EXPERIMENTAL STUDIES OF THE AFFORDANCES OF ASSISTIVE MULTIMODAL LEARNING DESIGNS: UNIVERSAL DESIGN FOR LEARNING IN MODERN LANGUAGE CLASSROOMS

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Abstract: *This paper presents the data from two empirical studies of the learning affordances of a novel sui-generis language learning material, whose design is guided by universal design for learning (UDL) principles. Excepting a pilot study, the two studies appear to be the first outside the US to explore UDL principles and technology integration in language classrooms. The author conducted 9 + 14 interviews of stratified respondents from experimental studies in two year-seven language classrooms after a series of three interventions. In the interventions, three ebook prototypes with UDL-guided digital scaffolds were used in regular teaching, collaboratively planned, implemented, and evaluated by the teacher in question and the author. The paper in part supports earlier findings from previous UDL empirical studies in language learning but elaborates individual learners' learning experiences interacting with individual scaffolds, studying how lexical acquisition and competence and self-regulated learning can be scaffolded in a componential UDL design.*

Keywords: universal design for learning [UDL], experimental study, language acquisition, language teaching, multimodal

Introduction

The teaching of English literacy is important for educators across the globe. Of modern languages, English has become the language of science and professional international communication (Crystal, 2003; Pandarangga, 2016) but also a preferred lingua franca in online social media. English is taught as a compulsory subject in 86 percent of the countries of the world (Crystal, 2003; Pandarangga, 2016), and increasingly, countries outside the English-as-a-native-language (ENL) inner circle expect applicants to have communication skills in English (Pandarangga, 2016). For a long time, English has been considered a global language and a leading lingua franca (Crystal, 2003). Unsurprisingly, research has identified adverse educative Matthew effects of accumulated (dis-)advantage regarding English literacy (Ari, 2013; Lamb, 2011) both in English as a second language (ESL) learners and English as a foreign language (EFL) learners. Global trade and industries call for the acquiring the four c's—critical thinking, creativity, collaboration, communication—of the 21st century skills, stipulating (international) digital literacy and collaboration skills, which are intrinsically linked with English proficiency.

Lexical competence is closely linked to (reading) literacy (Hsueh-Chao & Nation, 2000; Laufer & Ravenhorst-Kalovski, 2010; Rosado & Caro, 2018). Therefore, it is relevant to examine how digital scaffolds can be used in vocabulary acquisition. Without sight words—words immediately recognised by the reader—reading fluency is compromised. Moreover, struggling readers tend to use a bottom-up reading strategy, which is prone to affect global reading comprehension negatively (Laufer &

Ravenhorst-Kalovski, 2010). This strategy may obviously compound self-regulated learning processes as frustration or learned helplessness. Unsurprisingly, empirical studies in self-regulated learning also ascertain that "students need to have both the will and the skill" (Pintrich & De Groot, 1990, p. 37).

Aims and Contents

This paper aims to investigate how a UDL-guided instructional design for reading may increase engagement and foreign language learning by investigating the learners' functionality usage and learning afforded by multimodal scaffolds removing recognition networks barriers. The paper begins by providing an empirical and theoretical background and then presents the design of the instructional material, then the method followed by the analysis of interview data and a subsequent discussion and conclusion.

Theoretical and empirical background. The present paper draws on UDL theory and practice, primarily addressing recognition networks and providing the learner with multiple means of representation (Center for Applied Special Technology [CAST], 2011; Kasch, 2018). "Providing multiple means of representation" is but one pillar of the socio-cognitive UDL framework for learning based on socio-cognitive neuro-didactic studies of the learning brain consisting of

a. Recognition networks dealing with how to sense and assign meaning patterns to what we see and how to understand information, ideas and concepts.
b. Strategic networks relating primarily to executive functions" and being specialized in generating and overseeing mental and motor patterns so as to plan, execute, and monitor actions and skills.
c. Affective networks specialized in evaluating patterns and assigning them emotional significance, enabling the learner to engage with tasks and learning with the world around us. (Hall, Meyer, & Rose, 2012, pp. 2–3)

All three overlapping networks represent learning-process areas. Universal design for learning is guided by the idea that all learners display dynamic diversity in each area, and the rationale is thus for instruction and instructional materials to respect diversity to give access to learners and activate their resources. Rather than just provide ad-hoc retrofit solutions to special needs, such as general-purpose digital assistive software packages for learners with dyslexia or other learning disabilities, remedial functionalities can be integrated in main-stream learning designs (Rose, 2007).

