Plotting Persuasive Progress in Biblical Hebrew Language Learning: Online Students' Performance in Bible Online Learner

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Abstract: Bible Online Learner (https://bibleol.3bmoodle.dk/) claims to deliver a text that can persuade a language learner to practice best online. This corpus-driven learning technology was created as the engine and dashboard to drive learners through four crucial steps in a persuasive technology and design for language learning. The first step is to reduce challenges of learning through instant feedback on practice and to reward the learner with ongoing assessment of progress. The second step is to design for effective and efficient learning by forcing students to follow a specific path through tasks under surveillance of performance. This case is made for learning to read the Hebrew Bible through course material delivered at the My Biblical Hebrew Moodle website (https://mbh.3bmoodle.dk/). The third step is to enhance learning through adaptive tailoring to the need of learners who monitor their own practice. We discuss rich empirical evidence on daily online progression that documents self-directed learning. We have not yet reached the fourth and final step in a persuasive online language learning system, but we believe that it should include social experience from intensive courses, peer-based collaborative learning and enrichment by exposure to a use of modern Hebrew in Israel.

Keywords: Persuasive technology; Biblical Hebrew language learning; course design

When Cobb (2006) introduced the idea of a lexical tutor for language learning on the web, he wanted to "deliver the teacher with the text," bringing teaching to places teachers cannot physically go. This new approach to the nature and pedagogical function of the text can now be developed further, at least for the Hebrew Bible, thanks to a corpus-driven language learning developed for canonical texts from Ancient Israel: "let the text persuade for learning!"

Our case for a text delivering the teacher is without doubt easier to make for the Hebrew Bible because the learners usually will only desire to be able to read the Hebrew Bible with comprehension and acquire language skills for their professional work as teachers, translators or preachers, and they will not pretend to learn to speak Ancient Israelite.

Attitude is an important component of learning a new language. For example, Getie and Popescu (2020) find that if students have a strong desire to learn another language and feel like they have control over their learning environment (i.e., they do not feel impeded in their learning by a lack of opportunities to practice the new language or they sense a lack of encouragement from a teacher as they strive to learn a new language), they are more likely to successfully learn the new language and

use it in the lives (e.g., move to a country where this language is spoken, use the new language in their jobs, etc.).

We believe we can move beyond Cobb when the text takes over the role of the teacher to persuade the learner to practice. Furthermore, and much to our surprise and delight, an online learner studying Biblical Hebrew in the Autumn of 2019 responded that text-driven online learning is superior to classroom-based instruction:

> The learning outcome of an online course is more effective than traditional class-room instruction, at least for language learning. You will miss something if you do not have a teacher at hand, but the advantage is that you are forced to actively work your way through all aspects of the language, and this fosters deep learning. (Frederik Stølen Kofoed, quote at https://biblicalclassical.online/mod/forum/discuss.php?d=6#p6, translation from Danish by first author here and in all following citations).

The goal of this paper is to explain why and how learning technology can persuade an online learner to practice language skills far beyond classroom-teaching. We make our high claim for online learning by, in a manner of speaking, picking the online learner's brains. Our goal is not only to explain how to track learning outcomes through tests, but (1) how technology can *plot* continuous learning progress, (2) how facilitators can design for *persuasive* Hebrew, and (3) how learners can experience *progress* even online, when they learn through practicing Biblical Hebrew.

The data for this paper were obtained in the Autumn of 2019. The first author, a designer for technology-enhanced language learning of Biblical Hebrew, collaborated with the second author, a language learner and design-assistant, in a project to describe the learning processes in an online learning environment. Through this learner's tracking of total time consumption and actual performance, we can analyze empirically how an online learner learns Hebrew and we can compare these online learning experiences with the performance of other learners. Section (1) explains the persuasive engine and dashboard of Bible Online Learner (https://bibleol.3bmoodle.dk/), from now on Bible OL, that drives learners in their self-directed study of the forms and grammar of the texts. Section (2) describes the persuasive course design of three modules in My Biblical Hebrew (https://mbh.3bmoodle.dk). Section (3) discusses the progression of a persuaded online learner directing his/her own project for learning at his/her own pace, goals and efforts. Section (4) raises the challenge of social learning within this new context of persuasive performance.

1. Plotting Learner directed practice in Bible Online Learner

In order to be able to plot online progress we will first introduce Bible OL as our key technology for performance tracking and then explain how this technology is designed for the first step in persuasive learning.

The research and development of this application started with the programming of a PC program in 2008 (Winther-Nielsen 2011), and it was continued in a European Union lifelong learning project 2010-2013 (Behringer et al. 2013). The focus of this project was to develop persuasive learning objects and technologies, hence the acronym EuroPLOT and PLOTLearner as the name for our program.

The basic principles of persuasive technology were formulated by B. J. Fogg (2003) and have been tracked for educational projects 2010-2017 by Devincenzi et al. (2017). For the Bible OL project the first author turned the principles into a four-step procedure that gradually enhances learners' attitudes and abilities to engage in learning tasks (Winther-Nielsen 2014:84-85). Starting from step (1), a

reduction of learning complexity stimulated by conditioning in rote learning, persuasive design must proceed through step (2), a tunnelling of the learning tasks with support from teacher surveillance, in order to strengthen mastery and self-paced active learning. Step (3) is learning tailored to self-monitoring and mastery in self-directed practice. The last step (4) assumes that persuasive suggestion can be generated through machine learning and algorithms from artificial intelligence. It will generate complete learner autonomy and adapt to each learner's personal interests in reading the Hebrew Bible.[1]

The new concept of persuasive corpus-driven language learning has been developed as the RAMP model, short for relationship, autonomy, mastery, and purpose, the four crucial components of persuasive drive. As a launching pad for learning, the RAMP fires the initial stimulating purpose (P) of interested beginners and takes them progressively deeper into autonomy (A) and mastery (M) of language skills until they reach the ultimate heaven of social learning in relationships (P) among learners and in jobs (Winther-Nielsen 2014: 87-88).

The two most crucial needs of learners are to have instant feedback on their practice and to be able to track the learning outcomes in an ongoing assessment. This requires first a reduction of the hard task to practice the right forms and check whether an answer is right or not. While some teachers reject grammar practice as demotivating rote learning, the theory predicts the opposite through an encouraging reward of efforts. Through dedicated training learners improve their outcomes and experience a gratification from instant conditioning of improved performance. This is also how language acquisition works when toddlers through thousands of attempts get their language skills automatized. The usual language class usually only offers few manually constructed and artificial exercises, and delay in grading leaves the learner uncertain of success. In contrast, Bible OL instantly processes a learning task according to the morphological and syntactic data on the text stored in the database. The learner can have limitless canonical expert response for self-corrective training of skills.

The second essential need of learners is to be able to track their improvement of learning outcomes in an ongoing assessment. Bible OL now has a module for performance tracking, plotting learning outcomes in graphs and tables. This module will list how many correct answers were given per minute, at what speed, and for how many questions in total.

The goal of the EU project was to stimulate reuse and repurposing of persuasive technology, and we did so for Bible OL. It is now a website of the entire Hebrew Bible with grammatical information up to the level of clauses and sentences as stored in the syntactic database of the Eep Talstra Center for Bible and Computer for its Biblia Hebraica Stuttgartensia Amstelodamsis text (Kingham and Peursen 2018). Through the query language of an Emdros database, Bible OL can retrieve all linguistic data and turn queries into tasks for practice. Not only can the learner actively explore the text at all linguistic levels, but the learner also has access to endless practice of self-corrective training 24/7. In this sense, the database system serves as the engine of the leaning technology, working as a digital content generating teacher.

