The Corpus as Tutor:
Data-driven Persuasive Language Learning

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Abstract. This paper presents a new persuasive technology that uses a corpus stored in a database to generate learning objects for tutoring of self-directed learning. The technology was developed within the European Union project EuroPLOT 2010-2013 in order to drive effective learning through technology with, in, and around a corpus application. The paper argues that a corpus can generate learning objects, but a theory of Persuasive Technology must to be applied to optimise the design for learning. The paper presents Bible Online Learner as the implementation of this new architecture for persuasive corpus-driven learning, persuading the learner to focus on the form of the text through the interface and then guiding the learner into practice authentic forms. The corpus used is a database of the Hebrew Bible created by the EepTalstra Centre for Bible and Computer at the VU University in Amsterdam for and called ETCBC4.

Keywords: Language learning, persuasive technology, Bible Online Learner, Hebrew

Introduction and background

Personalized learning environments are among the most important research areas in current technology-enhanched learning, focusing on 'tracing accurately learners' activity, monitor their individual characteristics, and generate timely adaptive interventions according to effective pedagogical strategies' (Narciss et al 2013). However, many new intelligent tutoring systems have had limited impact, because '[h]igh development costs and issues of portability and technology transfer' (Schulze 2010:78).

In order to avoid the all too frequent danger of developing a sophisticated tutoring system that is limited to too narrow linguistic phenomena and locked in closed data, the present paper presents a project which was born from the start as an open educational resource for of reuse and repurposing of learning content and for global sustainability. In terms of Schulze's caveat, our development has made it beyond the prototype stage, and the claim of this paper is that a powerful database management system can create learning content which can adapt to effective pedagogical strategies for improving the enablement and motivation of learners and it can plot learner activity.

This tutoring system was developed in the European Union Lifelong Learning Programme EuroPLOT from 2010 to 2013 in order to offer 'persuasive learning objects and technologies (PLOTs) that are easy to create and adapt' (http://www.eplot.eu/). The corpus-driven learning concept was implemented in a work package designing and developing PLOTLearner, a PC program for persuasive learning from text databases (http://www.eplot.eu/project-definition/workpackage-5). This part of the project explored new ways to enhance the learning of language and text interpretation with, in, and around a database.

The first version of this paper was written in 2012 and it has influenced later research and publications, but is here completely revised in order to plot the state of the art in the development. [1] Work is now continued by the Global Learning Initiative (http://global-learning.org/) which seeks to form global partnerships for dissemination of language learning technology and training of facilitators. Furthermore, after EuroPLOT we are not developing PLOTLearner anymore, but rather a new application for Biblical Language Studies, Bible Online Learner (http://bibleol.3bmoodle.dk/), hereafter Bible OL. We now offer support for class administration and develop support for learning of irregular verb classes and other advanced features. Last, but not least, we now offer access to the entire ETCBC4 database of the Hebrew Bible developed by the Eep Talstra Center for Bible and Computer (ETCBC) under a Creative Commons Attribution-NonCommercial 4.0 International License. We also offer the Nestle 1904 edition of the New Testament as an open and free, linguistically annotated database for New Testament Greek.

Three sections describes the core principles of a corpus-driven persuasive language learning technology: The first section argues that a linguistically annotated corpus can function as a learning object. The second section presents the theory on Persuasive Technology guiding the design for learning. The third section illustrates how Bible OL works as a persuasive corpus-driven technology for skill-supporting, persuasive tutoring in language learning from the Hebrew Bible.

Repurposing a Corpus for Learning Objects

In the years before the start of the PLOTLeaner project in 2010, several programs for drills and display of the text had already been developed and had proved the value of using technology in the Hebrew language classroom (Winther-Nielsen 2011). This gave the impetus to explore the learning potential in linguistic corpora which have already proved important for pedagogy, teaching of translation and teacher education (Flowerdew 2012).

For Hebrew language learning the ETCBC4 corpus was an obvious choice. This database contains the original text of the Hebrew Bible in a linguistically annotated database for storage and retrieval of words and morphology. For almost forty years, a team led by professor Eep Talstra had not only constructed an annotated text database, but also a computational linguistic corpus which is 'both the product of research and an instrument to be used for research' (Sandborg-Petersen 2011, 263). Furthermore, the Hebrew Bible may seem a small corpus with its 305.520 words (Forbes and Andersen 2012, 4), but large-scale corpora in the range of half billion words or more are not necessarily preferable to 'more specialized, genre-related corpora .... around 50,000 to 250,000 words (Flowerdew 2012, 4).

The database management system used in the ETCBC4 database is called Emdros (www.emdros.org) and is fully described in a price-winning dissertation (Sandborg-Petersen 2008). In this database, the text plus the information about the text is treated as objects, and they are grouped into object types which can be word, phrase, clause, sentence, chapter, book, or other types. Each word type has features with a specific value. An Emdros database is also provided with a sophisticated query language. The details of the corpus architecture and search engine need not detain the Humanities scholar at this point, but a linguistically annotated sample is illustrated and discussed in Figure 3.