Reviews of foreign language literacy studies reveal that lexical competence has been found to be strongly linked with reading comprehension (Caro & Mendinueta, 2017; Rosado & Caro, 2018). Early studies into lexical competence addressed vocabulary breadth dimensions and reading comprehension. Hsueh-Chao and Nation (2000) found that adequate reading comprehension for all participants called for a lexical coverage of a statistically inferred 98 percent of textual lexis. However, these numbers for coverage were challenged in Laufer and Ravenhorst-Kalovski (2010). Moreover, Laufer and Aviad-Levitzky (2017) studied the validity of vocabulary multiple-choice word recognition test vs. recall test and found that recall tests had lower results than word recognition tests. Comprehension vocabulary was better detected with the word recognition test. As for teaching vocabulary, Laufer and Rozovski-Roitblat (2011) pointed out in their review of studies into incidental vocabulary acquisition vs. form-focused instruction:

> it follows that vocabulary learning is determined by repeated encounters with

> the words and by quality of attention that learners pay to them (or elaboration, or involvement) during a communicative or any other learning task. (p. 395)

Laufer (2003) found word-focused activities were significantly superior to mere incidental reading activities for vocabulary intake, which were corroborated in a later study (Laufer & Rozovski-Roitblat, 2011). Additionally, ELLs in 4th-grade in a UDL classroom manifested second-language lexical competence gains as well as comprehension gains when reading lessons were paired with text-to-speech vocabulary and strategy supports (Proctor, Dalton, & Grisham, 2007).

Engagement has been studied extensively in the literature on self-efficacy deriving from the agentic positive psychology of Bandura (1994, 2007). Studies of motivational and self-regulated learning components of classroom academic performance found a positive correlation between self-efficacy, intrinsic motivation, and academic performance (Pintrich & DeGroot, 1990). Because scaffolding has been found to aid task-persistence, it is relevant to examine whether learners' interaction with the scaffolds exhibit self-regulation and task-persistence (Wood, Bruner, & Ross, 1976).

Description of the Functionalities of the Instructional Design

The author constructed the instructional material using cast.org's bookbuilder e-book platform (see Figure 1). The platform features a built-in text-to-speech and highlighting functionality and an editable glossary interface that affords hyperlinked multimodal glossing. The author digitised and augmented an existing EFL learning material for Danish year-seven classrooms to feature a compendious bilingual multimodal glossary (text, sound, and image) and a bilingual retelling functionality representing paragraph contents and response field with a reflection question.

