GOBL: Games Online for Basic Language Learning

Helmer Strik1,2, Polina Drozdova1, Catia Cucchiarini1

1Centre for Language and Speech Technology, Radboud University, Nijmegen, the Netherlands  
2Department of Linguistics, Radboud University, Nijmegen, the Netherlands

w.strik@let.ru.nl, p.drozdova@let.ru.nl, c.cucchiarini@let.ru.nl

Abstract

In the GOBL project we develop and test small web-based mini games for low-educated and disadvantaged beginning learners of Dutch, English, and French. An innovative aspect of this project is that we incorporate speech and language technology (SLT) to practice speaking skills. The present paper explains the notion of mini games employed in the project and the advantages of their use with respect to the target group. We then present the first results of the project concerning pedagogical and user requirements, based on the literature and user-based research. We then introduce our plans for the immediate future.

Index Terms: serious gaming, speech and language technology, second language acquisition

1. Introduction

Worldwide millions of people have to learn foreign languages or a second language that they need to integrate in new socio-economic contexts. Still, some groups participate to a lesser extent, or lose interest in formal language education altogether. Moreover, it may be argued that in foreign language curricula speaking practice receives relatively little attention.

Adults and young people with low foreign language skills are commonly marginalized in European society. More specifically, a lack of basic communicative proficiency in foreign languages is an obstacle for (re-)integration into the labor market, especially in SMEs [1]. Also, adults and young people who lack basic communicative skills in foreign languages are less mobile in Europe, in educational as well as in economic contexts [3].

Although European member states invest significant effort in foreign language education, a number of social groups display a low degree of participation in language learning programs. First, young people who drop out of formal education before attaining a degree from upper secondary education do not acquire the foreign language skills needed to integrate into the labor market and European society. Although Early School Leaving has decreased throughout Europe in the period spanning 2000-2009, more effort is needed to reduce ESL under 10% by 2020 [10]. A second group comprises adults, whose participation in lifelong learning programs, and immigrants, low proficiency in a foreign language seems to be related to motivational factors and a lack of awareness, and it may be argued that these groups need an approach which transcends the national education systems.

With respect to the foreign language curriculum, two aspects deserve more attention. First, practicing speaking skills, in general, receives little attention in language classrooms, because of lack of time. However, speaking is a crucial skill in a second or foreign language and is relevant for all learners, independent of their background and educational or professional objectives. Research has indicated that practicing speaking skills is essential to learn to speak the target language [7]. Second, it may be argued that attention to formal and explicit knowledge of grammar and vocabulary has waned in recent years. Research shows that formal aspects of language acquisition are just as important to achieve proficiency in a second or foreign language as fluency-related aspects [14], and that grammar errors are known to persist also after years of immersion in the language of the host country [12]. The provision of feedback on errors is crucial in order to remedy this situation [20].

In the present paper we first describe mini games in relation to language learning (Section 2). We then introduce our project GOBL, describing its objectives and the approach adopted. Section 4 is about the design of GOBL, we first present the pedagogical needs analysis, the user-based needs analysis, and the GOBL implementation. In Section 5 we explain how speech and language technology is employed in GOBL.

2. Mini games and language learning

Educational mini games are small and self-contained games which are highly reusable, cost-effective, and motivating and focus on specific well-defined learning topics.

Games have been put to use for language teaching purposes over the last few years. The main advantage of using games for language learning is that the user tries to achieve a non-linguistic goal: reaching a new level, obtaining more points. It makes the learning process motivating for language learners. It has been shown that educational mini games lead to fast gains in L2 vocabulary and to increased speed of lexical access [4].

Virtual world-based (2D/3D) language learning games have been developed [15], [16], [23], but these products typically target advanced language learners. Moreover, many of these games remain in a phase of prototyping, are only used for research, or stay within the confines of the academic or military world. This may be due to practical reasons, such as the availability of expensive hardware, but also because these products are mainly technology-driven. As a result, many of these virtual world language learning games are not accessible to the
large mass of (low-skilled) language learners, who need them most.

Mini games, on the other hand, require only basic technical skills and hardware and are easy to use. They are typically embedded in other websites, such as social networking services. It makes them easily accessible and particularly fit for low-skilled and/or disadvantaged language learners. Research [13] indicates that resource-deprived language learners make more use of the web (including games) as a medium for entertainment than highly educated people, and prefer and profit more from mini games than from complex strategic games.