The interface for this database offers navigation for learners to log in, chose a language and a variant, and then decide whether they want to have the text displayed for enquiry or to practice a particular

[1] The technology exists. James Tauber experimented with the first graded reader for Greek in 2008 and presented his strategy of development for a number of years, and he is also developing a graded reader for Latin. There is a Github version from 2015 at https://github.com/jtauber/graded-reader. See all his projects for Greek at https://jktauber.com/projects/. Unfortunately, we do not have funding to implement his solutions for Bible OL.

language skill. Navigation also supports customization of fonts, enrollment in classes, tracking of performance and more. When learners engage in either enquiry or practice, they can select the grammatical features on word, phrase, clause, and sentence level illustrated in figure 1 for interlinear display or for pop-up display on each word. This is then the dashboard allowing learners and their facilitators to operate as individual self-paced directors of personal learning projects. The interface is also a conceptual illustration of skills that need to be mastered.

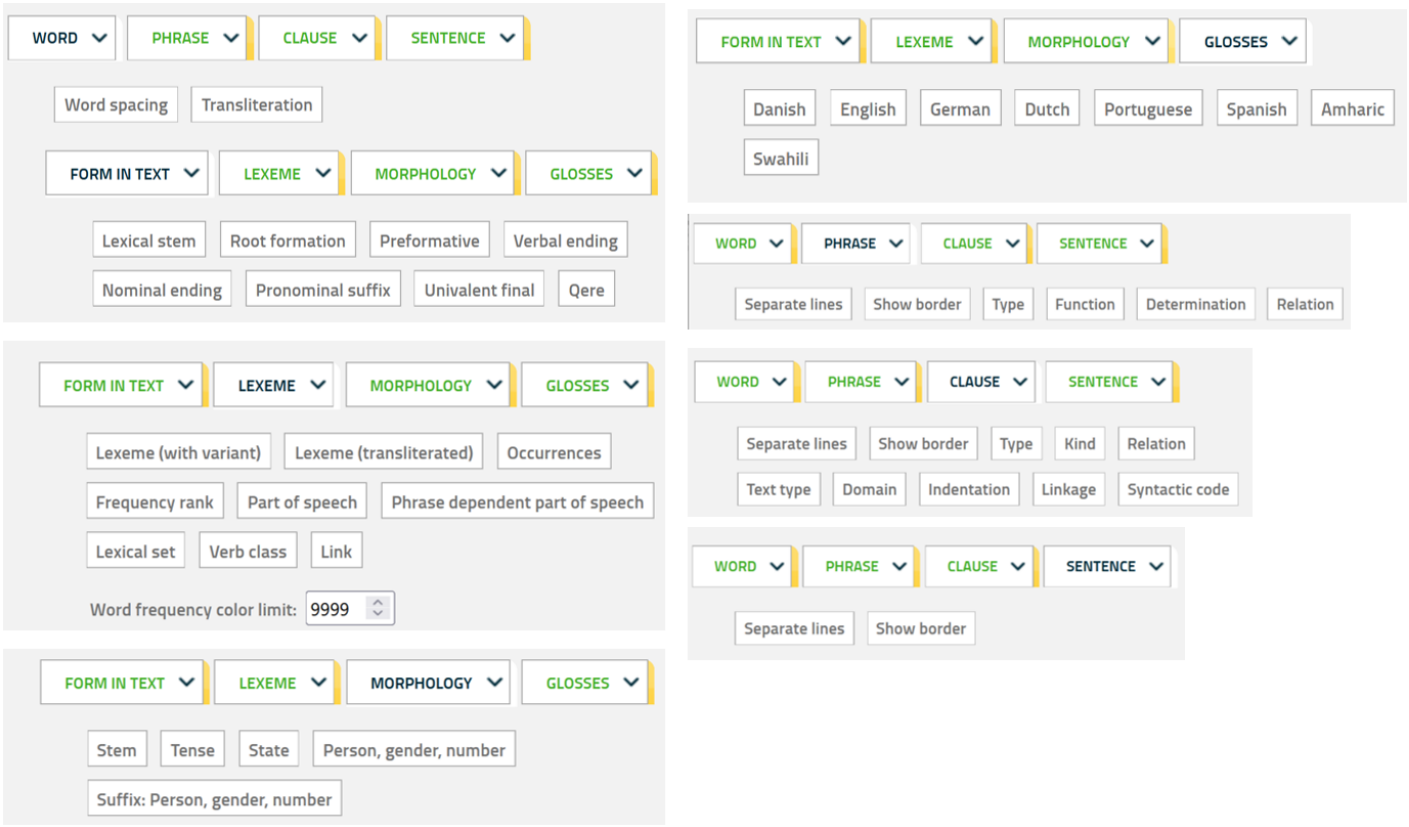

Figure 1. The grammatical and lexical features for learning Hebrew

The details of our agile development of this technology since 2008 need not detain us here, but has been tracked elsewhere (Winther-Nielsen 2011, 2019: 145-147). Suffice it to say that development has responded to needs of learners at Fjellhaug International University College in Copenhagen, Andrews University in Berrien Springs, the Lutheran Faculty of Theology in Madagascar, and the Mekane Yesus Seminary in Addis Abeba. Through online development we have implemented a responsive web design in order to more easily use Bible OL on mobile devices. We offer user-friendly Google and Facebook login, support for class administration and localization into English, Spanish, Portuguese, Chinese, Danish, Swahili and Amharic. The programmer of this technology offers a completely open source code for download on github (https://github.com/EzerIT/BibleOL). Other developers now join to improve usability (a Dutch DaDEL project) or add an exam module (a project at Andrews University). This guarantees ongoing development of the code despite lack of funding.

The basic distinction between a text database as an engine and an interface as a dashboard and their role in Bible OL can be further clarified by adopting Laurillard's (2012:59-63) model for learning from an external practice environment adapted in figure 2 from Laurillard (2012:61, Figure 4.1). The

model is a *knowledge-action-feedback-modulation* to explain how we learn (2012: 70). Learners must have access to a model of the relevant actions and their outcome, and actions must be within learners' current practice capability, as informed by their current conceptual organization. They learn from a learning designer's conceptual organization and from feedback on previous actions and articulations.

In our implementation of Laurillard's model of design for learning, Bible Online Learner is the external learning environment designed as a persuasive interactive Hebrew Bible for enquiry and practice. Facilitators are responsible for Model Action (B_E) as instructors of classes or peers collaborating in teams. Both the interactive Hebrew text and instructional content in digital learning objects such as video or text offer Explanation (C_C). Modulation of procedure and content fire the Action to achieve a goal (D_E) through checking or showing the correct grammatical information to be learned. Formative or summative exercises can be inspected by facilitators and monitored by users in order to start a new loop of enquiry and practice. The model also illustrates the absence of Articulation of (D_C) and Comments (F_C) on conceptual comprehension.

