A SERIOUS GAME FOR SECOND LANGUAGE ACQUISITION

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Abstract: This paper describes an interactive learning system specifically designed for second language acquisition. In order to render the learning experience more fun, to engage the learner and to help him maintaining long-term motivation, the system was implemented as a 3D video game. It brings together the ability of virtual reality environments such as Second Life to reproduce immersive experiences and NLP language technology, thereby providing both situated learning and automatic authoring of training activities in context.

1 INTRODUCTION

Interactive or situated learning has been acknowledged as one of the main pedagogical principle in second language acquisition. Indeed, many observations substantiate the role of immersive environments in facilitating learning. It has been noticed (Krashen, 1997), for instance, that adult learners acquire a second language more easily and their knowledge is more anchored, if they are exposed during learning to situations similar to real life, like those that children experience by acquiring the first language and further, that (Rutherford, 1987) raising the awareness of the learner on the phenomena of the target language in context, i.e. by noticing or highlighting them in a particular situation, fosters learning.

In the last few years, there has been an increasing interest in the e-learning research community for gaming and simulation technology as they allow close reproductions of immersive experiences. The first experiments in language teaching go back to the 1990's when the first computer-aided learning software was produced on CD-ROM. *Escape From Planet Arizona*[1] and *Who is Oscar Lake*[2] for instance, are examples of those early language games created for learning En-

glish as a second language. These language games represent first attempts to integrate traditional learning content, i.e. vocabulary, grammar exercises, etc., in a situational context (an adventure story), thus producing in the learner an impression of immersive experience.

In the last decade, some research on computer aided second language acquisition has focused on using online 3D virtual reality environments and video game technology for teaching languages. This type of environment further promotes learning as a social experience allowing learners to practice active communication over the web by means of chatting, emails etc. Thethis (Segond et al., 2005) , for instance, implements a web application providing a learning software for the language training of hotel receptionists. The learner is exposed to similar situations as if he were in the reception of an hotel. He can interact both with virtual agents simulating telephone calls, hotel guests arriving, etc. by means of preset dialogues or with a human tutor or other learners by means of chatting. The main innovative aspect of Thethis is the social, communicative aspect of the learning platform which allows learners to share the learning experience with fellow students and tutors.

More recently, the 3D video game technology has been used in so called culturally-aware tutorial systems such as ATL (Raybourn et al., 2005), TLCTS (Johnson and Valente, 2009) and BiLAT (Kim et al., 2009) to train social cultural skills in a military sce-

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[1]Escape from Planet Arizona: An EF Multimedia Language Game. [Software]. (1995). Stockholm, Sweden: EF Education.

[2]Who is Oscar Lake: A Language Learning Adventure Game. (1995). Jersey COW Software.

nario. The learner acts as an avatar in the simulated environment and must provide natural language utterances and in some systems even gestures thereby learning not only grammar but also cultural skills of the target language/society.

In these systems however, the virtual world is used mainly as a mean to immerse the learner in a simulation of the societal and cultural world of the L2 language. The linguistic sophistication of the exercises remains limited covering, e.g. preset dialogs and simple language exercises such as vocabulary training or drills. Moreover, these exercises are hard coded and all the systems described above rely on human authoring for the learning content. Recently, some work has aimed at automatizing the generation of learning content and learning activities. Indeed, teachers very often lament the high expense on time to produce different learning activities. Examples of works in this direction are for instance, VISL (Bick, 2005), a visual interactive syntax learning tool accessible though the internet for learning the syntax of different languages and TAGARELLA (Amaral and Meurers, 2007), an intelligent web-based workbook for learning Portuguese and more recently WERTI[3], a prototype of a system for the automatic generating of exercises (Metcalf and Meurers, 2006) based on arbitrary web content selected by the learner.

I-FLEG, the language game presented in this paper, integrates both these research approaches and provides a situated language learning environment together with automatic generation of learning activities in context.

This paper is structured as follows. Section 2 describes the architecture of the language game I-FLEG and illustrates how learning activities are automatically generated in the context of the game. Section 3 concludes describing the preliminary evaluation of the system and discussing pointers for future research.

2 I-FLEG

I-FLEG is a prototype interactive 3D game for second language learning. To ensure portability to different platforms, the system is implemented in Java and uses Second Life[4] as a graphical interface. The system consists of a reasoning module that implements the game logic linked to a natural language generation module and to a database.

I-FLEG is a sort of an adventure game. Its goal is to teach vocabulary (on some specific topics such

as *house*, *food*, etc.) and some grammar features (e.g. prepositions, adjective morphology) to learners of a second language. The current implementation is addressed to a target audience including learners of French at A1-A2 levels, i.e. beginners and intermediate level learners. However, the modular architecture of the system allows to easily set it to another language. At present, the system also includes an English grammar and lexicon that can be used for training.

Following pedagogical approaches (Uhl-Chamot and O'Malley, 2009) that emphasized the importance of learner awareness of the acquired language skills during the learning process and the role of independent learning, in the game framework we adopt a free learning flow strategy and let the learner free to explore learning contents and to organize the learning process meeting his own individual needs.

2.1 Game Scenario

The game scenario is a house containing different rooms such as a living room, a kitchen, a library, etc. A first person perspective is used. The learner is an avatar that can freely move in the game world. He can interact with the physical objects of the virtual world by touching, moving or taking them. By doing so he learns their names and characteristics or triggers learning activities. The player communicates with the system by typing text in a chat box.