A number of mini-game products exist, both via commercial licenses [24], [25] and through freely accessible websites [26]; [27]. The latter free websites, however, do not offer tracking and logging capabilities which do exist in non-game-based free e-learning environments. As a result, these websites offer a one-size-fits-all approach for the learning content, and take learner interests or characteristics only to a limited extent into account. In summary, existing mini games for language education are not adapted to the needs of the learner.

Opportunities to practice speaking skills through mini games are missing altogether. Automatic speech recognition (ASR) technology has until now especially been integrated only in full-immersive avatar-based games [16], [17].

First releases of games seldom reach the market success that is obtained by game titles that have several versions. This is mainly due to the complex design process of games, which needs to keep a close eye on technological, content-related and motivational aspects. For educational games, this problem is exacerbated by the fact that game design needs to be leveled with instructional design and teaching methods, and that this medium still has to catch on in formal education. This not only requires a strongly inter-disciplinary and cross-disciplinary approach, but also a methodology that takes into account the complex interplay of user research, instructional design, content development, and technological development.

In a nutshell, what is missing today are easily accessible web-based mini-game content for practicing basic language, including oral skills, integrated into a platform which motivates learners to keep practicing, also outside of formal language teaching contexts. The GOBL project aims to fill this gap in the state-of-the-art so as to increase the proficiency of low-skilled language learners by taking their expectations and goals into account. The advantages are that these aspects can relatively easily be addressed through human language technology while the extra teacher time that is freed up when these aspects are addressed in mini games can be employed for practicing other linguistic aspects that do require interaction with a teacher.

From a societal point of view, a crucial element is that the mini-game content developed within the project will be easy accessible for low-skilled language learners. In this way, we aim to bridge the gap between formal and informal learning contexts. The description of the project together with the solution it provides for the above mentioned problems is given in the following section.

3. Games Online for Basic Language Learning

The ‘Games Online for Basic Language Learning’ (GOBL) project started in January 2012. Participants of the project include the University of Nijmegen, the University of Leuven, the University of Newcastle upon Tyne, Televic Education and Council of Scientific and Industrial Research of Meraka Institute. The project aims at the providing youths and adults learning French, Dutch, or English with access to on-line mini games to improve their speaking proficiency, grammar and lexicon. In this section we present project objectives and project approach employed to reach these objectives and address the issues mentioned in the previous section.

3.1. The GOBL objectives

In the GOBL project we are aiming to develop mini games in a user-centered way for teaching of grammar in use, vocabulary and basic communicative skills in French, English and Dutch as a foreign or second language. As research has shown [14], a good command of these linguistic aspects is as necessary to achieve proficiency in a second language as fluency-related aspects. Learning materials target the A2 level of the CEFR. Dedicated speech recognition technology is employed for stimulating speaking practice in Dutch and English, and mini games and accompanying materials will be made available online.

In this project we address the needs of learners with low language skills, with a special attention to low-educated and disadvantaged youths and adults, because there is a high demand for qualitative, motivating learning materials for the lower levels of the CEFR. We choose gaming (instead of other tuition methods) because it has been shown to be an appealing medium of learning for learners in this category [13] and because we believe it can assist in overcoming the lack of motivation that is often observed in the social categories mentioned.

The materials proposed for the project specifically address such components in the foreign language curriculum that deserve more attention and can be easily incorporated into mini games. It means focusing on well-defined topics and communicative situations relevant for the target groups that take their expectations and goals into account. The advantages are that these aspects can relatively easily be addressed through human language technology while the extra teacher time that is freed up when these aspects are addressed in mini games can be employed for practicing other linguistic aspects that do require interaction with a teacher.

From a societal point of view, a crucial element is that the mini-game content developed within the project will be easy accessible for low-skilled language learners. In this way, we aim to bridge the gap between formal and informal learning for this particular group, to help them (re-)integrate into the labor market and society.

An additional, innovative aspect of this project is that speech and language technology, and especially ASR technology, is incorporated in many exercises, which makes it possible for learners to practice speaking skills and receive corrective feedback from the system on their speaking performance.

3.2. The GOBL approach

To make the complex design process easier, a number of important decisions have been taken at the beginning stage of the project, namely, to:

• focus on small and self-contained mini games;
• identify and isolate potential problems early on in the project by making lists of technical, user-related and pedagogical requirements, in order to limit the design space and reduce risks in development;
• rely on existing platforms and technology as offered by Televic Education and by the Centre for Speech and language technology (especially ASR).