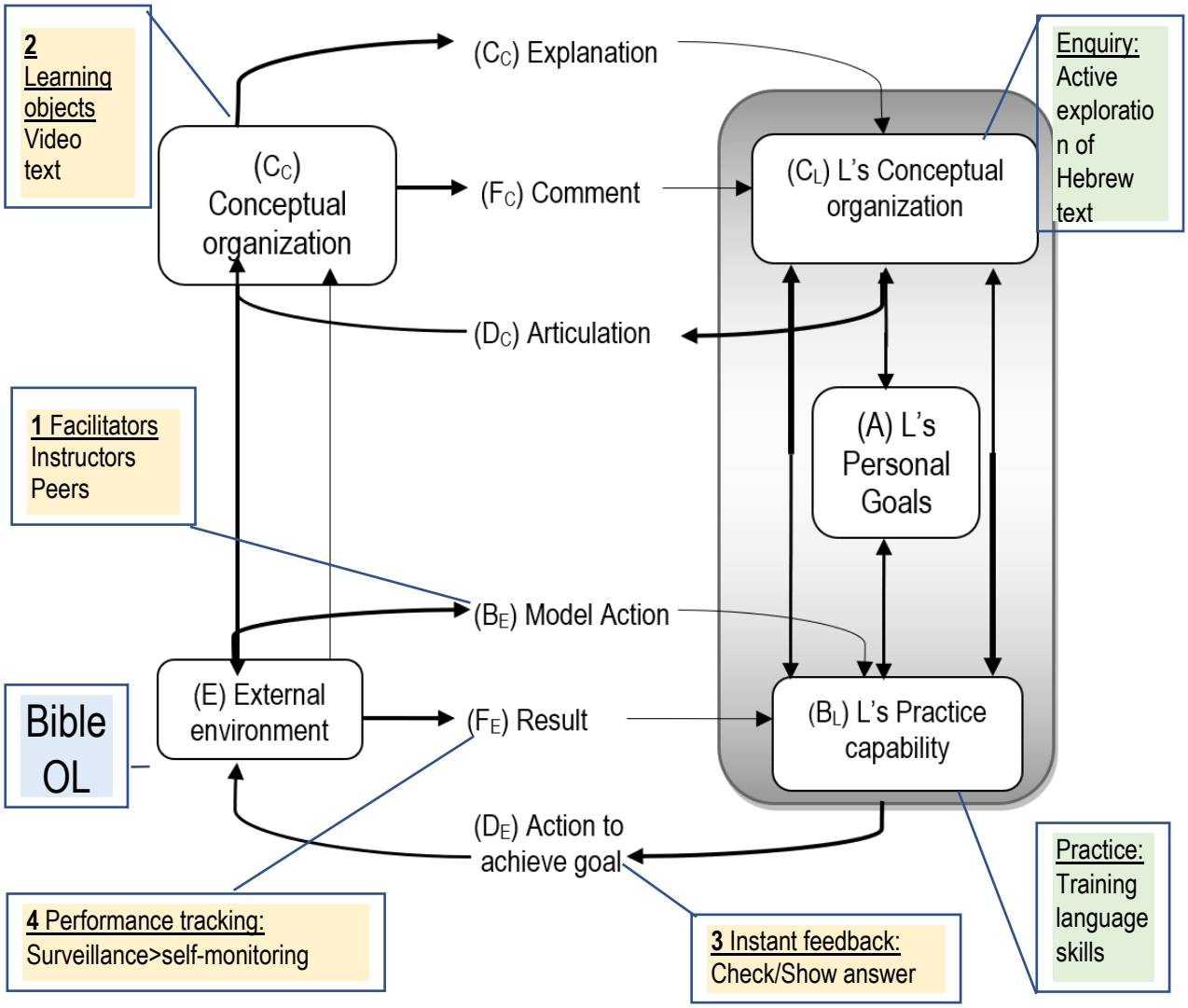

Figure 2. Bible OL as a model for learning from a practical environment

This practical environment and the theory behind enables a learner to get digital support for the most simple first step in active learning. A facilitator can create exercises from the corpus that gives the learner an option to practice his/her knowledge on forms through yes or no answers. This reduces the challenge of training one's mastery of the language, but the instant feedback also serves as an effective behaviouristic response mechanism.

This is the first simple technological step in plotting progress. It reduces reduce the efforts to be invested in practicing forms and the conditioning through instant feedback offers an immediate reward of the efforts invested in the learning tasks. This is the essential core of Laurillard's model for learning from an external source through instant feedback (3) and performance tracking (4).

2. Plotting progress through the curriculum

Once we have a robust persuasive technology, we can take the second step of tunneling and surveillance for persuasive learning. It is necessary to implement this design step before the learner can reach a completely autonomous and self-guided mastering of reading. We can now focus on persuasive design rather than persuasive technology, and we shift from practice capability in Bible OL to cognitive content in My Biblical Hebrew. Plotting progression is now a matter content organization.

Persuasion through tunneling implies that learners adhere to a pre-defined path for learning and thus inevitably are deprived of their freedom to follow their desires. Learners loose do not have full autonomy on their progression thorough the learning content, yet the persuasive force is still at work to the degree that tunneling offers the fastest track to best practice in language learning. In terms of the RAMP model, each new learning object must be sufficiently challenging to capture attention, yet not overly demanding to prevent progress. This is a matter of measuring how long it takes for a learner to finish a specific task correctly according to a standard set for each exercise. In terms of Laurillard's model, (3) instant feedback and (4) performance tracking establish requirements for (2) learning objects.

Bible OL is not a modern state of the art UX design and new learners do not find help on how to learn well from the website itself. We kept the essential engine and dashboard separate from teaching content to be provided outside Bible OL. The platform My Biblical Hebrew Moodle uses the world's most popular learning management system with some 184 million users globally (https://stats.moodle.org/). Through Moodle, we have state of the art user registration, data security, notifications, discussions, and e-learning modules developed by an active community of thousands of programmers and learning designers in open source and completely free of charge. The use of a separate website to deliver the learning content provides the opportunity to develop for user-friendliness. Bible OL's exercises are stored in folders created for specific classes and are easy to copy-paste into a fancy learning environment. Learners then never need to bother with directories and subdirectories in a quite technical file system. They just need to login at Bible OL and can then practice tasks that are fully integrated into the learning content in a Moodle or another learning environment.

My Biblical Hebrew is created as three modules that were designed from the beginning for corpus-driven language learning. The course material is designed for 7.5 ECTS, with each individual credit equal to 28 hours of student work according to the standards defined in the European Union Bologne process for accreditation of higher learning (cf. http://www.ehea.info/cid100210/ministerial-conference-bologna-1999.html). Three modules of 2.5 ECTS each equal 70 hours of student work, for a total of 210 hours, as part of various course offered at Fjellhaug International University College

in Oslo, Norway, and most of the learning is based on Genesis 1-3 as the learner corpus. An English online course equal to 20 ECTS uses a set of texts that will help the learner read Biblical texts with fluency (Bullard 2019).

Exam results are documented through performance tracking of learner proficiency in Bible OL tests followed by a final oral online or face-to-face exam focusing on checking skills in reading, translation and grammar. For each course, 60 % of the final grade is based on tests in Bible OL. There is no preparation time before the oral exam, because the goal is to document to what extent the proficiency scores are active automatized knowledge.

Bible OL's tracking of accuracy of correct answers, proficiency in terms of correct answers per minute, and scope in relation to number of exercises from particular texts is exemplified in table 1. The test in question tracks how well a learner masters the conjugation of the two Hebrew verbs, the *yiqtol* form and the *wayyiqtol* form. Accuracy as percentage of correct is straightforward, but speed will vary from task to task and needs to be estimated from performance of dozens of learners for low, high and elite values. It is clear that 96 % correct for 381 questions at an impressive 30.4 correct answers per minutes testifies to fluency, while on the other hand 93 % correct is not acceptable, if the learner only does 4.3 questions correct per minute, and only for the small number of 30 answers. Fortunately, three learners performed above the normal high score.

Table 1. Test 6 in the MBH1 module: parse regular (way)yiqtol forms

				Low 6
				High 21
				Elite 31
Student	**Date for exercices**	**Correct answers**	**Number of questions**	**Questions /Minute**
[redacted]	2019-08-27	88%	75	10.0
[redacted]	2019-07-05	96%	75	16.7
[redacted]	2019-07-06	97%	105	16.8
[redacted]	2019-08-22	97%	78	12.8
[redacted]	2019-08-23	96%	156	16.5
[redacted]	2019-08-27	97%	105	6.9
[redacted]	2019-08-27	92%	165	17.6
[redacted]	2019-08-28	98%	105	31.5
[redacted]	2019-08-30	90%	153	20.8
[redacted]	2019-08-26	93%	240	22.2
[redacted]	2019-08-27	97%	186	24.5
[redacted]	2019-08-28	93%	153	27.0
[redacted]	2019-08-24	93%	90	12.7
[redacted]	2019-08-27	93%	30	4.3
[redacted]	2019-08-23	96%	381	30.4

In the following discussion we will explain the design for learning through 210 hours of enquiry and practice. The first author designed the three modules with eight units for each and aimed for tasks that could occupy learners for 8 hours per unit, which leaves 6 hours for the final tests within the 70

hours allotted to each module. Each of altogether 24 units concludes with a formative proficiency test through which the learner can monitor actual accuracy and speed as indicative of proficiency. After each of the three modules there are six summative tests that have to be passed before the learner can continue to the next module (they are available for inspection and trial at https://bibleol.3bmoodle.dk/text/select_quiz?dir=GLI%2FProficiency%20Tests).

