

A Model of Dyslexia-Friendly Language-Learning Computer Game Development

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Abstract

Dyslexia is a difficulty in the acquisition of fluent and accurate reading and writing abilities that is neurological in origin. The cognitive processes that cause difficulties in the first language for the dyslexic individual are most likely to impact also on second language learning. These include phonological difficulties and orthographic difficulties. Grammar rules may also be problematic in the additional language.

While these difficulties may be the cause of lack of motivation to learn a second language, computer-based learning games have the potential to engage the dyslexic learner to overcome what are often psychological rather than cognitive barriers to learning. These games are seen as non-judgemental, as the teacher and peers do not see their failures. However, the level of engagement of the dyslexic user/player will depend on the software being developed in such a manner to being able to adapt the diverse, and changing, needs of the user through adaptive (artificial intelligence) methods.

In the present paper we are going to use Caldys2, an EU funded multinational project to develop language learning computers games for dyslexic individuals, as a case study for testing recommendations that should be included in any guidelines: multidisciplinary teamwork including educationalists, programmers, researchers and end user; evaluation of the product with respect to learner preferences, pedagogy, sustainability and technical considerations; adaptability to diverse contexts; inclusion of a consolidation process to ensure skill transfer. Since no appropriate evaluation method existed, the authors developed the Learning Games Education Evaluation Rubric, which involves 19 questions based around the areas of Learner Interface, Pedagogy, Sustainability and Technical Aspects. This process will be reviewed with respect to its potential to offer a model of development of effective language learning software for all learners, irrespective of their learning needs.

Introduction

In a society where speaking a second language can provide advantages, both social and economic, many people attempt the acquisition of one or more additional languages, for reasons of travel, work, enjoyment or several other reasons. However, not all individuals find language learning easy. This is the case for dyslexic individual, who are hampered not by motivation, but by the cognitive difficulties that impact upon the literacy learning in their first language. It is these individuals whose needs were being addressed in the EU funded project Caldys2, an extension of the original Calldysc project (See www.caldysc.eu).

Dyslexia is a difficulty in the acquisition of fluent and accurate reading and writing abilities that is neurological in origin (Smythe, 2010). The cognitive processes that cause difficulties in the first language for the dyslexic individual are most likely to impact also on second language learning. These include phonological difficulties and orthographic difficulties. Grammar rules may also be problematic in the additional language.

Research suggests that the most common (though not only) areas of difficulty are in phonological manipulation and memory (Snowling, 2000). These manipulation skills are developed by repeated (implicit and explicit) practice in the first language, that leads to development of an "algorithm" such that the skills like those related to segmentation (syllabification, rhyming, first phoneme identification, for example) can be performed not only in the first language, but in any language. Thus, if the individual can perform a rhyming task in Italian, for example, they should also be able to do it in English. However, while the rhyming task is widely used in English, being both explicitly and implicitly taught, since it is useful to analogies in reading and writing, this is not the case in all languages, especially the transparent languages such as Italian and Hungarian. This is true not only for the dyslexic individual but for all learners. Consequently, there is a need to develop activities that look to develop these core skills necessary for English, even if they are not used in the mother tongue.

The other important area of concern is memory. The large number of new words that need to be taught can create a major load on the memory of the dyslexic learner, in terms of both retaining and retrieving the words. The traditional approach of rote learning is problematic for the dyslexic individual, due to their difficulty in retention of word lists. It is important that for vocabulary learning, the approach should be highly motivating to ensure the individual repeatedly returns to the activity, thus ensuing reinforcement and overlearning, the key factors in learning for the dyslexic individual.

The repeated failure to learn using traditional techniques does not mean the dyslexic individual cannot learn. The original Calldysc project showed that given the motivation, these individuals can learn and want to learn (Gyorfi and Smythe, 2008). The purpose of Calldys2 was to provide more content to reinforce the claim that by making the learning more focussed on the needs of the user, learning would be effective.

Potential of computer-based learning games

The computer is often seen by the dyslexic user as a neutral teacher, who does not suggest to the learner that they are failing. It offers a tool to an overworked teacher who can provide suitable resources that ensure that every child is still actively involved in the learning process. The game can offer a learning environment that takes away the constant gaze of the teacher and replaces it with the more acceptable neutral "voice" of the computer. But just because an activity is made into a game does not make it inherently more learnable, motivating or accessible. There should not be complacency in the game development, with a diversity of professionals involved.

Some have voiced a fear that the pupils will see it as taking away their leisure domain. But they are happy to read book at home as well as use books at school. So any talk of hijacking their domain will need greater explanation. But while it is possible to imagine a social commentator saying "The child will see this as hijacking their leisure activity." it is difficult to imagine a pupil saying "I do not want to learn through playing computer games at school."

Barriers to accepting gaming in the classroom

There are many reasons put forward as barriers to gaming being widely used in the mainstream classroom. While some of those (e.g. internet access and hardware familiarity) are no doubt being brought down, others are more entrenched. A recent report (Williamson, 2009) suggested the following were significant issues:

Many teachers and parents are still reluctant to encompass the latest tools that can help their child to learn. Here are some of the main reasons highlighted in a recent report:

- Expense of games (software and platform) 74%
- Difficulty of assessing the work produced 34%

- Pupils being unable to make the link between playing the game and the wider learning objectives 50%
- Objections from parents (46%), governing bodies (28%) and colleagues (21%)
- Teachers lack of knowledge about the game/platform/software 56%

Not surprisingly, the negative attitude of pupils scored low (7%). Sadly only 3% reported that they could see no objections to using games.