Because this particular database stores well-structured objects with linguistic annotations we wanted to explore whether these objects could serve as learning content for data-driven learning. We looked

[1] As later papers published or in press refer back to the original manuscript, I have kept the basic argumentation, but thoroughly updated the content that was first presented at the Lorentz Center Workshop on 'Biblical Scholarship and Humanities Computing' in February 2012 (http://www.lorentzcenter.nl/lc/web/2012/480info.php3?wsid=480&venue=Oort).

at how learning objects have been developed as very diverse online and open educational resources stored in vast repositories. The reason for creating these pedagogical objects can be explained by means of a provocative cost-benefit calculation (Downes 2001, 2): If 1000 institutions all teach one particular topic as part of a first year course, it might cost $1000 to teach per institution, adding up to $ 1,000,000 in total for one lesson in one course. The average price could be reduced to $1 per institution if they shared material of these ten years, reducing expenditure dramatically. However, universities would not benefit from sharing courses, but rather from sharing learning material. Furthermore, Downes also envisioned the possibility of giving low cost access to high quality multimedia editions, which our project is doing for corpus-derived objects.

However, while a simple cost-benefit calculus argues in favor of developing and exchanging of learning objects, a more fundamental issues is weather learning objects afford the learning process. Unfortunately, learning objects have often been defined as just about any piece of digital information without addressing the pedagogical consequences. In fact, a review of 58 articles reached the uncomfortable conclusion that only two studies had focused on the impact of learning objects on learning (Kay and Knaack 2007). In general, the problems encountered were unreliable estimates, informal descriptions, lack of design features, and insufficient testing.

It is therefore necessary to prioritize effective evaluation systems which support a participant-oriented approach. For this reason Nesbit and Belfer have proposed a 'Learning Object Rating Instrument' which assess a number of crucial parameters like content quality, learning goal, feedback, design, and reusability (Nesbit and Belfer 2004, 148). Two of the features are especially important for the development of effective and efficient learning technology:

> Motivation: Ability to motivate and stimulate the interest or curiosity of an identified population of learners
>
> Interaction Usability: Ease of navigation, predictability of the user interface and the quality of UI [i.e. User Interface] help features

To address this issue, Boyle (2003) designed learning objects in the same way as a software system that can be programmed as the simplest possible and independent modules and therefore are easier to construct in agile development (Boyle 2003). More efforts must be invested into the design of learning objects generated in this way, but they will be much easier to use and maintain because they are reusable and repurposable. However, a good standard for storage and description of learning objects does not guarantee the target pedagogical goal (Boyle 2009). This requires that learning objects are developed according to clear design principles: orient the learning in simple terms; use visualisation with familiar examples to engage the learner; provide learner control; use 'scaffolding' exercises in a simple, supported virtual task. An effective design of learning objects along these lines will operate at many levels of granularity and impact everything from course design down to the design of activities focusing on specific learning objectives. It turns out to be a 'layered learning design' with objects inherited in an elegant and powerful network (Boyle 2010).

Boyle implemented these principles in the authoring tool GLOMaker, which in turn was developed further into PLOTMaker within the EuroPLOT project. These generative learning objects has had a wide distribution, but a study has shown that it was possible to document the staff's ability to reuse learning objects across different classes, but repurposing of learning objects required better ways to scale up the agile learning design (Holly and Boyle 2012). Yet for the Hebrew language learning project it was possible for a teaching assistant to repurpose learning objects into 12 sessions created

by PLOTMaker.[2] Furthermore, Kofoed (2013) used the tool for teaching historical method on Hebrew Bible.

The development of PLOTLearner was in several ways inspired by these basic principles for learning objects. Using a corpus for learning implements Downes' original vision of low-cost access to multimedia editions. Like Boyle we also used the design of a software system, in our case the Windows PC interface, which at least in 2010 was still familiar to the majority of users of computers. Following the advice of Nesbit and Belfer, we first and foremost developed the program from a learner perspective in order to provide a technology that would increase motivation for learning and ease the navigation into the database. Text and the grammatical features stored in the database should be easily accessible to learners studying the corpus. Facilitators should be able to generate an unlimited number of exercises for practice by learners. The learning content accompanying these exercises, describing learning content with links and hints, should be easy to write and edit and repurposable for the classes of other teachers.

To summarize, our understanding of learning objects has been influenced by the way linguistic data are hierarchically stored in the database. We applied the best principles from the theory of generative learning objects and redefined linguistically annotated content in a database as interactive reusable and repurposable learning objects.

Developing Persuasive Triggers for Learning

The idea of using a linguistic database for creation of learning objects has so far been set out in terms of its rationale, but this does not explain *how* a corpus can drive learning. In order to do this our project choose to explore the potential in the theory of Persuasive Technology and explore the notion of persuasive triggers.