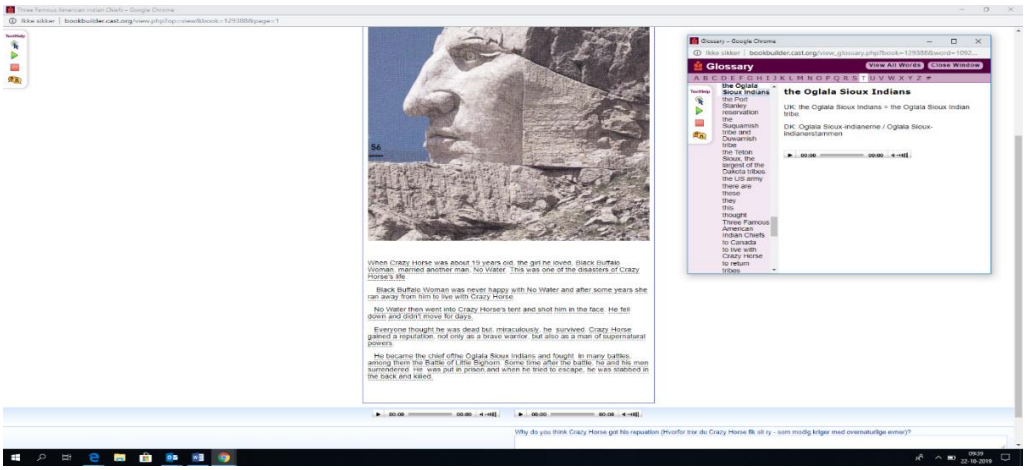

Figure 1. Screenshot of e-book designed by the author. It has nine scaffolding functionalities comprising of (a) compendious textual glossing in English, (b) compendious textual glossing in Danish, (c) pictorial glossing (see Kasch (2018) for multimodal semiotic and multimodality theories underlying multimodal glossing design), (d) compendious English audio glossing, (e) compendious Danish audio glossing, (f) retelling in Danish, (g) retelling in English, (h) text-to-speech with highlighting, and (i) a response field with a reflection question.

Method

Two qualitative studies of three interventions were conducted in two Danish public schools over four months and sought to have a representative breadth of learners and explore the learners' individual experiences learning English with access to comprehensive digital scaffolds. The learner diversity in the first study (Protocol 1) comprised four points out of a five-point range of proficiency levels scored at the Danish national English proficiency test (i.e. the strata clearly below average, below average, average, and above average) were all represented in the interview round of Protocol 1. As no clearly-below-average performers consented to being interviewed in the second study, Protocol 2 featured average and below-average, and above-average interviewees. No clearly above average performer was found in the two classrooms studied. Planning and running lessons were a collaborative effort by the participant teacher and researcher in search of ecological validity (i.e. applicability in real-world learning environment outside laboratories; see Brewer, 2000).

In strict conformity with Danish ethical standards, all interviewees were informed consenters as were participant schools. The first school was in a socio-economically middle-income municipality district but as can be seen from the sampling of learners in the classroom at hand performing a little below the national average. The second study was carried out in another municipality with a somewhat lower socio-economic base, but on average performing very well given the socio-economic variables though not for the intervention classroom at hand, which featured four times the national average of clearly-below-average performers and no clearly-above-average performers. In every intervention, reading activities led up to an oral communicative task. Field notes, recorded meetings, and lessons were shared with the individual teacher participating to give their points of view.

The author conducted semi-structured interviews with 23 student respondents translating research questions into interview guide questions into everyday language (Brinkmann & Kvale, 2015; Kvale, 1983). The author asked students if and how they used digital functionalities and how they felt (if they did use them) the functionalities helping them to learn English. Conducting interviews, the author used screen dumps of the functionalities to aid subjects' recall of these when asking them about their learning experience regarding the function at hand. In general, the interview design asked respondents to give further experiences, comments, and viewpoints, if any. The author used humour and tried to his best to have a relaxed atmosphere when conducting interviews. Learners generally succeeded in conveying their learner behaviour, providing interesting data about both self-regulated learning and language learning associated with the use of the scaffold in question and the intensity/quality of the usage.

The author transcribed the interviews aiming at verbatim standards, annotating paralinguistic features (e.g. laughter and emphases), and attendant situational circumstances when needed for comprehension. Then the interviews were iteratively coded for usages with respect to use vs. no use of functionality to investigate usage variety in interviews. Initial analyses queried into reading comprehension and engagement in general, which were coded and later on confronted with self-regulation theory and studies (Usher & Pajares, 2008) as well as self-regulated learning studies including intrinsic motivation (Pintrich & De Groot, 1990) and flow (Csikszentmihalyi,

2014) for reiterated scrutiny and coding. Soon it became apparent that engagement, apart from being scaffolded by functionalities, involved both receptive and productive lexical competence. Confronting the data with lexical competence theories (Laufer, 2003, 2014; Rosado & Caro, 2018; Stæhr, 2009, 2015) and reading studies, the author inspired by Laufer (2003) and Laufer and Ravenhorst-Kalovski (2010) investigated learners' engagement in excess of mere reading by examining their reading-plus behaviour. In analysing and categorising reading-plus behaviours, new coding was introduced drawing on theories of attention in language learning (i.e. noticing theory; Schmidt, 2010; and pushed output; Canale & Swain, 1980) to account for usage behaviours. Also striking was the use of multimodal access to meaning content, which lead the author to study literature on multimodal sensory integration, ideas of multimodal integration, and learned super-additive effects, which manifested in interviews reflecting further reading-plus categories (Cheetham, 2019; Stephens & Kaiser, 2018). This line of inquiry called for yet another iteration of coding to examine how multimodal reading integration was perceived to affect reading comprehension in the interviewee responses.