The following three tables list the main content of each unit plus the actual time used by the second author, to be discussed in section 3. The aim was to develop a sufficient number of formative exercises to enable practical learning as the primary task for all units. The design of learning content adhered to a principle of less is more and gradually reduced scaffolding (are these two different principles ["less is more" and "gradually reducing scaffolding"], or is this all one principle?). The early parts of the course had extensive detail on learning to read Hebrew, but later on instruction on morphology was gradually reduced in order to enhance explorative task-based learning, and syntax is supposed to be learned gradually through the study of texts. All content was introduced in tiny bits and pieces for instant practice through one sheet hand-out introductions that summarized content. The same essential content was then explained in pedagogical screen-capture videos that ideally last only 5 minutes, or 10 minutes at the most. The rationale is that many learners just need a bare minimum for a start and then will learn forms and rules more effectively through active practice in a trial and error process profiting from negative feedback. Other students will prefer primers or reference works and will then use their practice to test their grasp of the literature.

The first author's strategy in design for learning was to use the creation account and the Eden story from day one to motivate learners. All basic Hebrew grammar is introduced from Genesis 1:1-5 in MBH 1, widened to Genesis 1:6-2:3 in MBH 2-1, and completed for Genesis 2:4-3:24 in MBH 2-2. The second strategy was to focus on the most frequent forms in the Hebrew Bible first. Learners therefore do not in the beginning focus on forms that some require for conversational purposes, but are not used frequently in the texts, or in a different sense than in Modern Hebrew.

As for the details, the four first units of MBH 1 in table 2 aim to practice spelling and typing Hebrew. All rules and skills for reading and typing the Hebrew text have to be neatly divided into numerous discrete tasks organized according to the topics in table 4. The trick is to introduce small parts for training and then expand with content and skills that assume only what the learner already knows. Like Hackett (2010), all consonants are not learned before the vowels, but groups of consonants are introduced gradually along with vowels to ease pronunciation. We divide the consonants in a different way than Hackett in order to present a chiastic arrangement into series of Latin or Semitic consonants that are easier to learn and memorize.

Table 2. MBH 1: Beginner's workhours and topics

READ TYPE	**1**= 6 hrs	**2**= 13 hrs	**3**= 4 hrs 30 min	**4**= 5 hrs 30 min
	10 consonants A-vowels, roots	13 consonants Vowels	Dagesh 72 proper names	Shewa, reading Type Gen 1:1-5
NOUN **Basic VERB**	**5**= 9 hrs 30 min	**6**= 4hrs 30 min	**7**= 9 hrs	**8** = 3 t 30 min
	Nouns number, gender, class	Phrases, definiteness	Nouns construct Possessive prep.	(*way*)*yiqtol*
	+ 6 hrs	Vocab 101	**Test**= 2hrs	**64 hrs 10 min**

Unit 1 focuses on the notion of verbal roots that can be learned with their usual a-sounds for pronunciation, and unit 2 introduces the rest of the consonants as well as other frequent vowels. The first occurrence of all new consonants or vowel signs are always pointed out in the first chapters of

Genesis, because this helps the learner understand its frequency. Already in unit 2, the first author follows the brilliant idea of Bergman (2006) to use personal names for practice to read and type, introducing the 20 most frequent names are for typing consonants. In units 3-4 all remaining vowels are exemplified by the 72 proper names occurring 50 times or more in the Hebrew Bible. By unit 4, the learner is then ready to play the role of a copyist who has to type the Hebrew text of Genesis 1:1-5 supported only by a transliteration of the text. From a list of similar forms used in the Hebrew Bible, the learner in a kind of multiple-choice fashion has to select the correctly spelled Hebrew form based on a transliteration of the Hebrew form used in the text.

Units 5-8 introduce the notion of learning the 101 most frequent words ranked from 1 to 101 in terms of decreasing frequency. Unit 5 introduces practice of gender and number of nouns, an overview of simple patterns in the vocalization for unchangeable nouns, and two-syllable nouns with shifts in singular and plural and the segholates, following Cook and Holmstedt's (2013) overview of vowel change. After presenting practice on nominal and prepositional phrases in unit 6, it is possible to focus on word modifications through the "constructus" phrase relationships. Thanks to the hierarchical display of the text as words, phrases, clauses and sentences, learners are familiar with phrase structure from the beginning and know that a word is just a graphical unit, while phrases are essential constituents in clauses. However, the real goal of MBH 1 is to reach the *wayyiqtol* and *yiqtol* conjugations as fast as possible in unit 8. When learners master these forms, they are able to successfully parse more than 3 out of 4 of all verbal tenses in the Hebrew Bible.

Table 3. Content for spelling and typing in MBH 1 unit 1-4.

Consonants	**Vowels**	**Words**
Unit 1:		
A A(*ʔāleph*) - B- C(*gīmel*)-D	A: *qāmeṣ, pataḥ*	בגד, אבד
. B H-W-Z-Ḥ: *the H-series*		זבח, חזה
. . C Ṭ-Y: the two unique	…	חטא, היה
Unit 2:		
. . C´ K-L-M-N [Royal Dutch Airways]	I/E: *ḥireq, ṣērê, segōl*	לֵוִי, בָּבֶל
. B´ S-*ʕayin* (~O)-P- Ṣ; *the S-series*	silent *šᵊwāʰ*	בִּלְעָם, בִּלְעָם
A´ Q-R-S-Š-T	O: *ḥōlem*	שְׁלֹמֹה, אֶסְתֵּר
Unit 3:		
long vowel markers	*û, ô, ê, î*	בִּנְיָמִין, יוֹסֵף
doubling *dāgēš*		אַשּׁוּר, אֱלִיָּהוּ
	audible *šᵊwāʰ*	יַרְדֵּן, מְנַשֶּׁה
Unit 4:		
	more audible *šᵊwāʰ*	רְאוּבֵן, שִׁמְרוֹן
	ultra short *ḥāṭûf, ḥāṭefs*	יַעֲקֹב, רָבְעָם
Reading aids		

In MBH 2-1 in table 4, the knowledge of the pervasive verbal tense *wayyiqtol* makes it possible for learners to recognize most verbs in reading Genesis 1 for the next 70 hours. This form and the text calls for an introduction to the volitive functions of wishes and permissions which are expressed with by "cohortative" and "jussive" forms as prominent topics for divine monologue, and the imperative is just a 2nd person *yiqtol* without the preformative syllable. Because the goal is to learn a full qal regular stem in first part of MBH 2-1, it is natural to proceed to another non- preformative tense in

unit 2. Learning the less frequent *qatal* must precede the practice of infinitives and participles in unit 4, along with adjectives that have the same conjugational patterns as the participle.

Table 4. MBH 2-1: Basic initial workload and topics

QAL	**1**= 10 hrs	**2**= 5 hrs	**3**=1 hrs 30 min	**4**=10 hrs 30 min
SUFFIXES	Volitive	*qatal*; "nom" cl.	Suffix PP/NP	Non-finite; Qal
REGULAR STEMS	**5**= 3 hrs	**6**= 3 hrs	**7**= 5 hrs 30 min	**8**= 9 hrs
	Hifil; I´´alef	Piel, Hitpael	Nifal; III´´alef	Gutturals
	+10 hrs 30 min	Vocab 202	Test= 2 hrs	**60 hrs 34 min**

The only reference work explicitly recommended from MBH 1 unit 5 and onwards is a tool box developed by Halabé (2017). The third volume of her Hinneh material for practical Biblical Hebrew has tables listing all the most frequent forms of nouns with suffixes. This resource offers a complete overview of the essential forms to learn, and it is cheap as an online resource. The first author adheres to many of Rahel Halabé's (2022) principles of the practical way of learning Hebrew. From MBH 2-1 he introduces her color-coding of verb conjugations, which is available in the online version, though not in the printed version. Finally, he has successfully tested her proposal to introduce suffixes as early as possible, starting formative training in unit 7 for the following exercise:

> A prominent feature of Biblical Hebrew is to attach pronominal suffixes directly to the words they modify. The first exposure to this system is to learn how the singular forms of the pronouns are attached to the preposition לְ 'to, for'. … Note well that 2nd masculine singular pausal forms have a special form marked by silluq (לָךְ) or the ascent atnah (לָךְ).