An iterative and user-centered methodology, which will allow to design, develop and test the product in small but well-organized steps, is employed in the project. Target users are involved in several stages of the design and testing, so that we can take into account their needs, and can deliver a product which
appeals exactly to these audiences. Independent external experts are asked to give advice and feedback on pedagogical and gaming aspects.

Target groups that benefit the most from the project include:

1. low-skilled adult and young learners of English, French and Dutch as a foreign and second language in various European countries and beyond, who can use the language learning mini games developed in this project.
2. teachers of these languages in various countries who can use the mini games in the courses;
3. language teaching institutions which will be able to use the mini games and evaluate their use by adopting the various evaluation instruments developed in this project;
4. publishers of language learning materials which can use the developed mini games as examples;
5. companies that develop “computer-assisted language learning” (CALL) technology and applications, which will be given the opportunities of using the speech data and relative annotations made available by the project partners;
6. academic institutions that carry out research on language learning and teaching, lifelong learning, CALL and speech technology, which will have the opportunity of using the learning material, the protocols, the data collected and the evaluation instruments for their own research.

Language teachers and learners have been involved in focus groups and in the evaluation to provide input for system design. Moreover, contacts have previously been established with the consortium partners and their networks of language teaching institutions, publishers and CALL companies. At the beginning stage of the project focus groups interviews were conducted and questionnaires distributed among the language learners and instructors, which formed the basis for the list of user-related and pedagogical requirements.

4. The GOBL Design

For the design process we followed a procedure similar to the one used in the DISCO project [22]. To inform the design process a list of pedagogical, user-based and technological requirements was drawn up in the beginning stage of the project. The following section reports the results of pedagogical and user-based needs analysis, together with the steps which were undertaken within the project to answer these needs.

4.1. Pedagogical needs analysis

The list of pedagogical requirements was formulated on the basis of a literature review. It was decided that all mini games should be embedded in tasks, eliciting real language use. The task-based approach [19] thus formed the pedagogical framework for the design. Since the learners are trying to reach a particular goal while playing the game, language becomes the resource to reach this goal, and language use acquires an additional meaning.

Moreover, while performing the game tasks, users should receive sufficient support in the form of corrective feedback, which is one of the central elements of games [1]. The feedback can be provided in the form of right/wrong responses during the game, but should be more detailed in the end of the game.

Finally, mini games should primarily target development of fluency and accuracy, because of their fast pace and focus on particular aspects of language form. Since the aim is to develop materials for low-proficient language learners, the sentences used should not be too long and complex, so that a balance can be achieved between the speed of the game and its complexity.

4.2. User-based needs analysis

In May – June 2012 the user-based need analysis was conducted among language learners at the target levels of proficiency (A2-B1 according to CEFR) in the form of a task-based focus group. Additionally, their language instructors were interviewed.

The focus group with learners included the following phases:
1) a warm-up phase, during which the learners reported on the difficulties they have in learning the language;
2) a phase where the learners were introduced to and could play some of the existing mini games (Article Wolf [29], Frog Verbs [30], Beat the Keeper [27], Mindsnacks [25]), and share their experience and opinions afterwards;
3) a phase in which the overall scenario and first mock-ups of considered games under development were introduced;

Most participants evaluated grammar and speaking skills as the most difficult and necessary to acquire. For the games to be practically useful they should be relevant for the target users and contain communicative situations the learners come across in real life. A number of such topics was mentioned: going to the doctors, getting a citizenship document, job interview, etc. Moreover, some of the participants mentioned that the scenario should be adapted to the needs and gender of the players, and that they would like to be able to choose the topics themselves.

In general, the participants were positive about the games which were demonstrated to them. It was mentioned that mini games can be used for additional practice outside the classroom. The fast pace of the game was found motivating, but the learners would like to be able to adapt it to their needs. Motivation for playing the game can also be facilitated by providing rewards for correct answers, or through a competition with others. Another important motivating aspect mentioned by both teachers and learners is providing comprehensive feedback. Seeing that your answer was right or wrong is not enough, the users would like to know why it was incorrect.

Graphics and music were found to be important factors: the learners in the Dutch group, for example, did not like the first games presented to them, since the graphics were too simple. At the same time one of the reasons why the Mindsnacks game was preferred to the others was the good-matching music.