EuroPLOT took as its point of departure the promising framework laid out in *Computers as Persuasive Technology* by Stanford professor B**.** J. Fogg (2003). He was the first to explore how computers as persuaders change the way we think and act, and he envisioned that education will be a 'domain positioned for imminent growth' (Fogg 2003, 246). He predicted that educational designers will create 'computing applications that will deeply motivate people to acquire new knowledge and skills'. The technology will then motivate learners to persist in learning tasks that are highly demanding, and they will be able to review content whenever and wherever they need. In this way Fogg believed that a computer can serve as a more efficient persuader, taking on the role of teacher, coach, instructor and other kinds of facilitation for learners.

Fogg proposes a functional triad which can help us understand persuasive corpus-driven language learning technology as a tool for training as well as a medium for simulation, embodying social actor aspects (Fogg 2003, 23-29). As we were planning the architecture of PLOTLearner, we realized that the tool functions can be rearranged into a hierarchical architecture with suggestion at its core and two branches of increasingly stronger persuasive influence on ability and motivation as illustrated in Figure 1. As learners are autonomous creatures who want self-determination and strive for mastery, the maximally persuasive system will invite the ideal learner to choose at will from a pool with (4)

[2] The original 12 sessions were built for testing PLOTLearner in the Summer of 2012 and called "PLOTLearner Introductory Course (Metacourse - Guest Access)" (http://bh.3bmoodle.dk/course/view.php?id=2). The repurposed course built in PLOTMaker by the teaching assistant is called "Persuasive Biblical Hebrew e-Learning (Login as guest)" (http://bh.3bmoodle.dk/course/view.php?id=10).

suggestion, but it will also offer to gently guide the learner into knowledge and practice by stimulating activity and interest.

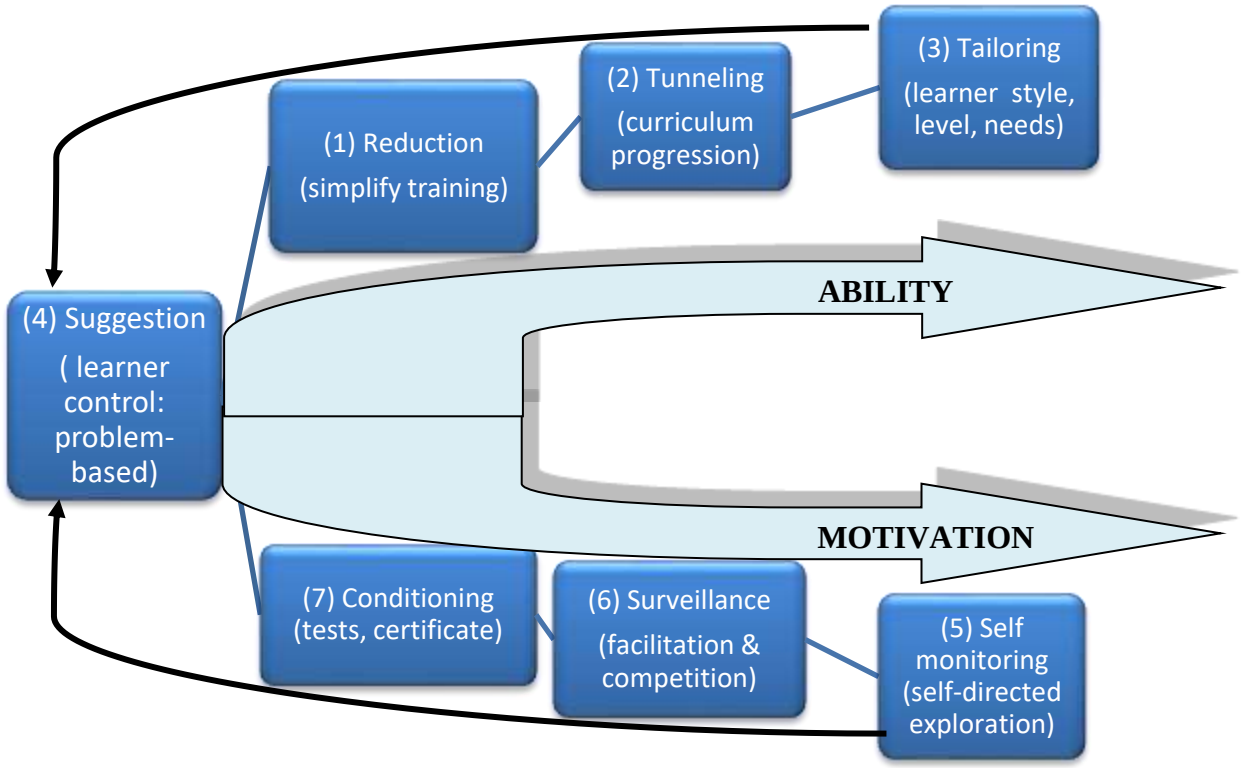

Figure 1. A process diagram for a persuasive architecture

Fogg at a later stage developed a simple system with the two parameters of motivation and ability plus triggers to order to increase persuasion by means of activating the appropriate moment for crossing the 'behavior activation threshold' (Fogg 2009, 3). Therefore, by default, the learner is presented first with the least obtrusive of three triggers, 'signal', which will activate learning processes for the learner who is able as well as motivated. However, herein also lies the inherent problem for the learner who first has to learn how to learn, and therefore (4) suggestion must trigger the learner to select the appropriate kind of enablement and motivation. The trigger 'facilitator' activates and increases ability by simplifying the learning content for a person who is already motivated to learn. The trigger 'spark' activates and increases motivation for a person by changing the learner's attitude towards the learning activity in a more positive direction. The persuasive trick in a learning system is to persuade a self-directed learner to want to select the next appropriate zone of development without feeling condescending pressure. Furthermore, the ultimate goal for both branches of persuasion is to bring the learner back to the desired self-determination and mastery at play in (4) suggestion.