The author used thematic meaning-condensation analysis of the interviews (Brinkman & Kvale, 2015; Kvale 1983, 1998) and found a variability of functionality affordances defined by Gibson (1986) as "…properties taken with reference to the observer…" being "…neither physical nor phenomenal" (p. 146) and what "an environment offers" (p. 127). Analogously, digital environments see affordances as what functionalities can be used and are used for by learners/users in human-device interaction (Beatty, 2013).

Thematic Analysis: Affordances and Experiences

The 23 interviews furnished the interviewer with a window on affordances in EFL learning as experienced by the diversity of learners in their classroom use of multimodal scaffolds. The analysis starts with examining reading task engagement.

Reading Task Engagement: Self-efficacy and Self-regulation

A recurrent theme in both protocols was how task-persistence—the student's management and control of their effort—was aided by the assistive functionalities. This finding seems remarkable as neither affective networks nor strategic networks played a prominent part in the scaffolds design and hence not the UDL model's cognitive components directly associated with self-regulation and self-regulated learning.

How comprehension scaffolds assist engagement and intrinsic motivation is illustrated in the excerpt from the interview of a clearly-below-average interviewee's account (Protocol 1, interview 1):

> KUM: Yes, to comprehend things. If you can't comprehend things up here (pointing at a page of the ebook), then you can go here (pointing at the re-telling function icons).
> I: So, you started reading here?
> KUM: yes.
> I: That is reading the text and then going down here and say okay I am not sure I understood this and then you could …
> KUM: (interrupting) yes.
> I: hear things in English or in Danish.
> KUM: Exactly!
> I: And you used … both of them, or?
> KUM: Yes. First, I heard things in English and then in Danish afterwards.

Here KUM told the interviewer how they can use functionalities for textual comprehension and that with access to re-telling functions in English and Danish, they can persist in the task even when failing to comprehend the text at hand. Immediately before, KUM spoke of how good it was to have assistive functionalities in general and that they used all of them. Assistive scaffolds here aided task-persistence in reducing barriers to learning (reading comprehension) and possibly alleviating degrees of learned helplessness, but the resources lead to doing more than just reading—listening to both further English input and Danish re-telling. Both comprehension gains and further input, that is further work on the lexis and domain at hand, were afforded by multiple means of representation.

Learners from all performance strata liked to have a plethora of functionalities at their disposal, even above-average learners, as expressed by OM3 (Protocol 1, 7):

> I: …Was it nice to have all the (assistive) functions?
> OM3: Yes.
> I: Yes.
> OM3: Then you can always, you know – then you know you can always make it (work)—that one can always get help from it—on the individual words.
> I: Yes.
> OM3: You are never stuck.
> I: Yes.
> OM3: which is delightful. (Parenthetical words added for comprehension.)

OM3's delight, indicative of intrinsic motivation at having the scaffolds (assistive functions) at their disposal aiding a smooth learning process is also attributable to the non-lemma glossing design.

> OM3: Then I would not have to look up words in dictionaries, so it was rather easy to deal with.
> I: Yes. Do you think–did it help you? How did it help you to learn English?
> OM3: With respect to some words, which at Ordbogen.com (an online bilingual dictionary used in the classroom) can be hard to use because…
> I: Yes.
> OM3: They (the words) are divided into different syllables–or (found in) inflected forms…
> I: Yes.
> OM3: then I just went to the form it (the word) was in (the text).
> I: because I have, I have, it is not just a base form.
> OM3: Yes
> I: I just take the form…
> OM3: exactly…
> I: that it is in.
> OM3: and that was rather delightful. (Parenthetical words added for comprehension.)