As learners already have practiced preposition plus suffix, it is very easy for them to recognize the first suffixes in the Hebrew Bible in Genesis 1:11-12. In unit 3 of MBH 2-1 they also soon learn the two forms that suffixes can have when they attach to nouns and prepositions.

The main strategy for vocabulary learning is to learn and memorize glosses through their inflected forms in the text. The 101 most frequent words are introduced for initial but informal training in MBH 1, but in MBH 2-1 the 202 vocabulary is introduced gradually during the eight units, 12 words per unit and with reference to Halabé (2017). Learners can practice these forms earlier or later, when and where they like, depending on whatever gives them most pleasure and joy for learning. They can train with or without the lexeme form listed, but they are regularly exposed to the actual and frequent forms used in the text. The course material emphasizes that the 303 most frequent glosses must be learned as an automatized skill.

Most primers will introduce the "nominal clause" or verbless clause as the first grammar or very early on, presumably because this clause type is considered simple formations, or they have value for an immersion approach. However, from a Biblical linguistic point of view they are complex and demanding constructions. First, the learner has to comprehend that nominal, prepositional and adjectival phrases can be used as predicates, and that the copular *be*-verb can be left out. This can all be explained from the three different clauses in Genesis 1:2. However, they also need to understand the distinction between obligatory phrases such as subjects and complements and facultative phrases like manner adjuncts and temporal and locative setting phrases. When the first author therefore introduces the verbless clause in unit 2 of MBH 2-1, his purpose is to have the learner begin training of simple grammatical analysis of verbal and non-verbal predicates along with subject, object and

complement. This kind of analysis is slowly and gradually expanded to include functions of more complex forms until the learner is well trained in grammatical analysis of all of Genesis 1-3 after the end of MBH 2-2.

For the second half of MBH 2-1 the goal is to learn the regular verb in all stems following frequency principles. The learner is first introduced to the forms of the next most frequent stem, the *hifil*, and its core use as a morphological causative. In unit 6 the learner has the challenge to learn *piel* and *hithpael*, and to struggle with an understanding of the use of *piel* on the basis of the 25 verbs that occur 49 times or more in this stem in the Hebrew Bible. Unit 7 is the occasion for introducing the notion of passive stems and practice *nifal*, as well as *pual* and *hofal*. The conclusion in unit 8 focuses on full training of the regular and the guttural verbs in all stems. The few I´´alef verbs are trained in unit 5 and the III´´alef in unit 7.

The MBH 2-2 in table 5 covers the last 70 hours of the MBH basic modules. We will not go into detail for several reasons. First, the focus is on learning irregular verb classes and this would be the same in other introductory courses, except if you learn all of them along with the regular verb classes. We start with the most frequent irregular pattern, the III´´hei forms (unit 1-2), proceed to I´´nun and I´´yod verbs (unit 3) and I´´waw (unit 4), continue with II´´waw and yod (unit 5), and finish with the rare and highly irregular geminate verbs (unit 6). By unit 7 the learner is ready to parse all frequent verbs and in unit 8 should be able to recognize all verbal forms with direct object suffixes.

Table 5. MBH 2-2: Basic sequel workload and topics

IRRE-GULAR	**1**= 11 hrs 18 min	**2**=2 hrs 39 min	**3**=1 hrs 18 min	**4**=1 hrs 37 min
	HYH, *wayyiqtol*	III´´H; numbers	I´´N, I´´Y	I´´W, pronouns
SLIM SYNTAX	**5**= 1 hrs 59 min	**6**= 1 hrs 6 min	**7**= 2 hrs 23 min	**8**= 2 hrs 28 min
	II´´W/Y; adverb	II´´Gem; dem.	All verbs	Objekt suffix
	+24 hrs 7 min	Vocab 303	Test=5 hrs 36 m	**54 hrs 37 min**

The unusual calculation of the time spent by the second author for the MBH 2-2 module (+24 hours and 7 minutes) is explained by the fact that she tested a preliminary version of the course and then later the second version developed for learning in the fall of 2019. It was only at this stage that the first author introduced the training of less frequent forms like the Hebrew numbers (unit 2), personal pronouns (unit 4), adverbs (unit 5), and demonstratives and interrogatives (unit 6).

The first author over the coming years will continue to design and test new elements for the MBH 2-2 component of the course. The first author has developed a verb cruncher with a series of pseudo-algorithmic steps for parsing of verbs following Hackett (2010). It has a stepwise procedure for the analysis of highly irregular, but also very frequent, *wayyiqtol* forms and these steps need to be better integrated into practice. But more than anything else, in the next loops of design, performance tracking, and evaluation for re-design, the first author will need to develop a gradually evolving slim learner grammar from the reading of Genesis 1-3 and then slowly unfold this grammar during the reading of more text after the MBH 1 and 2 modules. At this stage, the reference grammar of Van der Merwe et al. (2017) will serve as the main resource for training of syntactic skills.

The Danish learner, Frederik Stølen Kofoed**,** quoted above for his preference of online learning has commented favorably on the general design for learning. He finds the balance between presentation of cognitive content and practice capability especially helpful:

> Furthermore, there is a clear rationality in the course material, because you need to be introduced to a fair amount of grammar in the beginning and this is then constantly and repeatedly trained in ongoing practice.

Encouraged by our work on design for learning, we will now proceed to the real issue of how to plot the persuasive force of our design for online learning.

3. Plotting Online Learners' Progress

When the full potential of persuasive technology and design for learning is implemented, we are able to take learners to the third step of persuasive tailoring and self-monitoring. The goal is now to understand to what extent persuasive technology can enhance self-guided mastering of reading. At the same time, we can now also focus on the learner's experience and actual progression in learning.

Our analysis of the online learner's performance rests on feedback from early June until the end of October 2019. A short version of this program has been presented by Halabé (2022: 108-109). The data were created by the two authors in a project on co-design in order to "develop scenarios that may promote more flexible learning experiences and address students' individual needs and goals, thereby attempting to focus on the student experience of learning" (Garcia et al 2018: 1). The project began when the second author of this paper wanted to study Hebrew during the summer, more than two months ahead of other learners, and voluntarily shared extremely valuable feedback on upstart and user experience. The first author realized the potential for documenting use of time and learner experience on a daily basis in a kind of online diary for co-design.

The second author is a full-time midwife at a hospital and a full-time theology student as well as a mother, but was still able to put in some estimated 813 hours of work on learning Hebrew and give feedback until the end of December. The diary consists of a daily reporting by the second author in six files shared on Google Drive. They consist of 167 pages of unedited learner feedback and facilitator response for co-design. These documents are referred to in the following as 01 to 06 followed by page number reference, and the date is added in the format YYMMDD, e.g. the second author in the third documents on page 7 on July 18 remarks that the number of repetition tasks may not be sufficient (03: 7 [190718]).

The data provide empirical data on learning processes and how much time was spent on each of a total of 319 exercise tasks constructed for the MBH 1-2 modules. The diary data guided agile course development. When new tasks were created, the second author would test them, and the facilitator could evaluate whether an anticipated effect could be ascertained. If not, an exercise could be improved and tested again, or else removed. In this way the first author implemented the build, measure, and learn cycle used in lean start-up development (Ries 2011). The data also helped us select topics for a simple introductory guide for new users based on learner-experience (03: 8 [190718]). The performance tracking module of Bible OL also makes it possible to compare the second author's performance with other learners' performances. One option is to have the module plot the total working hours for half a year for all students active in the course in figure 3. This figure shows the activity of the second author on this module during weeks 24-27 and then other learners joining to learn primarily in weeks 33-35.

