%. Similarly, learning a set of selected 15 and 67 words will produce improvements of 30% and 60%, respectively.

C. Design Process

The traditional ITS architecture is used to design the game. The three basic modules of this architecture are:

- *The domain model*, which stores the knowledge to be taught. In SAMO, the domain model contains the basic vocabulary and orthographic rules.
- *The student model*, which stores the knowledge level for each student. Obviously, the better the quality the student model is, the more effective the adaptive capabilities of the system. This model must be able to identify the student level (beginner, intermediate, advanced) and will be used to sequence the contents, that is, to establish the most suitable order for exercises and to select the words presented in each one.
- *Pedagogical module*, which has to decide both *what to teach* and *how to teach it*, using the information contained in the domain and student models.

Besides these three basic modules, SAMO will include a *help module* and an *exercise library*. The help module will be an intelligent agent able to provide support when necessary. The agent can act autonomously (at any time that the system detects that the student needs help) or on the request of the user. To increase student' motivation, the agent will be a character within the game, and will try to interfere with the gaming process as little as possible.

In the exercise library we plan to include templates, so that the same type of exercise can be used in different levels of the game just by using different words or rules. As mentioned before, an authoring tool will be developed so that teachers and/or parents can include new words or rules in the domain model and exercise templates in the exercise library.

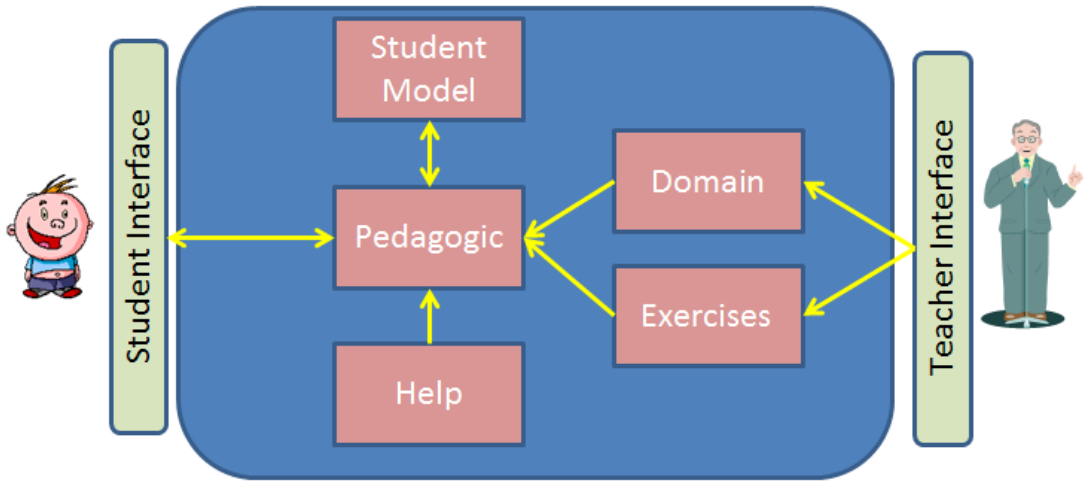

Fig. 5 SAMO basic architecture

The basic architecture for SAMO is shown in Fig. 5: using his/her interface, the teacher can access the domain model, to update words and rules, and the exercise library, to update exercise templates. The pedagogic module will use the information given by the domain model and the student model to select words and a template from the library. With this information the exercise shown to the student will be instantiated. During the exercise, the student may need some support, so the pedagogical module will use the help module. When the exercise has been completed, the pedagogic module will update the student model with the student results.

VII. Conclusion and Future Work

In this paper we have shown our approach to the difficult problem of teaching Spanish orthography. We have described our initial work on the educational game MITO which tried to teach orthography while engaging students in games. The evaluation of MITO showed that the system was more successful in generating student interest than in stimulating learning. Such results have led us to completely change the underlying learning philosophy and to design a new system called SAMO. SAMO will interact more with agents, and will teach and help students using interactions adapted to their specific knowledge level.

The experiment with MITO also showed that students showed little interest when answering either the pre-tests or the post-tests, so in SAMO these tests will be incorporated into the game.

Once this new prototype is fully operative, a more intensive and in-depth evaluation with real students will be performed in schools. This evaluation will allow us to determine if the new teaching strategies and motivation techniques in SAMO are as efficient as we expect.

But the final goal of our work is much more ambitious. With these studies we are using the Spanish orthography domain as a test-bed to identify the kind of interactions, strategies and features of an educational game that promote significant learning. Once such effective elements of the game have been identified, we plan to abstract them so that they can be included in a more general architecture thereby facilitating the implementation of effective educational games for different domains, which is our ultimate objective.