Finally, the participants commented on the possible scenario of the GOBL mini games. Both the learners and the instructors mentioned the necessity of full immersion into the game, which can be achieved through presenting the tasks in a particular scenario. As suggested by the learners from Belgium it would be interesting to play the role of a detective and solve some mysteries or murders while playing mini-games. At the same time, the idea about using the developed mini games in one scenario received mixed feedback from the learners. It was considered important that the games can be played separately from the scenarios as well.

4.3. Implementation in GOBL

The results of the analyses were taken into account in the development of the first demos of the mini games. Following the comments of the learners, the initial scenario around the reporter was changed to the scenario of a detective story, where the
learner plays the role of a detective and has to find the stolen cookbook with chocolate recipes.

Three game types were developed within the project:
1) The lie-detector game, where the learner has to decide whether the sentence pronounced by the suspect is correct or incorrect;
2) The finger-print-collector, where the learner has to collect finger prints in the form of the words, which can be used to fill in the gap in the sentence;
3) The roof-surfing parrot, where the learner has to move a parrot and save it from smog by pronouncing or clicking on the sentence to continue the dialogue.

All the games are time-paced, so that the learner has to provide an answer at a given time. In the case of an incorrect answer, the learner gets the “right-wrong” feedback from the system, and can see the result of his/her activity on the screen: the suspect is happy, the finger-print is destroyed, the parrot is suffocated by the smog. An example of one of the forms of such feedback is given in Figure 1. Moreover, after playing the game, the learner receives a feedback screen showing which items he answered correctly or incorrectly. The need for more detailed feedback mentioned in the needs analysis will be considered after evaluation of the first prototypes.

The following motivational strategies mentioned by the second language learners and teachers during the needs analysis stage have been incorporated in the current design of the mini-games: timing (the learner has to answer at least half of the questions correctly before time elapses) and scoring (the learner receives points for each correct answer and extra points for a number of consecutively correct answers). The scoring board is planned to be implemented in the future where the users will be able to compare their own scores after different attempts and/or to compare their result to the results of their peers.

Since music and graphics were mentioned to be important for the target users, background music was incorporated in all the games. The appropriateness of the chosen music and graphics will be evaluated during the evaluation stage. To answer the needs of the learners at the target levels of proficiency, a list of relevant linguistic topics and themes was created for developing the content. Vocabulary and grammar can be practiced with the help of the first two games, while the “roof-surfing parrot” mini-game is in the form of a dialogue. Two of the games presented will be powered with ASR to practice speaking skills. The incorporation of speech and language technology (SLT) in the exercises is discussed in the following section.

5. Speech and language technology

An innovative aspect of GOBL is that SLT and in particular automatic speech recognition (ASR) technology is incorporated in many exercises, which makes it possible for learners to practice speaking skills and receive corrective feedback from the system on their speaking performance.

There are 3 possible versions of the CALL system:
1. no ASR, completely text-based
2. with ASR, but it will not determine the flow of the game
3. ASR is decisive for the game

Not all exercises are suitable for ASR. Since good (acoustic) conditions are required for the optimal functioning of ASR, it should be possible for the user to practice with non-ASR versions of the mini games if these conditions are not available (see below). Then there are two options: the user is warned that the conditions are not optimal for ASR, but still can use ASR, or if the conditions are not good enough ASR cannot be used at all.

LST will be employed to analyze the learners’ language output. Therefore, LST is developed for Dutch and English versions of the mini games, to recognize and further process the spoken utterances produced by the learners. At first no assumptions are made regarding language pairs (all L1’s). Later we can look into specific, frequent L1-L2 pairs (as an extension). In developing technology for GOBL, we build on technology developed for other projects at the Centre of Language and Speech Technology (CLST) of the University of Nijmegen, such as the projects Dutch-CAPT [32], DISCO [33], MPC [34], FASOP [35], DigLIn [36] (for an overview see also [21]).

The integration of ASR technology in CALL programs needs to be done with specific care. ASR technology has reached a level of maturity sufficient for language learning applications, but still has a number of limitations, which need to be taken into account in the design process. First, in the context of web-based mini games, ASR technology needs to be optimized for web-based delivery, and the software design has to take into account several platforms, browsers, and contexts in which it will be used. Second, ASR for foreign language learning needs to be adapted to the speech of non-native speakers, and to the kind of mistakes they make.