On the ability branch, the simplest level is (1) reduction, which is known from quizzes that satisfy the learner's basic need for reviewing knowledge and in this way simplifies training for memorisation. A more sophisticated persuader system will take the learner to a more persuasive (2) tunnelling, which proceeds by a predefined progression through a course in a curriculum. This predetermined sequence will enforce prescribed goals for mastery, but it also limits the freedom of the learner. The

carrot in tunnelling is that it reduces the danger of disorientation, but this also blocks any fertile cognitive dissonance. Therefore, the most persuasive activation of ability is achieved when a system is construed to use (3) tailoring. This persuader technology will gear the training to the learner's level of knowledge, age, sex, learning style, progression, goals and other highly individual parameters related to vocational needs, although it is not clear to what degree learning style and technology is 'a match made in heaven' (Trinder 2006, 96).

Motivation is the other branch with functions set up in a parallel track focusing on increasingly persuasive feedback. In the traditional curriculum, the first and often only motivational factor is (7) conditioning. The learner is motivated by the fear of failing a test and the hope of acquiring a certificate, making the learner want to suffer and make sacrifices in order to gain some public reward in the form of a degree or social recognition. Learning technology with simple exercise functions and instant conditioned feedback works this way. A more sophisticated system is involved in (6) surveillance which offers the learner the choice to let others survey the learning outcome, be it the teacher, fellow learners, or a larger community. Based on logged data a facilitator can provide more instructional help which will motivate the learner to invest more efforts in learning. In addition, it can be extremely motivational for the learner to attain a certain status as a master learner in a competition with other learners or to become the best helper in a collaboration among peers. An even more persuasive system will use self-monitoring (5) to help the learner actively self-direct a personal track through the learning content and plan an individual learning journey based on a visualisation of progress and the right kind of corrective feedback.

The most persuasive system will use artificial intelligence and natural language processing to record the individual's processes and outcomes and measure performance on language learning tasks (Schulze 2010, 70). This system would then automatically adapt to individual learner differences and learning processes in (3) tailoring and it would prime the student for the task and to review material following (5) monitoring.

Many other design principles have been proposed for persuasive technology. The contextual anchoring is emphasized in the Persuasive Systems Design Model (Oinas-Kukkonen 2010). Its four design principles include the persuader's relation to the primary task, to the Human-computer dialogue, to the perceived credibility of the system and to social influence from other users. The basic approach proposed above in 2012 has now three years later been refined into the concept of a persuasive launching RAMP (Winther-Nielsen 2014): The ultimate goal of persuasive learning is now defined as a social relatedness (R) in collaborative and social learning. The ability and motivation branches are now associated with the drive towards autonomy (A) and mastery (M), and as ignition trigger for start-up of the learning process we now posit the purpose (P) of the learner, setting the learner in motion onto the Persuasive Flow Channel. The persuasive flow into ability and motivation are then driven by the corpus.

To summarize, back in 2012 the developers of PLOTLearner started developing triggers of the persuasive functions in Figure 1. These basic principles have stood the test of time in the project, even if they can and are now being further developed in more recent work. The theory of Persuasive Technology has served as a helpful theoretical lens through which we can analyse, design and test how technology can enhance ability and motivation that lead to autonomy and mastery.

Implementing Corpus-Driven Persuasive Tutoring

Once we have now supplemented the corpus-driven generation of learning objects with a theory of Persuasive Technology, we can invest corpus learning with persuasive functions in a new technology for persuasive corpus-driven language learning. The following account is the state of the art in our development of the Bible OL and it explains how we both simplify and motivate language learning by designing for change in behavioural activities as well as in motivational attitudes. It will in detail describe how the corpus gives access to all linguistic levels of the text for inquiry and exploration and how the learner can check his or her grasp of the text and the forms by practicing on exercises generated by the corpus.

The architecture of the old-fashioned PPP method—present, practice, and produce – was unidirectional as illustrated in Figure 2A. It has been and still is often the standard method for teacher-dominant Biblical Hebrew classrooms and it is known as the Grammar-Translation Method. The method usually required considerable lecturing time in the beginning and the examples used for practice were usually decontextualized artificial samples with little appeal to learners' interests. Practice was rote learning focusing on drills of vocabulary and morphology learned through paradigms with artificial content devoid of context. Production only focused on reading the text aloud in class and translation of the text was the final goal. The use of real authentic texts for interpretation was banned from the language class or postponed till later stages in a course at best. In the worst case scenario the philologian would teach the language and afterwards the theologian would use the text for interpretation. It should come as no surprise that these language classes were boring and demotivating for students - many failed and few acquired any lasting recall of the grammar of Biblical Hebrew.