Direct access to glosses appears to be a removal of lemma glossing-related barriers to learning seen to impede OM3's reading process. In other words, the learner's delight and intrinsic motivation seem to reflect aided self-regulation and the pleasure of task-persistence and flow.

A few learners used to the response field for the intended strategic use (self-regulated learning), as found in OM1's response (Protocol 2, 1):

> I: Yes. How do you think it (the response field) helped you to learn English (laughing lightly)?
> OM1: It um -
> I: - if it did, you know?
> OM1: Yes, but it helped in the way that you…you had to think back on what you had learnt…
> I: Yes
> OM1: and then you had to give an answer.

Here OM1 uses the response field for reflecting on their learning, as was the original purpose of this functionality, but the increased engagement of writing the answer also implies a reading-plus strategy.

Reading-plus Strategies: Receptive Lexical Competence

Vocabulary learning depends on "repeated encounters with the words" and "the quality of attention that learners pay to them (or elaboration, or involvement) during a communicative or any other learning task" (Laufer & Rozovski-Roitblat, 2011, p. 395). It is more than just reading the text once.

Some learners used the text-to-speech functionality (TTS) with highlighting to have bimodal access to comprehending lexis, which research into multisensory integration and language learning point to as having what Cheetham (2019) calls a super-additive effect. In the clearly-below-average learner KUM's learning process (Protocol 1, 1) the strategy seemed to lead to intrinsic motivation and aided self-efficacy. The scaffolds enabled them to form positive expectancies of their ability to perform their reading task and extended their engagement into a reading-plus strategy. Providing multiple means of representation, thus meant providing multiple means of input. In this way, the original assistive functionalities afford inclusive practice and the help for struggling learners like KUM. KUM said it was a little "strange to use functionalities" at the beginning, but then "it became alright", suggesting that they had not had access to such functionalities before, which may be why they emphasised how good it was for them to have multiple input access.

Average learners used multimodal input as well, using a combination of text-to-speech and retelling functionalities for aiding reading comprehension. M2 responded (Protocol 1, 4):

> I: ... Yes, there was this TTS function with which you could highlight some of the text, and then there was yellow highlighting and blue highlighting telling you how far you had made it into the text. Did you use that for anything?
> M2: I did every time I read the text.
> I: What did you use it for?
> M2: to um get a – to understand things better –um – a little more precisely (than) if I was reading things myself.

It may seem odd that an average learner like M2, who was not a struggling reader, had just expressed that they did not need the sound gloss but used a remedial TTS function to heighten their reading comprehension. Super-additive effects and comprehension gains in multimodal access seemed to be manifested by M2. Another average learner (Protocol 2, 14) found another affordance in the TTS functionality—hypothesis-testing:

> I: Did you use the text-to-speech function? The one where you highlight …?
> M4: No. no. I couldn't … I used it for a few words
> I: yes
> M4: If you were thinking, "What kind of words are they?"
> I: Yes.
> M4: And then I had it read aloud and then one would think: now I know what it, it made sense, if you didn't quite …
> I: So, you used text-to-speech to make sure it was indeed the word that you thought it was?
> M4: Yes, you know what it's like.

Here, the TTS function apparently enables testing a lexical hypothesis and activating partial receptive lexical knowledge (Henriksen, 1999). Haastrup's (1991) ideas of lexical-inferencing and long-term memory

retention gains come to mind, but these have been rejected by Laufer (2003). However, M4's lexical inferencing is followed by a further bimodal hypothesis-testing comparing sound and spelling. This learner strategy elaborates and strengthens lexical competence paving the way (in part at least) for long-term memory storage. The additional cues in the aural input seem to involve multisensory integration of multimodal inputs with the perceived comprehension gains reported supplementing the learner's partial unimodal lexical comprehension. Moreover, the TTS function was used to heighten attention or for noticing and further or deeper processing resulting in a reading-plus strategy.