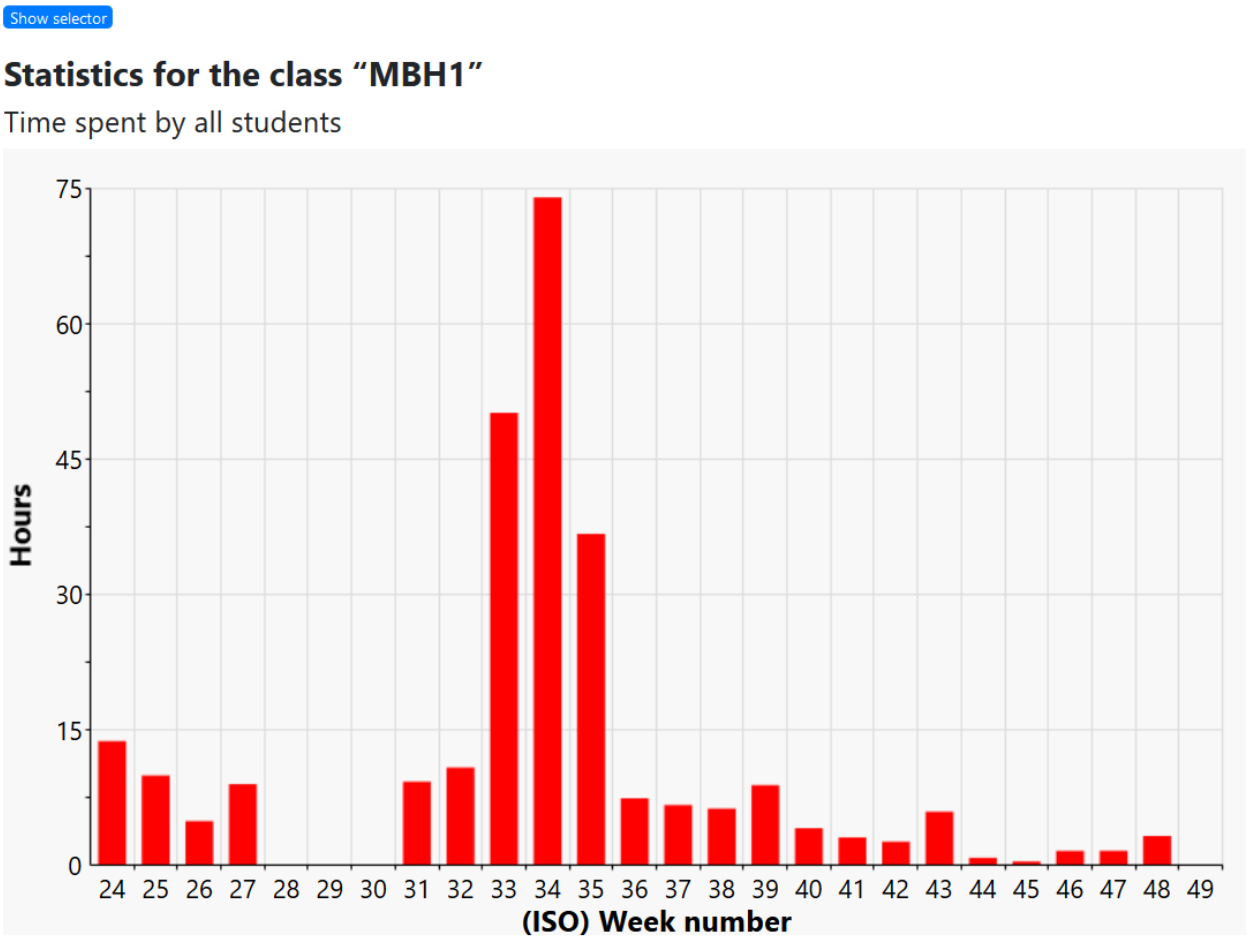

Figure 3. Bible OLs graphical plotting of time for all MBH1 students

Data are also available in a table format that allow the facilitator to use them for plotting the relationship between the total time spent on practice and the proficiency of a student in table 6. It helped the facilitator understand that when weaker students who do not learn an ancient language practice more they are able to improve their results considerably, while students without the same challenges do not exhibit the same tendency for practice time. Some will study reference material for a longer time and only check their ability to understand, while others will learn everything through practice. In any case, ultimate success will depend on proficiency demonstrated through practice on vocabulary, morphology and syntax. Without using the time it takes to reach 80 % correct answers at a diagnostic speed per minute, depending on the exercise in question, a learner will not be able to master the language well. Facilitators can use such data on individual learner to decide who may need special attention.

Table 6. Time consumption for students in week 31-39 and total for MBH 1
Total* covers week 24-49; for population, see below

ID	*31*	*32*	*33*	*34*	*35*	*36*	*37*	*38*	*39*	*Total**
1		02:17	04:01	02:07	02:40				00:07	11:11
2			00:25	00:30	00:31	00:03	00:09		00:03	37:60
3	01:22		05:39	04:20	02:07					22:28
4			05:19	06:26	04:22					13:28
5	02:24	02:31	03:05	00:15	00:19	01:00	00:51			16:13
6			06:14	13:09	13:44	01:06			02:28	37:11
7			11:08	10:29	00:56	00:16				22:49
8			03:57	05:51	03:58	00:03		00:01	00:10	14:49
9			02:45	08:50						11:49
10			00:18		04:36	02:34	01:10	01:03	00:32	20:03
11				00:33	00:07	01:47	00:42	00:10		04:05

We can also compare the performance of the second author with four other online learners during a few weeks in figure 4. The total time ranges from 38 hours down 4 hours and 5 minutes for student 11, who did not proceed to the final exam.

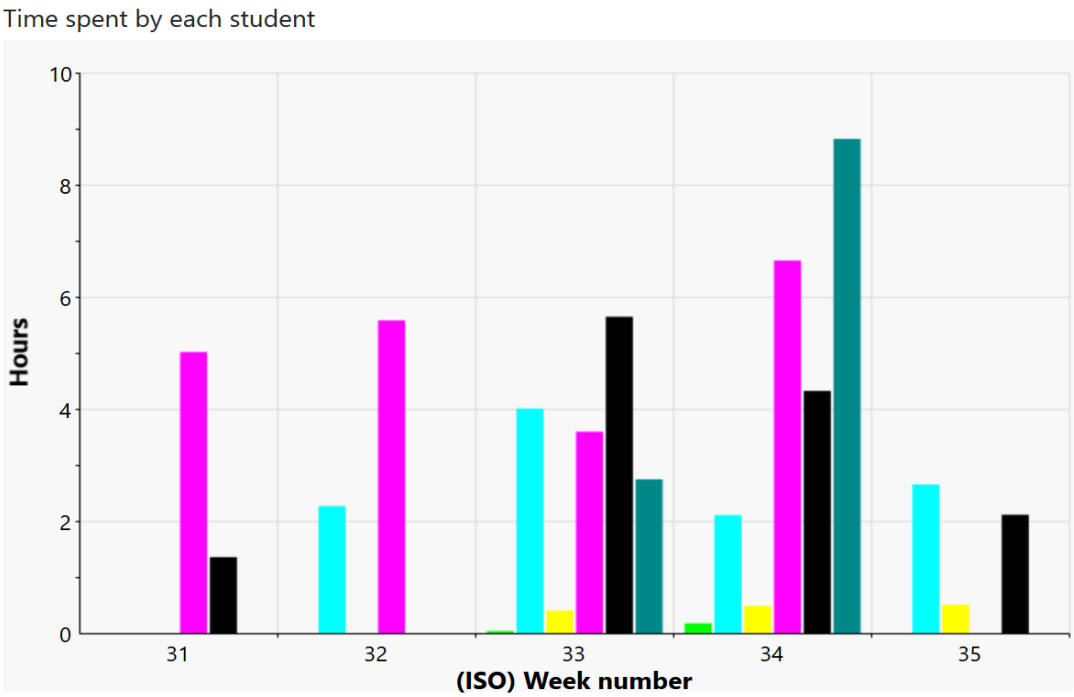

Figure 4. Bible OLs graphical plotting of selected online learners

The overview of the second author's total time consumption throughout the three modules in table 7 indicates the balance between exercises and other activities for the second author. To have such unique data is very rare, and it helped the first author learn how an online student learns, and he was then able to take this information and inform other students about the time they need to spend in each individual unit in the course.