The game aspect is represented by the challenge the player has to master. Somewhere in the house, there are strange objects hidden, that are not part of the furniture. These objects when touched trigger learning activities, i.e. exercises. The player has a limited amount of time to find out where they are, touch them and solve the learning activities linked to them. By solving exercises the player earns credits points (the score). The game consists of different levels. Each level represents a language proficiency level in the second language (e.g. A1) and includes a set of training activities covering several teaching goals ranging over different grammar topics, e.i. vocabulary, syntax, morphology, etc. A level is complete when the learner has totalized the score that define the accomplishment of that language level.

2.2 Learner Model

The system monitors the user during the whole game session and maintains a learner model. After each game session, the interactions of the user with the system are stored in a database. The content of the database is retrieved each time the same user logs in

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[3]http://prospero.ling.ohio-state.edu/WERTi/

[4]http://secondlife.com/

Figure 1: Game scores examples from the demo session.

Player	Vocabulary Score	Syntax Score	Total Score	Start Time	End Time
AvatarT2	9	4	13	11:59:22	12:12:11
AvatarT4	3	2	5	11:40:35	11:53:45
AvatarT3	6	1	7	10:49:48	11:12:45
AvatarT1	14	8	22	11:12:01	11:36:01

the game. Before a new game starts, the results of the previous game are evaluated so that the level and type of new interactions depend on the evaluation of previous results.

In the prototype, a simplified model of learning performance is used based on scoring. The score is a structured datatype mapping learning performance to the credit points the learner has totalized in each training activity and to the time needed for the game session. Scoring is used both to evaluate the learning progress of the learner and to give him feedback. The total score is shown to the learner during the game as an immediate simplified form of feedback. Whereas at the end of the game, a more structured output is shown including the results achieved in each grammar field that has been trained.

2.3 Generation of Test Activities

I-FLEG supports the automatic authoring of test activities. As mentioned in Section 2.1, exercises are triggered by the learner interactions with the world. Whenever the learner touches a teaching object, an exercise is produced whose precise content depends on the learner profile (his level, his game score for each activity type) and on the teaching goals being pursued (e.g., teaching the passive form, the use of clitics or adjectival morphology). Importantly, the system is non-deterministic thereby supporting the production of varied output. That is, the same touching event might trigger different exercises.

This automation of learning material relies on a generation module which combines constraint driven content selection and surface realization. Starting from an ontology describing the content of the 3D world, the generation module first selects a set of facts (content selection) and then turns this set of facts into a sentence (surface realization). From this output sentence, the I-FLEG system will then derive a test item consisting of the exercise itself (e.g., a fill in the blank utterance) and its solution. More specifically, the generation of a test item is parametrized for

- Language Content: the syntactic form the output should have, e.g. a sentence, a noun phrase, etc.
- Semantic Content: the set of individuals the test item refers to, generally corresponds to the touched object.
- Teaching Goal: the linguistic topic which the test item should illustrate, e.g. adjective morphology.
- Type of Activity: the type of test item that should be generated, e.g. vocabulary, fill in the blank, scramble sentence, etc.

The generator then uses these parameters together with a grammar of the specified language to build all possible syntactic realizations (i.e. paraphrases) that satisfy the constraints above. At this point, only one of these realizations is selected by the system and used to instantiate the expected answer. This selection strategy ensures that repeated interactions with the same object can generate different test items.

Next, the test query is build from the expected answer on the basis of both the teaching goal and the required activity type. The test query is used as a training item to test the language knowledge of the learner. The generated expected answer is used to evaluate the answer of the learner and is sent as feedback by the system in case his answer is wrong.

Figure 2 for instance, shows the parameters sent to the generation module after the learner touched a table ($table_1$) together with the test item generated by the system for an exercise of type fill-in-the-blank focusing on adjective morphology.

Generation Parameters
Semantic Content = [$table_1$]
Language Content = *Sentence*
Teaching Goal = [ADJ_{morph}],
Type of Activity = $FILL\_IN\_THE\_BLANK$
Generates Test Item
Test_Query = "*C'est une table (blanc)* "
Expected_Answer = "*C'est une table blanche*"
Game Session
Please, complete the following sentence.
System: *C'est une table ... (blanc).*   User: *C'est une table blanc.*   System: *Non, c'est une table blanche.*

Figure 2: An example of automatic generated test item.

In the different levels of the game, language content and teaching goal are chosen to meet the language proficiency level of the learner. Therefore, the complexity of the generated test items depends on the

game level. For instance, after the user has touched the same table, the system outputs (1a) if the user is a beginner. However, if the learner is more advanced and the teaching goal is for instance, to teach pronouns the system outputs (1b).

(1) a. *C'est une table.*
         This is a table.

     b. *C'est une petite table. Elle est blanche.*
         This is a small table. It is white.

Figure 3: An example of tutorial interaction.

3 CONCLUSIONS

This paper presented I-FLEG, the prototype of an interactive language game specifically designed to foster second language acquisition. The game is integrated in Second Life and is accessible for everyone through the web. It brings together 3D graphics, virtual reality and NLP technologies thereby providing immersive, situated language learning and context-driven automatic generation of learning activities.

We conducted a preliminary evaluation of the game prototype during a demo session at our institution open house day. The game was set to train English and was presented to a general audience mostly composed by French speakers. The test participants played short game sessions including a tutorial, a vocabulary and a syntax test unit. We asked them to express their subjective opinion about the game. They found the learning platform very fun and natural to interact with. Further, most of them judged playing the game a very engaging and entertaining experience.

Despite the limited number of test participants (about 10 people) we believe the feedback we received is very encouraging.

In future work, we plan to improve the language learning system so to allow the automatic generation of learning activities for more complex language phenomena. Further, we want to formalize the process of evaluation of the learner output so to define more efficient ways to present feedback to learners.

Finally, we envisage a large-scale web-based evaluation of the system as well as a comparison of the efficiency of different teaching methodologies, such as for instance free vs. prescriptive learning flow.

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