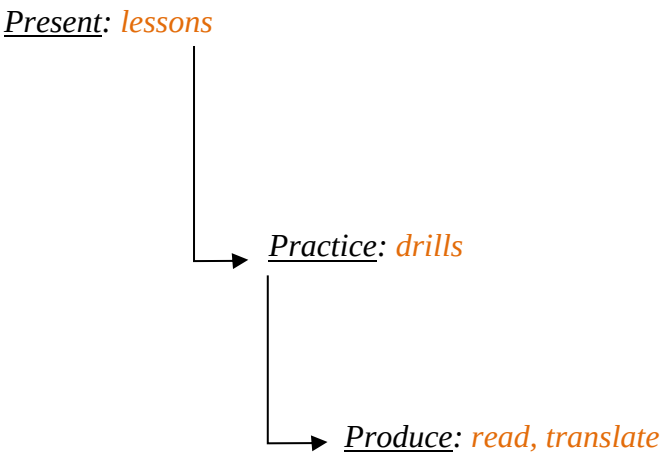

Figure 2A. The PPP architecture

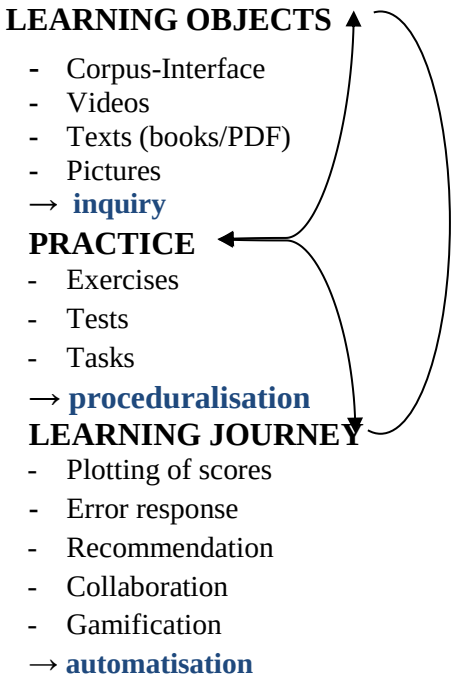

Figure 2B. The PLOT architecture

In contrast, the new PLOT-architecture illustrated in Figure 2B is centred around technological enhancement of the learner's self-directed practice. The learning practice at the core of the system is

driven by bidirectional access to both the learning objects in the corpus as well as other instructional material, and the learning journey which is a database storing all outcomes of the exercises used by the learner.

Our point of departure for the project was the strategy to let the Emdros database management system drive the generation of learning objects, and it is now possible to set out the overall design of the system and the addition of statistics from tests. The goal of this PLOT-system is to integrate inquiry, practise, and acquisition in seamless moves between all three areas. We have designed for a persuasive force which will take the practicing learner through the Learning Objects onto the Learning Journey, and individualized journey guidance is then in turn supposed to guide the learner back to the objects of learning for deeper learning, but all fuelled by practice. The architecture in this way is a blueprint of iterative learning progression informing self-direction.

Learning objects and practice integrate bidirectionally. Inquiry of the text in the corpus prompts the learner to form hypotheses about linguistic forms and functions, and the learner may then want to test how well this temporarily established internalized learner grammar works in practice. In turn, when feedback on practice indicates that forms are not yet understood well, the learner may want to return to the learning objects. This cyclic reiteration of enquiry and practice can enable proceduralisation: the learner will discover if a simple rule works in memory, or whether a grammatical item has to be learned by heart.

Likewise, Learning Journey and practice integrate bidirectionally. Practice is logged as big data and then displayed in tables in a pilot version for experiment and testing during agile development (Gottschalk and Winther-Nielsen 2013).[3] From logged data the system keeps score of right and wrong answers, plots the outcomes of learner practice and registers how long time it takes for the learner to obtain a right answer. All wrong answers are registered as error responses for inspection, analysis and improvement through facilitation. The system also has a recommendation function, because exercises with the highest percentage of wrong answers are listed as optimal for further practice. The time and duration of exercises is registered so that learners and facilitators can document their practice time and efforts. This cyclic reiteration of outcomes and practice can motivate for automatisation: learners and their facilitators can continually monitor the progress and the feedback and compare with other learners in the same class through self-monitoring of all learning activities.

Learning Objects are not restricted to the corpus-driven inquiry and exercise generation, because any teacher can use other familiar material as a supplement, or even only use Bible OL as a supplement. The system can call videos, pictures, hyperlinks, textbooks, Pdf-documents, hand-outs and whatever else is associated with a text or a place name in the corpus. Facilitators can produce learning objects in PLOTMaker or link to material on Moodle or on another learning management system, but *tasks* with support for participant reference and interclausal connections is yet be supported through the corpus. Finally, the current implementation of the Learning Journey is only for our test of display of learning metrics, and not a fully developed intelligent tutoring system based on statistics. At the moment we have no funding for development of *gamification* and *collaboration*, but it sits high on our strategic plan.