Table 7. Total time spent on learning activities by second author

Activity	MBH 1	MBH 2-1	MBH 2-2
Exercises Time/	38 hrs	26 hrs 52 min	25 hrs 12 min
Total number (approx.)	13000	15500	10000
Study	15 hrs 5 min	12 hrs 14 min	12 hrs 13 min
Anki vocab	10 hrs 20 min	12 hrs 58 min	7 hrs 7 min
Reading	10 min	8 hrs 30 min	10 hrs 5 min
Translation			9 hrs 5 min

One of the important aspects of the second author's learning strategy was to learn how to read correctly by checking through transliteration (03:11 [190707]). She soon started to read texts aloud in order to get familiar with the sounds of the language in the texts (03:6-7 [190719]). Because of the value of this strategy she recommends that online learners get virtual support from a facilitator who can correct wrong pronunciations that otherwise are stored in memory with the wrong sound (03:29 [190720]). After two months of study, she was able to develop her own strategy for reading (04:8-9 [190814]): (1) first, she focused on pronunciation [190707-190724]; (2) next, she worked on increasing the speed of her reading [190725-190804]; (3) then, she read texts aloud and tried to translate word meanings [190808-190813]. During the rest of August, she read new texts in a kind of devotional mode and experienced the greatest pleasure of the day through this method of study (04:13 [190821]). We believe that this persuasive force must be enhanced in future curriculum design.

The second author also observed how performance is influenced by practice based on sheets and videos, which gradually wean her off instructional support (03:27 [190715]). Persuasive learning theory posits loops that develop an individual's path for enquiry and practice. After having finished the tests for MBH 2-2 (04:26-27 [190825]) she reflected on completing 95% of the exercises correctly and on how she is now able to: (1) parse verbs; (2) keep track of the relationship between correct and incorrect answers in order to improve results; (3) master the most frequent forms of a new topic by heart after a few hours of practice; (4) use mental dedication and energy to perform well on tests. Furthermore, when a good result is obtained under the pressure to achieve accuracy and proficiency through a high number of correct answers per minute, this fluency is not lost when the test is repeated at a later stage.

For grading, the first author followed data on mastery learning which puts language proficiency at 81-87 % correct (Kime 2015). Speed is a strong indicator of proficiency because it prevents reliance on instructional material, and dozens or even hundreds of reiterated correct answers require automatization of language skills. However, at the end of the MBH 2-1 course the second author reflected on the hindrance of speed caused by slower computers or poorer kinetic movement (03: 56 [191008]). While the first author acknowledges this fact, he nevertheless defends the proficiency tracking, because an oral exam following summative tests can detect the degree of automatization independently. Furthermore, only the 24 summative tests rely on proficiency, while all the other formative tests leave ample room for deep thinking about the exercises in study phases. However, while 80 % correct should be the goal of formative tests to indicate proficiency, the final tests may be passed at a lower percentage correct and at a relevant speed, allowing weak learners to get a chance to proceed to the oral exam with the lowest permissible grade, if appropriate. For most exercise 60 % correct will be accepted, in some cases such as syntactic analysis even lower, but speed per minute

for correct answer need to indicate that the learner is not using reference resources in order to document a particular language skill.

We used the Danish online learner Frederik Stølen Kofoed as our control participant because he would be the first learner to use what we had designed and tested. Towards the end of the course, the first author arranged for an independent person to do a short survey with this learner. His feedback was translated by the first author in order to serve as independent input for our study. This responder confirms the evaluations of the second author on efficiency and effectiveness of persuasive learning and on vocabulary learning.

Efficient practice: The second author gradually discovered the most efficient practice procedure. For any text she found it was best to begin to practice on grammatical functions of phrases, then to focus on new and difficult words, and finally to practice all instances of the 727 vocabulary items occurring 50 times or more (06: 26 [191026]). At some point she reflected on the fact that sometimes it is not immediately clear what a task is trying to help a learner learn. In this sense, practicing language learning is like a puzzle: in the beginning it is difficult to see where pieces belong, but gradually the learner gets the whole picture. This was the experience when practice of the regular verb in *qal* was expanded to include guttural verbs (03: 49 [190807]).

She also discovered the value of a cyclic spiral in her learning strategy. After practice of a specific form, it is most helpful to quickly move on to other content, but then to return to the previous task until it is learned proficiently (06: 33 [191008]). In her experience, grading on the first day yields a lower grade on the next day, but continuous practice over the next several days solidifies easier recall (06: 23 [191026]).

The first responder leaner in the survey elaborates on the efficiency of the learning environment:

> The best part of Bible OL – and what distinguishes it crucially from face-to-face teaching in the language classroom – is that every learner has to go through all aspects of the language. The course material forces the learner to explore all grammar, morphology and translation. This might be more time-consuming, because the learner cannot skip any area, yet the advantage is that all aspects of the language are included. The constant repetition of all aspects of the language increases the efficiency of the learning.

Effective practice: The second author struggled at times with having too little information on a specific task, yet she also realized that it is very persuasive to be able to figure out on her own how the morphology works (03: 18 [190710]). She assumed that practice constantly creates connections in the brain through instant feedback and believes this is why she did not need more theory in her instruction (03: 53 [190808).

Bible OL practice helped her decide on the right balance between working through all the formative exercises and then proving a high accuracy and speed in the unit proficiencies and tests (03: 13 [190708]). She originally decided that having 80 % correct answers at a speed higher than the minimum required for a specific task would be sufficient, yet she would find herself motivated to improve to 90 % correct. It felt wrong to leave a task at only 89 %, but if she only had achieved 81 %, she would think twice about whether it would be worth her efforts to improve accuracy (06: 31 [191008]). Aiming for a high accuracy from the start may slow progression forward through the course, and online learners therefore need to prioritize what to learn next and even when to leave a topic for later. New tasks will motivate learners to learn new subjects and do more tasks, and they can calculate the costs involved in improving their proficiency. Monitoring progression does not only give persuasive reward, but also stimulates strategic reflection on learning.

Our responder Frederik Stølen Kofoed also mentions this as highly motivational:

> Hundreds of micro-tasks for practice constantly increases engagement and satisfies a competitive disposition in the human condition.

Vocabulary acquisition: The driving force behind Bible OL is to help learners study and memorize vocabulary text-by-text in inflected forms that are rich in contextual connotations. The strategy of the second author as a second language user of English was first to learn to spell difficult English words and then to look at other words in a clause in order to convey meaning from context and activate contextual memorization (03: 28 [190719]).

The first author has seen learners use decontextualized memorization programs for rote learning like Memrise (www.memrise.com) and Anki (https://apps.ankiweb.net) fail badly on translation of texts because learners only remember dictionary meanings at best, but do not associate actual words with contextual connotations. The second author confirms that she has learned much better to recognize inflected vocabulary and remember contextual meaning (03: 54 [190809]). After having finished MBH 1-2, she realized that precious memorization time was wasted on using Anki rather than on more effective reading of the texts (06: 32 [191006]). She finds it directly demotivating to study vocabulary that is infrequent and out of context. She prefers learning 8 or 10 words at a time in a regular progression rather than 25 words (06: 25 [191023]).

