PLOTLearner as Persuasive Technology: Tool, Simulation and Virtual World for Language Learning

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The Lifelong learning project EuroPLOT (www.eplot.eu) has developed PLOTLearner as a new learning technology that uses a text database to drive persuasive language learning. In terms of B. J. Fogg’s theory of Persuasive Technology from 2003, the function of PLOTLearner can be characterized as a tool to use for practice of language skills, but also as a simulation of the interaction with the grammar of a text. It automatically scaffolds the text with a virtual world consisting of pictures, videos, and documents. PLOTLearner is furthermore developed according to Diana Laurillard’s model from 2012 of how to learn a practice capability from an external environment, which in this case is a corpus for training and exploration.

A particular database of the Hebrew Bible from Amsterdam is used in this project, but both the database management system and the PLOTLearner application are developed as open source. The approach illustrated in this project could work for learning language and culture from any text and for any language. This persuasive technology and its learning objects is an example of a completely repurposable sustainability in learning technology.

Keywords: Persuasive Technology, Learning technology, Design for learning, Corpus-driven language learning, Hebrew Bible database.

1 Introduction

“Let the Hebrew Bible be your tutor!” This is the sales pitch used for a new learning environment where a text drives the motivation and enablement of learners. This new brand of learning technology, PLOTLearner, is one of two technologies developed by the lifelong learning project EuroPLOT 2010-2013 (www.eplot.eu).

EuroPLOT has developed this technology for the small and manageable pilot case of learning from the ancient corpus of the Hebrew Bible (Winther-Nielsen ms). However, the technology could scale to any open project for learning to read from texts in any ancient or modern language. The project has already experimented with texts in New Testament Greek, Danish texts from the Kaj Munk collection and Frankfurter Rundschau texts from the German Tiger database. Other papers from the project, and especially Behringer et al (2013), explain how EuroPLOT has developed learning design and patterns for other areas of learning. This paper will illustrate the principles of persuasive language learning that were developed for PLOTLearner as a tool, medium, and virtual world for learning.

The acronym PLOT is short for Persuasive Learning Objects and Technologies. However, it also hints at several senses of the verb ‘to plot’, such as planning projects, mapping progress, generating processes, and constructing plots in texts. These different usages capture the structure of this discussion of PLOTLearner, explaining how

- the project planned a new kind of persuasive interface for an EU project (section 2)
- the tool maps a journey of learning through statistics and graphs (section 3)
- a learner plans self-directed learning from texts (section 4)
a learning environment supports scaffolding for a better understanding of the plot of the text (section 5)

2 Plotting a persuasive technology

When EuroPLOT in 2010 proposed persuasive technology for language learning, we already knew that quiz technology provided by the program 3ET can solve many basic needs of beginners learning to read in a new language (Winther-Nielsen 2011). Understood in terms of B.J. Fogg’s (2003) theory of Persuasive Technology, we already had a tool that could ‘motivate people to exercise’ (2003:32), but we lacked a stronger persuasive capability in the technology to change the behaviour and motivation of users. We were persuaded by Fogg that when a learning technology takes on the roles of pedagogical persuaders like teachers, instructors or coaches, it may have great potential for education:

From the classroom to the workplace, educational designers will create computing applications that deeply motivate people to initiate a learning process, to stay on task, and then to review material as needed. ... As sophistication increases, we’ll see adaptive education and training products that tailor motivational approaches to match each individual learner – motivating ‘accommodators’ to learn through cause-and-effect simulators, or providing ‘convergers’ with rewards for performance on interactive problem sets and quizzes. (Fogg 2003:246).

Principles of persuasive technology are now finding their way into digital design. At the same time edutainment and gamification are emerging as big industry in the marketplace, culture, and entertainment. However, it is equally clear that sophisticated technology per se does not guarantee effective learning or widespread use. The goal of our project was therefore to explore how current work in design for learning, interaction design, and computer-assisted language learning could inform our development of an application we called PLOTLearner, with the aim of deployment and evaluation in a pilot project on a corpus of the Hebrew Bible.