As repeatedly emphasized, practice is the central activity in this PLOT-system. Figure 3 below illustrates the interface. The Hebrew text selected is displayed in the middle in the form encountered in the printed editions, but the text can also be displayed in various clause by clause modes. The learner can select display of word, phrase, clause and sentence level information in the left-hand navigation

[3] The pilot version was developed by Claus Tøndering for PLOTLearner: http://www.ezer.dk/3ETusersguide/PL-2.0.1/en/statistics.php. It had graphs project on the mountain landscape of Mount Sinai to give a feel of climbing up a steep path of exercise towards the top.

pane. By hovering the cursor over a word, phrase, clause or sentence unit in the text, an information window opens in the right-hand side of the text as a pop-up window. Without a click all the information in the database on features and values for a selected object type is therefore instantly available, and these corpus data can then be uses for practice to train and solidify knowledge. The workhouse in this system is the regular use of exercises to give instant feedback and plot performance. Exercises can also be used for tests. Although the system does not yet support the *task* of interpretation of words and interclausal connections, a teacher can at least use the text for tasks outside Bible OL, especially its multiple selections for display of individual clauses.

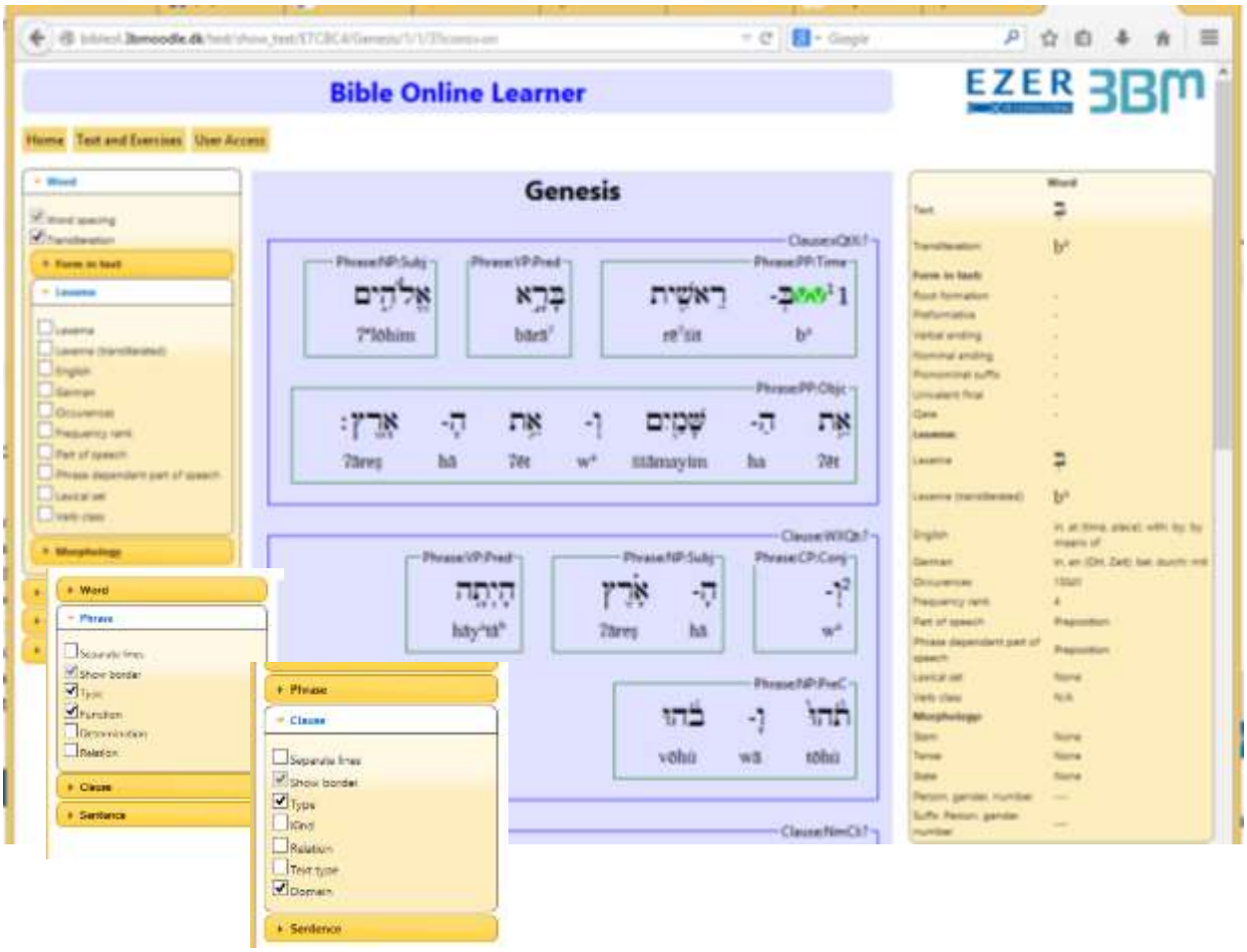

Figure 3. Display features available in Bible OL

In terms of the theoretical framework of tool, simulation and social actor from Fogg's functional triad, Bible OL is a tool to simplify the practice involved in the acquisition of morphology, phrase structure, syntax, as well as most other basic language skills. As argued at length by Winther-Nielsen (2014), the interface illustrated in Figure 3 affords (4) suggestion through selection from text display. The learner is enabled to gradually acquire a level of mastery through (1) simplification of practice in exercises and (7) conditioning from corrective feedback. By means of learning objects the facilitator can create a course with sequence of exercises for (2) tunnelling and supervise the outcome by (6) surveillance. More advanced learners can then self-direct their own course through (5) self-monitoring, but there is only very little true corpus-driven (3) tailoring at the moment. Technology-driven (4) suggestion will only be possible in an intelligent tutoring system that adapt learning to big statistical

data, levels of difficulty and complexity, personal and cultural differences in order to generate the *khairos,* which is most optimal time, place and manner for learning.

However, in terms of the functional triad, Bible OL is not only a tool, but also a tutor, because it is a simulation of the linguistic study of an ancient corpus. Although Bible OL has not been designed as a virtual desktop, classroom or manuscript, the interface is a fully functional hierarchical text scaffolded for tutoring on practice and inquiry. The interface offers a translation informant for displaying and checking of glosses to assist memorization of vocabulary in context. The strength of this feature is that glosses can be studied and learned according to their frequency of occurrence, and this supports a text-driven vocabulary acquisition. As a typist helper, the interface will check the learner's writing, reading, and spelling skills. Typing Hebrew text helps learners observe the minute details of the foreign script's visual shape. The most important function is the syntax visualization which shows the hierarchical layers of words, phrases, clauses and sentences in the text and then allows for practice of this knowledge. A learner can from day one begin by learning clause and phrase structure. Pronunciation is not supported by sound files in the present system, but a machine-generated transliteration of Hebrew text according to contemporary Israeli pronunciation standards has proved to be of immense help to learners struggling to decode the challenging Hebrew writing system. Interlinear display and the pop-up information window helps the learner do many different tasks which improves and simplifies the learning of Biblical Hebrew.