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References

[1] J.M. Randel, B.A. Morris, C.D. Wetzel, and B.V. Whitehill, "The Effectiveness of Games for Educational Purposes: A Review of Recent Research", *Simulation & Gaming 23*,pp. 261-276, 1992.

[2] M. Klawe, "When does the use of Computer Games and other Interactive Multimedia Software help students learn Mathematics?", *NCTM Standards 2000 Technology Conference*, Arlington, VA, USA, 1998.

[3] C. Conati and J.F. Lehman, "EFH-Soar: Modeling Education in Highly Interactive Microworlds", *Advances in Artificial Intelligence, Proceedings of the third Congress of the Italian Association for Artificial Intelligence*, AI-IA'93, pp. 47-58, 1993.

[4] J. Piaget, "How children form mathematical concepts", *Scientific American 189 (5)*, pp. 74-79, 1953.

[5] J. Piaget, "Piaget's Theory", *Carmichael's Manual of Child Psychology*, third edition, volume 1. New York: Wiley, 1970.

[6] I. Arroyo, J.E. Beck, K. Schultz and B.P. Woolf, "Piagetian Psychology in Intelligent Tutoring Systems", *Proceedings of the Ninth Artificial Intelligence in Education*, AIED'99. Le Mans, France, pp. 600-602, 1999.

[7] I. Arroyo, R. Conejo, E. Guzmán and B.P. Wolf, "An adaptive web-based component for cognitive ability estimation", *Proceedings of the Tenth International Conference on Artificial Intelligence in Education*, AIED 2001. San Antonio, TX., pp. 456-466, 2001.

[8] R. Conejo, E. Guzmán, E. Millán, M. Trella, J.L. Pérez-De-La-Cruz and A. Ríos, "SIETTE: A Web-Based Tool for Adaptive Testing", *International Journal of Artificial Intelligence in Education, 14*, pp. 29-61, 2004.
[9] E. Millán, C. Carmona, R. Sánchez and J.L. Pérez-De-La-Cruz, "MITO: an Educational System for Learning Spanish Orthography", *Workshop on Educational Games as Intelligent Learning Environments*, AIED'05, Amsterdam, The Netherlands,pp. 39-47, 2005.
[10] C. Carmona and E. Millán, "Implications of a Formative Evaluation for Improving the Educational Effectiveness of an Educational Game for Spanish Orthography", *The 6th IEEE International Conferences on Advanced Learning Technologies*, ICALT 2006, Kerkrade, The Netherlands, pp. 596-600, 2006.
[11] C. Conati and X. Zhao, "Building and evaluating an intelligent pedagogical agent to improve the effectiveness of an educational game", *Intelligent User Interfaces*, pp. 6-13, 2004.
[12] M.J. Esteve and J.M. Jiménez, "La disortografía en el aula", *Editorial Disgrafos*, Alicante, 1988.
[13] J. Mesanza, "Didáctica actualizada de la Ortografía", *Editorial Santillana*, 1987.
[14] D. Gabarró and C. Puigarnau, "Nuevas estrategias para la enseñanza de la Ortografía en el marco de la PNL", *Editorial Aljib*e, Archidona-Málaga, 1996.
[15] V. Barberá, "Cómo enseñar la ortografía a partir del vocabulario básico", *Ediciones CEAC*, Barcelona, 1988.
[16] D.W. Shaffer and J. P. Gee, "How Computer Games Help Children Learn", Palgrave Macmillan, 2006.

Cristina Carmona received her master degree in Computer Science from the University of Málaga in 1997. Currently she is a Ph.D. candidate at the department of Computer Science of the same University. She has been working some years developing medical software for the company Novasoft S.A. Currently her research interests are related to student modeling in ITS and in instructional games. She contributed in the organization of some conferences, like CAEPIA'97 and has published papers at different related conferences such as ICALT'06, AIED'05, UM20005 and AH'2004.

Dr. David Bueno obtained his Computer Engineering degree at the University of Málaga, Spain, in 1996 and his PhD. in Computer Science in 2003 at the same University. He has carried out several research stays in *l'Institut National de Recherche en Informatique et en Automatique* (INRIA), France. He is presently working as an Associate Professor in the Department of Computer Science at the University of Málaga. His research interests are related to user modeling, recommender systems, interactive TV and AI game research. He belongs to the Spanish Association of Artificial Intelligence (AEPIA) and to the User Modeling Organization (um.org) and has participated in the organization of different conferences as CAEPIA97, AH2002. He has also served as reviewer for different journals, like Web Intelligence and Agent Systems and conferences like ISDA, RAAW, CAEPIA, and AH, among others.