Fogg (2003) characterizes the three core functions of a persuasive technology as tool, simulation, and social actor. The following will explain how we are implementing those functions in language learning, guiding learners to

- practice skills in reading, writing, and parsing for proficiency with a tool for practice
- explore the structure of a text for engagement in a simulation of the grammar of the text
- exploit resources activated by the text for a virtual world which functions as a learning environment

In light of this, the aim of EuroPLOT is to develop a learning technology that empowers and motivates self-directed learning driven by a database. Learners can use this technology to explore the text through a text corpus interface. They can practice skills of reading and vocabulary memorization and gain proficiency in morphology and in analysis of syntax and text. PLOTLearner supports the construction, reuse, and repurposing of exercises which are loaded, edited or created through a Windows interface. It generates activities for learning of language or culture from a database storing a text corpus.

The programming of PLOTLearner has been structured as an agile development, with new releases produced by Claus Tøndering for testing by Nicolai Winther-Nielsen about every second to third month from April 2011 to December 2012. From April 2013 Claus Tøndering is developing an online version without funding from EuroPLOT (http://pltest.3bmoodle.dk/). The plan is to continue open source development after the end of the EuroPLOT project in
October 2013. Furthermore, we are now working on support for online display of the progress of learners in a “Learning Journey Online” (Gottschalk and Winther-Nielsen ms).

The persuasion envisioned through PLOT Learner focuses on conditioning through certificates, surveillance by teachers and peers, self-monitoring by self-directed learners, and persuasive suggestions directed at autonomous language learners (Winther-Nielsen submitted). The technology can be characterized in different ways due to its support for language drilling, text display, reading, and vocabulary learning: PLOT Learner is

- a tool to simplify the practice involved in acquisition of morphology (drills)
- a tutor that simulates the study of grammar in text (interactive display)
- an interlinear guide with transliteration (pronunciation support)
- a reading helper that checks typing, reading, and spelling skills (self-corrective reading)
- a translation assistant with glosses and ranking of word frequency (vocabulary training)
- a virtual world with display of cultural background material (interpretation)

The following section will explain how PLOT Learner uses the three functions of tool, tutor, and virtual environment for practice and exploration into a corpus-driven learning scenario, and how the interface is designed to enhance the persuasive effects during active learning of a language and its texts and culture. The core of the present technology is explained from Laurillard’s (2012) model of learning from an external environment.

### 3 Learning from a plotted practice environment

The step we first have to take is to plot how the tool marks a course for skill training and displays learner progress through statistics and graphs. This tool aspect was already developed for the technical quiz solutions in 3ET, but the goal now was to develop a persuasive framework for practicing mastery of forms in a language. In Fogg’s terms, the focus here was how to initiate, continue, and complete the practice of a skill by review.

The best way to explain the role of practice is to use the robust theory of design for learning developed by Diane Laurillard. Her figure is reproduced with minor changes in Figure 1:

It shows the learner learning by using their personal goals and current conceptual organization to select from their current practice to generate actions on the external environment. The learner can use an action modeled by the teacher, or use results from their own action to modulate and build their practice capability. What they get from the teacher or the environment may modulate their concept, their personal goals, or current practice capability, and so generate new actions in continual iterative process. (Laurillard 2012)

Laurillard’s mapping of learning from an external environment explains how a persuasive skill practice can emerge, and especially how, “the shading identifies the internal cognitive components the learner deploys during the process, which the teacher is trying to influence” (Laurillard 2012: 61). The figure clearly illustrates how the learners’ practice capability depends on action modelled by the environment (Be). Crucially, in PLOT Learner the learners interact with the external environment (E) through an interface to the database. However this
content is generated from concepts provided by the computational linguists who created the database as well as by the course developers through conceptual organization (C_T). In this sense the learners’ action to achieve the desired practice skills (D_E) is embedded within a larger environment of facilitation. The persuasive effectivity is afforded by a simplification of practice and by the enablement of a pleasant training environment that encourages learners to improve performance to the level they want to achieve through their efforts.

Figure 1: Learning from an environment and a teacher (Laurillard, Fig 4.1)

PLOTLearner was developed and tested as a Windows program with two entry modes: learners activate the program in the “PLOTLearner” mode and they are instantly brought to exercises to train in a skill. Learning designers, teachers, and advanced learners can choose to activate the program in its “PLOTLearner – Facilitator Mode”, which will allow them to edit exercises or create new ones. They can provide descriptions of learning content or hints addressing potential frequently-repeated mistakes and supply links to external content (see http://www.ezer.dk/3ETusersguide/PL-2.0.1/en/intro.php). Each time the learner clicks on a load exercise button, he or she is presented with a screen that enables him or her to study information on the practice task in the "Exercise description" field, or else begin to practice right away by pressing the “Run this exercise” button. The content of this description can be