About Caldys2

The aim of this project is to develop a suite of activities that could be used to teach the English language to the non-English dyslexic learner. While motivation in Calldysc games was generally high, this project will also pay greater attention to the game-playing side, with enhancements of the activities being provided through gaming theory combined with pedagogic principles. Just because an activity is made into a game does not make it inherently more learnable, motivating or accessible. There should not be complacency in the game development, with a diversity of professionals involved.

The Caldys2 project is looking at the various roles in a multidisciplinary development team which includes educationalists, programmers, researchers and end users. This combination was noted as critical to the development of appropriate games. Despite the apparent necessity, research suggests that such consultation rarely is used in development of learning games, or at least not at an appropriate level.

In this project, language teachers will be equipped with tools for creating motivating, dyslexia-responsive, technology-enhanced learning content for their dyslexic students. The project will demonstrate in the widest sense the possibilities of the dyslexic individual to learn one of the most difficult subjects for them - learning a language. It is hoped to show this during the lifetime of the project in a manner that will maximise the potential to ensure sustainability with Ministries, policy makers, Educational Professionals, supporting NGOs, language teaching professional associations.

Not only language teachers and their dyslexic (and non-dyslexic) students of any age will benefit, but parents or special educationists will also gain a valuable tool for more effective additional support.

This project builds on results and experiences gathered in Minerva project Calldysc, by 3 ways: a) further developing outcomes based on user needs, b) involving new types of user groups and c) expanding the original partnership towards new countries.

Teaching activities will target vocabulary building, grammar, communications skills and usage. SEN students will benefit from a) elements of multisensory teaching, b) personalized content and c) integrating assistive technology. Learning content will be generated in a web2 manner, i.e. content is created, uploaded and shared by language teaching professionals.

Based on feedback from the original Calldysc project, this new project aims to:

- Expand the activities in the existing games
- Develop new games
- Deliver to three new languages (Italian, Czech and Turkish)
- Improve the dyslexia friendly nature of the games.

Furthermore, there will be greater engagement with the teachers, providing them with training and resources to better equip them to work with the tools and with dyslexic students.

It is hoped that the results of the Caldys2 project will encourage learning not only in primary and secondary school, but also provide content and methodology for adult learners and vocational trainers, by which their foreign language related workplace competencies can be enhanced.

Evaluation of the product

Despite the growth of computer-based learning activities, there is surprising little written on the effective evaluation of computer games, at least from an educational perspective, and few models that can be outside the fact-based games learning as found in science, history and geography computer-based learning games.

Two approaches will be highlighted here, with their applicability to learning and the Caldys2 project in particular. The first is the RETAIN model (Gunter et al, 2008) which attempts to identify a series of key areas to measure. For each of these, it provides a weighting factor, to derive a single value that is intended to represent the quality of the game. However, this suggests (say) that if a games scores very well in all areas, but "relevance" is low, it may score as well as one that is good pedagogically, but the graphics are not as good as they could be. This would seem inappropriate in a game where all areas are important and significant in their own way.

A second approach is LGEER (Smythe and Giulivi, 2011), a rubric that identifies factors in 19 areas, and provides possible responses in each. The rubric is designed to be adaptable for different evaluators, such as researchers, teachers and end users. It looks at the four key areas of

- learner preferences – How suitable it is for the dyslexic user?
- pedagogy – How it used learning theory?
- sustainability – How it is integral to classroom activities?
- technical considerations – How technically sound it is?

It is this second approach that has been developed for the Caldys2 project, and has already been used in other EU game projects.

Conclusions

The project is, currently (October 2011), half way through, but already there are a number of outcomes and recommendations that will have an impact not only upon this project, but are also of wider interest. This is not only the evaluation tool (LGEER) but also the guidelines for creating dyslexia-friendly games. These, in summary, are as follows (Smythe, 2011):

- Explain the learning purpose from the outset
- Ensure the interface takes account of the cognitive difficulties
- Minimise "failures" and compare to others only when necessary
- Ensure it is embedded in mainstream classroom activities
- Demonstrate learning (value added) not just Hi Score
- Make the game adaptive, to suit their learning level and needs.
- Ensure there is learning consolidation with the teacher
- Finally, make extensive field trials with dyslexic users.

Finally, the project offers an opportunity to reflect on the principles of using technology to support learning developed by Smythe (2010), contextualised to the gaming environment. That is, do not just assume that because it is a game that it will work. It has to conform to certain criteria, which are summarised in the LGEER game assessment rubric. But if gaming works for dyslexic learners, then use it!

Unless the games are understood by those supporting the dyslexic individual, the dyslexic student will continue to struggle to learn. External consolidation to embed the learning in mainstream activities will remain, at least for the foreseeable future, and important role for teachers. It is the aim of the Caldsy2 project to investigate how to make games exciting and motivating, and deliver the learning to students who otherwise may become disengaged in a society that increasingly values those who acquire the second language.

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