Around half of the learners experienced comprehension gains from pictorial glossing, as expressed by the average learner M3 (Protocol 2, 12):

> M3: I cannot remember which words it was exactly
> I: No. It does not matter anyhow.
> M3: yes.
> I: Because what I want to ask you – that is – um, did you use the picture?
> M3: It helped, you know. I looked at the text and then I saw the picture, and then I felt absolutely sure.

This average learner gives us clues how modality overlap aids comprehension and self-regulation, M3 apparently using pictorial input as feedback to test a hypothesis on lexical meaning, which when confirmed removes a possible comprehension barrier so that the learner can continue their reading process. An above-average learner from the first study, OM5 (Protocol 1, 7), even reported that they used the pictorial glossing first when consulting the glossary:

> I: Um – did you use the picture?
> OM5. Yes kind of. I looked a little at the picture…
> I: yes.
> OM5: because then you know what you are dealing with kind of, if it is something completely different or…
> I: yes
> OM5: s-something. And then I read the text afterwards.

The related experience presents a reversal of M3's learning path. Here, pictorial glossing helped the learner form a general impression of their lexical inferencing and then textual explanations are consulted for elaboration. As OM5 explained,

> I: So, so, you read perhaps … what-what, how, how did you read?
> OM5: I read this (pointing at the gloss in English in a screen dump) for starters
> I: in English, yes
> OM5: and if I did not understand it, then I just read, then I just read the Danish one (gloss in Danish)
> I: The Danish one, yes. Okay, so…
> OM5: Then I also listened a little to this (sound gloss)
> I: This you also used, what it is now, the sound, sound …
> OM5: yes.

In this excerpt, OM5 explained how they used the glossary, looking at the picture then the gloss in English, then the one in Danish, and then sometimes even the bilingual sound gloss, which they liked to (apparently out of intrinsic motivation) listen to because it was "a nice recital", as they "knew how to read it (the gloss)". Pictorial glossing here opens a trimodal reading-plus strategy, supporting both the learner comprehension and learning gains from super-additive effects, thus, strengthening intrinsic motivation and self-efficacy.

Reading-plus Strategies: Productive Lexical Competence

The functionalities also offered affordances for working with productive lexical competence. Thus, TTS bimodal input presented apparently still other affordances as found in this conversation from Protocol 1, 7:

> I: … Do you remember that there was this built-in text-to-speech function highlighting text in yellow and highlighting the word and highlighting in blue the word …that it had just reached? Did you use that one?
> OM2: Yes, I used that one, there was a time, though, when I had forgotten my earphones, but then I read instead.
> I: Yes. But if you had brought your earphones, did you use it then?
> OM2: Yes.
> I: What did you use it for?
> OM2: Um, I used it you know for kind of listening to – if there was a word I did not know how to pronounce…
> I: yes
> OM2: Then it pronounced it for me
> I: yes
> OM2: And then it was like, you know: well, okay the pronunciation is just like that.

For this above-average learner, the TTS functionality afforded a bimodal input useful for augmenting partial lexical knowledge and getting the pronunciation right as the learner said when asked to clarify how it helped to learn English. Such an affordance was also expressed by an average learner and a below-average learner, who also expressed that they used the functionality for working on pronunciation, of which UM2 (a below-average learner) in Protocol 2, 9:

> UM2: And then I listened to the text, you know, later on to – hear how the words...
> I: yes
> UM2: were to be pronounced.
> I: yes. So, you used it – okay – to get better at knowing how to pronounce it (the words)
> UM: mm (confirming)
> I: but maybe also to pronounce – did you practice the pronunciation of it?
> UM2: Yes. (parentheses added to original transcription for comprehension)

Here, we see how receptive practice may be used together with productive reading practice but an aware attempt at a gap noticed in one's lexical competence, and thus facilitating phonological pushed output.