The PLOT-architecture (Figure 2B) has many advantages over the PPP-architecture (Figure 2A). In this persuasive architecture, learners are encouraged to plan their own self-directed learning for solidification and retention of skills. Exercises are available 7/24, at the learners bequest. To create drills, exercises and tests used to be a time-consuming task for language teachers, if even done at all. With the PLOT-architecture teachers can facilitate the practice of learners through reuse and repurposing of exercises and supervision of individual progression. Teachers can effortless offer unlimited practice content in no time and generated in a completely randomized fashion, yet driven by the most frequent form occurring in authentic text. The persuasive force on teachers is that they are now motivated to avoid the use of infrequent and artificial rote knowledge. They can encourage their learners to take full responsibility for determining their personal goals and the desirable level of language skills, which can only be achieved through practice. The new system supports the focus of the Bologne process on developing personal skills through self-directed practice, and measure practice hours in relation to the requirements specified for ETCS points. Ultimately, this system can support the mobility of global learners, because they will be able to document the extent and outcome of their practice.

In our development we used the principles of design for learning by developing in a feedback loop between design and outcome (Laurillard 2012, 5). Considerable quantitative and qualitative data from learner testing from Denmark, Sweden and Madagascar has helped the developers improve on persuasive efficiency (Winther-Nielsen 2013). Nobody can enforce a persuasive outcome, but we can at least design for persuasive force and flow (Winther-Nielsen 2014). Nevertheless, only scaling to much larger populations of learners through the Global Learning Initiative will ultimately plot the effectiveness and efficiency of persuasive corpus-driven learning.

To summarize, the PLOT technology is implemented is fully implemented in a persuasive corpus-driven learning technology guiding enquiry and practice on the journey of language learning. The learner can engage interactively with the corpus to observe and memorize the structure and functions of the text and its hierarchically structured forms. The text gives instant feedback on practicing of skills for reading, writing, parsing, and syntactic analysis of forms. The learners progress is plotted for score, analysis and recommendation.

Conclusion

The paper has explained how a corpus drives ability and motivation to enhance the learner's self-direction in language learning. We plotted the development from EuroPLOT's PLOTLearner to Bible OL and from learning objects to our implementation of the theory of Persuasive Technology. We described the system as both a persuasive tool and a tutor and how both functions works in learning a language from a linguistic corpus. We pointed out how this new approach is more persuasive than the present-practice-produce model for language learning: the seamless moves between corpus driven exploration, practice and monitoring and the effortless adaptability of the corpus for any course or learner proves the strength of this particular implementation of a persuasive learning objects and technologies system. It affords inquiry and acquisition of grammar and text from an ancient cultural and sacred heritage like the Hebrew Bible, but could work for any corpus, ancient or modern.

References

Andersen, F.I. and Dean Forbes. 2012. *Biblical Hebrew Grammar Visualized* , Winona Lake, Ind: Eisenbrauns,

Boyle, T. 2003. Design principles for authoring dynamic, reusable learning objects. *Australian Journal of Educational Technology*, 19(1): 46-58.