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1 Used by permission from Laurillard, including changes of her siglas: (C_c), (F_c) (D_c), replaces (C_T), (F_T) (D_T), because (C_T) explanation can be confused with (C_T) conceptual organization. Subscript letters (\{C, D, F\}_c) are functions of the conceptual organization, hence by analogy (\{C, D, F\}_E).
repurposed by any facilitator for any learner. In this way the facilitator can repurpose practice to provide the exact amount of persuasive motivation to encourage engagement as well as explain how learning routines can be simplified. Crucially, the description should define the learning outcome and give easy access to whatever additional content with which the facilitator wants the learner to engage.

For any language learning immediate feedback is crucial. PLOTLearner handles the Result (F_E) function by checking answers in the database and generates feedback. While the facilitator does not have the ability to supply hints to address every possible wrong answer, he or she can supply pedagogical advice on potential problems in the exercise description. Learners receive instant feedback on their knowledge by directly checking answers or getting feedback through the Result (F_E) function. During the practice of a specific exercise for language learning, the learner will always be able to press a “Check answer” button to improve on the fly until the right answer is matched in the database. The learner can at all times go back to the description and study some more, but this will have an impact on performance speed. Another button will allow the learner to have an answer shown, but this will count as a mistake. Otherwise, the learner can skip ahead to subsequent questions or end the exercise. Throughout the process, a bar visualizes progress, showing unanswered questions remaining.

Other sophisticated displays support the tracking of the learner’s journey, displaying the duration and results of exercises and listing mistakes in a statistics files called “Complete local report” (http://www.ezer.dk/3ETusersguide/PL-2.0.1/en/statistics.php). The learning journey can be tracked in an “Exercise graph”, which graphically plots how many right answers were given per minute. In this way there are several options available for display of crucial feedback (F_E). The value of these statistics and their use in tests and exams is discussed in Winther-Nielsen (ms).

4 Self-directed learning plotted in a motivating interface

A further step on our path into this new learning technology leads to the new functionality offered in the second prototype, PLOTLearner 2. Our route of agile development has taken us far beyond 3ET, which only supported exercises on morphology and writing.

Earlier analyses of persuasive functions had indicated that we should support learning through active exploration. Learners must begin with an overall understanding of the form of the before they can be persuaded to learn actual forms. This enables the learner to gradually acquire a higher level of mastery because the learner is in complete control of planning the content, pace, and range of his or her learning journey through the interface. It clearly indicates that PLOTLearner is not only a tool for practice, but also an adaptive technology that implements Fogg’s category of persuasive media. It places the learner within a simulation of the objects of the text, empowering the learner to gain full control of all active exploration.

In practice this implies that technology supports the learner’s interest in engaging interactively with the text. This is the part where the learner will engage with PLOTLearner to activate the conceptual learning process (C_L). For this stage, the model action (B_E) has to be prepared through the teacher’s conceptual input for explanation of concepts (C_T). In this
regard, PLOT Learner also offers what is available in more traditional teaching scenarios and classrooms. However, it redefines the role of the teacher’s conceptual instruction as supervision and coaching on how to use the content and structure of the database. This implies that in PLOT Learner the learning of concepts is primarily structured as how to learn the content of the main source of the corpus-driven learning and hence also how to use the rich conceptual content stored in the database. Moreover, this part of the system is very persuasive from a user experience point of view because the learner can point to language features he or she wants to have visually highlighted. The relevant content from the database is readily available as pop-up displays in a user-friendly mouse-over fashion. To study the database content of a selected text segment is therefore very pleasant for the learner and the interactive environment fulfills learners’ desire to have interactive information available at the tip of their fingers. In terms of the analysis of the functionality of a Persuasive Technology, this is the ultimate function of persuasive suggestion (Winther-Nielsen submitted, and briefly summarized by Gottschalk and Winther-Nielsen ms).

However, the shift to a corpus-driven environment for the study of grammar has even more profound implications. When we researched our new approach to language learning, we discovered that persuasive language learning must start with engagement with the interface into the grammatical categories stored in the database. PLOT Learner therefore radically changes the curriculum and topics of language learning by enabling interactive access to the text through the hierarchical levels of word, phrase, clause, and sentence and the features and values stored at each level (http://www.ezer.dk/3ETusersguide/PL-2.0.1/en/firstex.php?lang=he).