Further in a couple of cases, the response field, originally meant to scaffold task-persistence and executive functions, also lent itself to working on productive lexical competence expressed by OM2 (Protocol 1, 6):

> I: What did you use it (the response field) for?
> OM2: I just wrote what it was I was told to write; if a question was posed on for example what I thought witches were.
> I: Yes
> OM2: but then I wrote what I thought it was.
> I: Okay. How um – how does it help you to learn English – Does it help?
> OM2: Yes, you get to, you know, think about how I can put this (in English).

Here the learner appeared to use to the response field for working on output, or how to express something in English.

In OM3's responses, productive lexical practice appears to work in with elaboration (receptive skills):

> I: Okay. Yes. Then there was this response field (pointing at functionality), which …?

> OM3: It was alright – then you got to – then you had a chance to elaborate a little…
> I: Yes
> OM3: after you had read the text…
> I: Yes
> OM3: And if you had not understood things, then you had to, you know, read things again so that you could answer the question and such. I thought it was nice that it was there.

Furthermore, self-regulated learning scaffolding is suggested, in the excerpt "then you had to, you know, read things again, so that you could answer the question".

Misaffordances and Overall Functionality Usage

Some learners, however, expressed suspicion of misaffordances of the remedial learning design, especially when asked if they thought it a good idea to have all such assistive functionalities in general. This idea is exemplified by the average-learner M1 (Protocol 1, 3):

> M1: Yes, but there must not be too much of it. There shouldn't be too much help because then we don't learn things by ourselves.
> I: So, you think that then you would just use the Danish one (retelling in Danish functionality)?
> M1: yes, yes.

Later on, when asked to clarify, it turned out that their apprehension concerned reading tasks not involving speaking or writing in English, though. A misapprehension similar was formulated by another average learner (Protocol 2, 13):

> M3: What I was thinking was that it would just be the easy way; then you might as well just stop reading it and listen to it and so on. Then you have sort of understood things in Danish, and then THAT is what you remember instead. I don't know if a lot would do that – to get it read aloud in English or something – and then just listen to it in Danish and then – just like being given a story in Danish.

Here M3 fears that people might be tempted just to have the passage retold and also feared that even an input in English would impede learning because people would not read the text and just remember the aural input, in general expressing that the access to scaffolds made things too easy. It is remarkable, though, M3 themselves reported preference for using retelling in English for comprehension gains, only using retelling in Danish once when struggling with a particular text, thus, used scaffolds as intended and engaged in an reading-plus learning behaviour.

Even so, all learners tended to engage in viable reading practices that would go beyond mere reading comprehension. Thus, interview data coding learning-relevant use only saw two learners not using (one possible below-average "outlier"—the only informant only appearing in the last intervention—and one above-average learner using only two) at least three functionalities, and four using less than four functionalities. This functionality usage is depicted in the boxplot below in which the lower whiskers (minimum values) of the respective strata below. (The singleton clearly-below-average learner has been lumped into the below-average stratum for ease of presentation). The box plot presents percentile-ordered data.

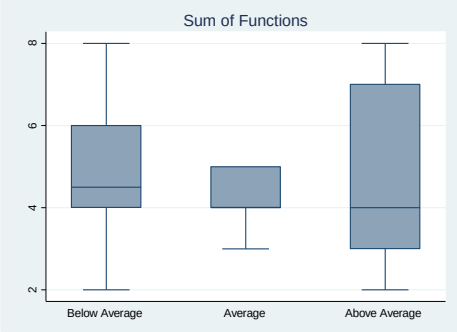

Figure 2. Box-plotted functionality usage in learner strata. The boxes account for 75 percent of each stratum, and here the respective strata represent functionality usage values between four and six for below-average learners, between four and five for average learners, and between three and seven four above average learners. In other words, multiple functionality usage - and hence enhanced engagement and lexical competence acquisition - seems to be the norm in the two-study sample, which is admittedly relatively small (n = 23), and hence, due caution should be taken.