Recognition of non-native speech is more complex than the recognition of native speech [2]; [5]; [8]. In order to deal with this increased complexity, specific LT modules are developed and optimized. The exercises are organized in such a way that the LST modules can handle the user’s spoken output. Spoken utterances are elicited such that the possible (correct) answers by the users are restricted. The examples of the mini-games within the GOBL project which can be powered by an ASR are given in Figure 2 and 3.
For each exercise a list of possible and probable correct and incorrect responses is drawn up. This list is then employed to build a specific language model for each individual exercise. The language model is created automatically. For every exercise the CALL system has to choose among these correct and incorrect responses. The most suitable decoding technique is applied.

After the LST modules have determined what was spoken and where mistakes have been made, the appropriate feedback has to be generated. For this purpose, the study of the most appropriate feedback moves is necessary.

Two types of feedback are possible:
1. Implicit feedback during the game
2. Explicit feedback after the game

The game has to be fast-paced. Therefore, during the game only feedback is provided that does not hinder the speed of the game.

If an exercise is not carried out correctly, or not within the time limits, the user gets negative feedback (e.g. points are deducted). The user thus gets implicit feedback, which increases the 'game feeling', and supports learning. Still, it might also be possible to give some explicit feedback during the game, such as highlighting errors (e.g. denote pronunciation errors by underlining or coloring the corresponding graphemes).

After the game, the user can get explicit feedback, e.g. an overview of (language) errors made. This kind of feedback is language learning supporting, and thus probably not part of the game play (penalty, reward, etc.). The game keeps track of errors made during the game, and after the game the user can get feedback on these errors in different ways. In some cases users can listen to correct examples, model-answers. These model answers are recorded speech utterances. Speech synthesis is also an option provided the quality is sufficiently high.

The application is web-based, accessible in various browsers. A client-server architecture is used, and obviously the use of a microphone should be supported. The server performs the computationally most demanding tasks, while the ('thin') client performs more simple computational routines. The server consists of three components: (1) the course software; (2) the LST software, and (3) the content.

ASR of non-native speech is already challenging, as was already mentioned above. However, there are also other problematic issues such as noise (especially background speech), and end-point detection (EPD).

We intend to use head-sets for better performance. In addition we employ standard noise reduction and adaptation techniques such as 'spectral subtraction', 'cepstral mean subtraction' (CMS), and 'vocal tract length normalization' (VTLN). The question is whether calibration is necessary. If it is going to be used, it has to be a short procedure, probably at the start, possibly combined with an automatic (background) procedure during the game. Or calibration is done only when there are problems. The experiments we have carried out have made it clear that at start it is preferable to show the voice level (VU meter), and an option to choose between different microphones on the computer. Furthermore, users also prefer to see an indication of the voice level during use, mainly to be sure that the microphone is still working correctly (especially if the system tells them they have made an error).

The question is also what kind of end-point detection (EPD) is best suited for a fast-paced game. Options are:
1. push-to-talk, i.e. user specifies begin and end
2. user only specifies begin (e.g. with space bar), and automatic detection of the end
3. automatic detection of begin and end.

In options 2 and 3, for automatic detection of the end, the length of the correct answer(s) might be useful information. Option 1 is probably less error-prone. However, for an optimal game feeling option 3 is 'the better'. In practice, we have to find the compromise that works best, maybe option 2. To start recognition immediately, while the utterance is being pronounced, streaming of the user speech seems the best option.

A first version of the system will be ready in April-May 2013. In May-June 2013 it will be evaluated with language learners in the Netherlands, Belgium, the UK, and South-Africa. At the SLaTE 2013 workshop, the system will be shown and results will be presented. The results and the feedback will be taken into account, and used to develop a second, improved version of the system, which again will be evaluated.
6. Acknowledgements

This project has been funded with support from the European Commission under project number 519136-LLP-1-2011-1-NL-KA2-KA2MP. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

We are indebted to the other members of the GOBL team for their contributions, in alphabetical order: Frederik Cornillie, Piet Desmet, Febe de Wet, Johannes De Smedt, Andrew Grenfell, Marijn Huijbrots, Ann-Sophie Noreillie, Thomas Snell, Sylvie Venant, and Scott Windaatt.

7. References


[34] http://www.ru.nl/arts/mpc/.