Frederik Stølen Kofoed confirms that contextual vocabulary learning enhances reading of the texts and for this reason is highly persuasive:

> The strong emphasis on learning words is also meaningful, because it makes it much easier to read texts, and the need for consulting a dictionary is reduced considerably. You get the sense of really being able to read the texts.

This response in effect shows how self-directed learning can foster deep learning beyond an instructional class environment. The responder wanted to read more texts on his own and asked the first author to tailor additional vocabulary learning to his persuasive drive for learning.

With these data, we believe the qualitative evaluations of the two authors are corroborated by the evidence and can "pick the online learner's brains." We now have empirical baselines for persuasive learning processes to guide new online learners.

4. Online learner's relationship

Our point of departure was Cobb's vision to deliver the teacher with the text to "places where human-peer reading tutors and teachers are not available and computing is needed to replace human resources to the extent that they can" (Cobb 2006: 640). We have so far presented our evidence for delivering the text as the learner's persuader, but we still need to address crucial aspects of social learning.

The fourth step of persuasive design, suggestion, is not supported directly through Bible OL at present. Bible OL cannot suggest new passages to read based on what each individual learner already knows, nor does it suggest which tasks to practice based on what hundreds of other learners would usually do. We are not able to point out who the best learners in the world are based on data mining.

However, Bible OL as is can still be used for tasks to support the ultimate goal of learning. Persuasive suggestion is in the RAMP theory defined as relationship. From this perspective, the goal of persuasive language learning is to enhance supervision by teachers, collaboration among peers and informal social learning. In terms of the famous zone of proximal development, all design for learning must ultimately aim for "the level of potential development as determined through problem-solving under adult guidance, or in collaboration with more capable peers" (Vygotsky 1978: 86).

Our first responder, Frederik Stølen Kofoed**,** rightly pointed out that this is one the main challenges of online learning:

> What is missing in comparison with the normal classroom is a teacher, depriving online learners of the opportunity to ask grammatical questions. … However, [the first author] is always easy to reach and he is eager to answer questions online. This requires that one records questions to ask the teacher on a daily basis.

The first author at the outset encouraged online learners to contact by Skype, but many students are reluctant to do so. Some learners no doubt want to solve problems on their own, while others do not want to disturb a professor or they fear asking silly questions. The reasoning is not entirely clear.

Another solution grew naturally out of the co-design process. The second author on her own initiated a self-directed peer-based instructional project in order to help another learner. The first author encouraged this as part of his recommendation to form learning teams for peer-based collaboration. The goal is to encourage learners to actively articulate their understanding of content and practice according to Laurillard's model (D_C). Furthermore, online contact fosters a relationship that is crucial for social wellbeing. This added value to the co-design processes as well, because the second author was able to receive peer-based response on her own cognitive understanding of the content. This generates some of the comment (F_C) on learner comprehension, if shared with the facilitator.

Based on the data on leaner progression through units in section 2 and the learner experience in section 3, we can now make comparisons with a control group of 15 other learners. Of those in the control group, our primary responder, Frederik Stølen Kofoed**,** and three other learners worked online. Four other students preferred to engage in social learning while using the first authors' instruction in blended learning. They formed a single learning team, had a weekly question and answer session and passed a traditional 5-hour sit-in exam. For data protection reasons details on individual performance cannot be shared, but both groups in the end reached B levels on an average (a score of 80-89 %). Three other online learners had full-time jobs or other tasks and proceeded at a much slower pace, postponing exams to a later stage. Finally, four other learners unfortunately never started practicing. Their excuse was lack of time or illness, but possibly they were not able to learn this way.

Thanks to the crucial process of co-design and qualitative evaluation, the first author has been able to improve the course in different ways. His primary conclusion is that online presence needs to be strengthened through regular online sessions, and online students need to practice peer-based learning. He started formulating a slim learner syntax for MBH2-2, and a skeletal syntactic understanding must be formed at an earlier stage through on a text-by-text basis. Finally, oral production needs to be stimulated. Online learners must be able to practice reading aloud and do problem-based translation exercises on a regular basis in order to gradually build active reading skills. However, in Halabé's experience, communicative components "used for practice can support BH curricula when they are used in addition to, not *instead of* the systematic, though learner-friendly, presentation of *needed* grammar and the considerable input of authentic biblical text" (Halabé 2022: 105). Presumably, even better results could be achieved if learners were exposed to live interaction and simplified language use in a live setting in Israel.[2] This assumption will be tested in a course in

[2] The best program for Bible translators is offered by Mirja and Halvor Ronning at the Jerusalem Center for Bible Translators (https://bibletranslators.org/). A popular alternative is Randall Buth's program at the Biblical Language Center (https://www.biblicallanguagecenter.com/). Rahel Halabé will March 13-17 2023 in Jerusalem in collaboration with Elisabeth Levy and Nicolai Winther-Nielsen test this hypothesis in her course on "Modern Hebrew for Biblical Hebrew Students" for learners trained in Bible OL as well as other learners (see the information https://biblicalclassical.online/).

Jerusalem, 13-17 March 2023 on Modern Hebrew for Biblical Hebrew Students taught by the author of the Hinneh primer, Rahel Halabé (2017). We expect that fostering rudimentary oral and productive skills and scaffolding with cultural and geographical knowledge will enhance reading, translation and communication of the Hebrew Bible, and it will help us to strenghten the corpus-driven learning process through interactive engagement.

Our empirical data underpin that a successful upstart is the "weakest and most vulnerable part of a persuasive technology" (Winther-Nielsen 2014: 10). In fact, an intensive face-to-face learning week at the beginning of the course is the optimal solution, and an intensive course after the end of MBH 2-1 or 2.2 would be extremely useful, if offered in the live setting in Jerusalem. Indeed, research shows that online learning is more effective when it takes place in conjunction with some form of interactive learning such as communication with the teacher and with fellow students (Castaño-Muñoz, Duart, and Sancho-Vinuesa, 2013). Some of this may be replaced by online activities for learners who do not have the means to attend a physical course, but at least do have internet access.

Another significant lesson is the value of the engaged online learner involved in co-design. The second author is an excellent case for how learners trained through 500 or more hours of learning are able to serve as teaching assistants and modulate their skills for other learners, and they will be tomorrow's ambassadors for persuasive corpus-driven learning. All data on progress plotted so far seem to indicate that Bible OL can generate very rich and deep online performance when supported by peer- or team-based learning.

A small group of only 16 students is not a representative population for evaluation, and the course is under constant construction and improvement. Our impressive results are preliminary, and they need to be corroborated by valid statistical data from true double-blind testing. However, similar results have been obtained in a blended learning class with 30 students at the Mekane Yesus Seminary in Addis Abeba in February and March of 2019, and they confirm data from Madagascar and Copenhagen (Winther-Nielsen 2017: 8-13). Such blended learning classes provide an opportunity to explore how a flipped classroom can enhance the effectiveness of persuasive technology and design for learning.

Conclusions

This paper has discussed the four steps in design of persuasive learning of Biblical Hebrew driven by the Hebrew Bible itself. Thanks to a co-design project, we have been able to track the online learner's progression through a course, evaluate progress through formative and summative tests, and redesign the course from daily and extensive feedback.

We first argued that persuasive progression can be documented from a corpus-driven system offering constant feedback for modeling formative practice, and we introduced a theory of persuasive learning to guide us in evaluation. We then pointed out how the first author's design for learning would optimize the learning processes required to be able to read the Hebrew Bible. Next, we discussed how the second author's learning experience give us solid evidence on self-directed enquiry and practice. Finally, we suggested how to enrich online corpus-driven learning through intensive face-to-face courses, peer-based collaborative learning and exposure to language and culture in Israel.

If funding were to be obtained, Bible OL could be improved through machine learning and artificial intelligence that would improve autonomy and mastery. At present, we can improve the design of

course material and hopefully get data from more learners, as we localize Bible OL and teaching material in new languages.

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