Discussion

In general, the interview data seem to replicate findings from Proctor et al. (2007) and Strangman, Meyer, Hall, and Proctor (2014) with assistive technology like TTS being found to aid lexical competence in addition to reading comprehension. However, the novel affordances in design of compendious multimodal glossing and bilingual retelling functionalities scaffolded both executive functions and lexical competence acquisition. In other words, scaffolds helped learners self-regulate their learning processes and assistive functionalities and were put into meaningful vocabulary acquisition practice, including both usages foreseen and unforeseen. All respondents except one (a possible outlier) engaged in reading comprehension processes going beyond reading and incidental learning (Laufer, 2003). Learners' interaction patterns with the ebook prototype presented ways to pursue what may be considered reading-plus strategies stemming from a variability of affordances both scaffolding self-regulation, comprehension and lexical competence.

In general, interview data appear to support that the UDL-guided instructional material design is conducive to language learning and comprehension, and that both glossing design and retelling sources as well as working on the response field assisting learners in self-regulating their learning. In addition to aiding comprehension, learner experiences present a wide variety of reading-plus interacting with the scaffolds (Laufer, 2003).

However, eight learners pointed to misaffordances or negative affordances imagined occasionally citing their own observations of other learners. In classical scaffolding theory and social constructivist learning practices, it is vital that the scaffolder facilitates the learner's learning process and does not prevent them or let themselves prevent themselves from taking the next step into their zone of proximal development (Vygotsky, 1978; Wood et al., 1976). Experienced ease of learning as associated with intrinsic motivation or self-efficacy could give rise to suspicion of misaffordances, namely, learners engaging in intrinsically motivating behaviour at the expense of learning engagement (Wood et al., 1976). Here scaffolding also called for the tutor to guide the learner to have a task focus and not engage in task-irrelevant activities. Therefore, when an above-average learner is

so delighted by the easy access to lexical meaning, it could be speculated that a higher intake could have evolved from forcing the learner out of (overly) smooth learning flow. On the other hand, according to flow theory, too low learning demands are associated with boredom rather than delight (Csikszentmihalyi, 2014). When the self-same learner expressed avoiding using the retelling functionality in Danish, as it would make learning "too easy", the autotelic behaviour of the learner seemed to reflect a sound task engagement rather than counterproductive, self-regulated learning. Far more serious were the misaffordances owing to regular inexpediencies in the design found in the experiences of two learners—one with dyslexia finding the dotted-line interface a visual impediment and one with (self-expressed) OCD-like behaviour finding contiguous glossing hard to use when they only wanted one word. Although such inexpediencies did not compromise learning flow in general in the cases cited, self-regulation is at risk of being discontinued owing to (intrinsic) demotivation and negative self-efficacy.

The study used a sample of consenting interviewees, which may lead to biased answers. An aggregate sample of 23 respondents with verbatim-transcribed interviews amounting to approximately 140 pages may be fairly large for a qualitative study. In fact, functionality usage affordances explained found to be close to a point of saturation, with only a small deviation of explained experienced functionality usage found in the last series of interviews. However, different conditions in the two studies, with the latter study not being run contiguously may have led to less than optimal survey conditions (as does the absence of clearly-above-average learners in the two samples). Moreover, the interviewer participated actively in classroom teaching, giving them access to an ecological learning environment, and personal relationships between interviewees and researcher may have influenced the way comments were made.

Conclusion

This paper examined the affordances of a componential UDL design used in a Danish EFL classroom. Remedial functionalities aided both self-regulation and viable lexical competence acquisition strategies. The viability and efficiency of the strategies were made plausible by accounts of the learners' diverse interactions with functionalities, laying bare both self-regulation affordances like self-efficacy and intrinsic motivation as well as language learning affordances like multimodal super-additive effects leading to comprehension gains via multisensory integration, lexical inferencing with feedback, pronunciation practice, and phonological awareness. In this way, UDL-designs may help to reduce adverse Matthew effects and help educators promote plurilingual literacy in EFL learning environments across the globe. This seems to be the case if vocabulary learning is determined by repeated encounters with the words and by quality of attention that learners pay to them (or elaboration, or involvement) during a communicative or any other learning task (Laufer & Rozovski-Roitblat, 2011). A UDL design stimulates lexical competence acquisition for all learners by scaffolding the quality of attention, involvement, and elaboration in vocabulary learning across the language classroom.

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