—. 2009. The design and development of learning objects for pedagogical impact. In L. Lockyer, S. Bennett, S. Agostinho, B. Harper, *The Handbook of Research on Learning Design and Learning Objects: issues, applications and technologies*, Hershey PA: IGI Global, *391-407*

—. 2010. Layered learning design: towards an integration of learning design and learning object perspectives. *Computers & Education* 54(3): 661-668.

Downes, S. 2001. Leaning objects: resources for distance education worldwide. *International Review of Research in open and Distance Learning*, 2(1). [Available online at: http://www.irrodl.org/content/v2.1/downes.html (Accessed 19 February 2010)]

Flowerdew, L. 2012. *Corpora and Language Education.* New York and Houndmills, Basingstoke: Palgrave MacMillan

Fogg, B.J. 2003. *Persuasive Technology. Using Computers to Change What We Think and Do*. San Francisco: Morgan Kaufmann.

Fogg, B.J. 2009. A Behavior Model for Persuasive Design. In S. Chatterjee, P. Dev, *Persuasive Technology, Fourth International Conference.* ACM International Conference Proceeding Series, vol 350. [Quoted from online version at http://bjfogg.com/fbm_files/page4_1.pdf (accessed December 19, 2012)].

Gottschalk, J., and N. Winther-Nielsen, 2013. Persuasive skill development: On computational surveillance strategies for modeling learning statistics with PLOTLearner. In Behringer and Sinclair, *IWEPLET 2013, Paphos, 16.-17.September 2013*, 109-116.

Holley, D. and T. Boyle. 2012. Empowering teachers to author multimedia learning resources that support students' critical thinking. *EURODL, European Journal of Open and Distance Learning*, Published 21.02.1012. [Available at: http://www.eurodl.org/materials/contrib/2012/Holley_Boyle.pdf]

Kay, R. H and L. Knack. 2007. Evaluating the learning in learning objects. *Open Learning*, 22(1): 5-28

Kofoed, J. B. 2014. The Perfect e-Storm: Repurposing Generative Learning Objects. *HIPHIL Novum* 1(2): 54-77 [http://hiphil.org/index.php/hiphil/article/view/60],

Laurillard, D. 2012. *Teaching as a Design Science: Building Pedagogical Patterns for Learning and Technology*. London: Routledge

Narciss, S., S. Sosnovsky, L. Schnaubert, E. Andrès, A. Eichelmann, G. Goguadze, E. Melis. 2014. Exploring feedback and student characteristics relevant for personalizing feedback strategies. *Computers & Education*, 71: 56-76

Nesbit, J. C. and K. Belfer. 2004, Collaborative evaluation of learning objects, In R. McGreal, *Online Education Using Learning Objects*. London: Routledge, 138-153

Oinas-Kukkonen, H.. 2010. Behavior Change Support Systems: A Research Model and Agenda. In T. Ploug et al, *Persuasive 2010.* LNCS 6137. Berlin and Heidelberg: Springer-Verlag, 4–14

Sandborg-Petersen, U. 2008. *Annotated Text Databases in the Context of the Kaj Munk Archive: One Database Model, One Query Language, and Several Applications* (PhD diss, Aalborg University; available at http://www.hum.aau.dk/~ulrikp/PhD).

—. 2011. On Biblical Hebrew and Computer Science: Inspiration, Models, Tools, and Cross-Fertilization. In W. Th. van Peursen and J.W. Dyk, *Tradition and Innovation in Biblical Interpretation. Studies Presented to Professor Eep Talstra on the Occasion of his Sixty-Fifth Birthday.* Leiden: Brill, 261-276.

Schulze, M. 2010. 'Taking Intelligent CALL to Task.' In M. Thomas and H. Reinders, *Task-based language learning and teaching with technology*, New York and London: Continuum, 63-81

Trinder, R. 2006. *Language Learning with Computers: The Students' Perspective. A Theoretical and Empirical Investigation*. Frankfurt: Peter Lang

Winther-Nielsen, N. 2011. Persuasive Hebrew Exercises: The Wit of Technology-Enhanced Language Learning. In W. Th. van Peursen and J.W. Dyk, *Tradition and Innovation in Biblical Interpretation. Studies Presented to Professor Eep Talstra on the Occasion of his Sixty-Fifth Birthday.* Leiden: Brill, 277-98

– . 2013. PLOTLearner as Persuasive Technology: Tool, Simulation and Virtual World for Language Learning. I Reinhold Behringer og Georgi Sinclair, *IWEPLET 2013 Proceedings*, p. 21-28 [http://www.iweplet2013.eu/ http://www.lulu.com/shop/reinhold-behringer-and-georgina-sinclair/iweplet-2013-proceedings/paperback/product-21189131.html]

– . 2014. PLOTLearner's Persuasive Achievement: Force, Flow and Context in Technology for Language Learning from the Hebrew Bible. *HIPHIL Novum* 1(2): 78-94 [http://hiphil.org/index.php/hiphil/article/view/57].