- At word level: “spacing” is added to display individual lexical morphemes within words, as well as transliteration to help beginners learn to read much faster. (Transliteration also gives access for those who are not able to read the Hebrew script, but still want to learn aspects of the grammar).
- Form in text lists the form of the root and affixes for easier display with the text.
- Lexeme offers access to dictionary words and vocabulary learning based on gloss(es) in English, their frequency, and their part of speech.
- Morphology displays stem and tense of verbs, state of nouns, and person, number, gender
- At phrase level: phrase types in terms of part of speech and functions like predicate, subject, and object are shown with labels.
- At clause level: clause type labels and text type are given.

Thanks to this new potential in corpus-driven self-directed learning, the next generation of learners can now begin to learn lexical and grammatical categories through the interface. They can get a first-hand interactive and visual feel for the hierarchal structure of the text, and all language data supports the pursuit of personal interests and goals. Evaluation data supports our assumption that engagement with the text through an interface motivates learners to initiate skill training for acquisition of forms, vocabulary, and syntax.
5 Corpus-solutions enabling language learning plots

The last step on our tour is to examine how this new kind of database-driven persuasive technology can support even more effective and efficient learning in and around a database by triggering the engagement of learners. Fogg (2003) has pointed to the crucial role of khaioio, or the opportune moment for learning, and the challenge is how this kind of timing can be triggered for persuasive language learning from a database.

Current language learning theory has moved away from communicative language teaching and is heading towards task-based language teaching. The focus in this approach is on learner defined tasks that support the understanding of the form of the text rather than memorization of rare forms (Robinson 2011). The theory of Task-based Language Teaching has for long focused only on development of a curriculum for the classroom and not paid attention to learning technology. However, PLOTLearner joins a new trend of applying computer-assisted language learning to task-based language teaching, such as seen in the studies published by Thomas and Reinders (2010). The ultimate goal is of course to let the learning technology generate scaffolding that activate content for the Vygotskian zone of proximal development.

PLOTLearner does not support this ultimate goal yet, but we have made a start by creating a flexible database system that can store pictures, videos, and documents for use in problem-based learning. Whenever PLOTLearner is opened, the program will automatically connect to the internet and activate the database EuroPLOT Resources (http://resources.3bmoodle.dk/img.php). This database is developed as a kind of open source learning repository that allows learning designers to construct their own content for the text collections they want to include. In the EuroPLOT project, PLOTLearner is set up to automatically search in the metadata for any resource that is linked to a text or to a geographical reference mentioned in this particular text, but the pictures additionally contain information on archaeological periods and cultural customs. A developer of learning content can create any kind of new sub-topics and add any kind of content for this kind of intelligent scaffolding of the text by multimedia. The filenames refer to the name of the creator of the content, the category of the learning material and resolution types. It creates a visual world that triggers a pedagogical visualization for persuasive learning and can be used for problem-based learning activities. PLOTLearner automatically scaffolds this for the texts and displays the metadata that are provided for learning objects.

For the present test of the learning environment, the bulk of the content in the database is some 5000 pictures with metadata primarily in Danish. However, this database will be used for ongoing experimentation with persuasive learning objects offered as open educational resources for scaffolding with PLOTLearner and content provided in English.
Ultimately we want to go beyond suggestions generated by the text database and move towards an intelligent tutoring system with tailored triggers. Our ultimate dream is to construct a learning environment that scaffolds a deeper understanding of the world of the text. Through further open source development of PLOTLearner, we aspire to support reading for the plot from the beginning of a text through its unfolding in dramatic turns and peaks and all the way to the resolution of the problem and the end of the story.

Conclusion

This concludes the tour of the learning environment of PLOTLearner, with the introduction to an entirely new way of learning a language from a text database. The journey included the story of the birth of the project as well as a description of the crucial hallmarks of PLOTLearner as a Persuasive Technology. In terms of the theory of Fogg (2003), it started as a tool for practice of language skills and was developed into a simulation for the study of language in texts. The social world is so far only included as part of pedagogical texts, images, and videos automatically displayed by the program.

This sophisticated learning technology is developed as a highly adaptable and repurposable open educational software. PLOTLearner is constructed to allow for inclusion of any kind of text in any kind of language that has been stored in an Emdros database. It is our firm conviction that this novel kind of persuasive technology has great potential for future persuasive corpus-driven learning.

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