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EXPLORING WHAT LOG FILES CAN REVEAL ABOUT LESLLA LEARNERS' BEHAVIOUR IN AN ONLINE CALL ENVIRONMENT

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ABSTRACT: The topic of the present paper is CALL research involving LESLLA learners. To date, both CALL and LESLLA have received scant attention in the research literature. Learner behaviour can be tracked to obtain insightful information about actual computer-user interactions in CALL environments. Log files are introduced in this paper as an accurate and precise, yet currently underemployed, research tool to investigate LESLLA learners' decoding skills. Based on log file information both the performance of LESLLA learners and their process of learning in a computer environment can be investigated. Previous studies have found that log files contain valuable information indicating learner engagement, preference and productivity. CALL applications have the potential to enhance the individual learning process and can be seen as a feasible solution for enhancing initial late literacy development of LESLLA students.

KEYWORDS: Computer-assisted language learning, log-files, learner behaviour, grapheme phoneme awareness, decoding

1. CHALLENGING LESLLA EDUCATION

Worldwide educators struggle with the challenge to provide language and literacy education to a very special population of adult second language (L2) learners that have traditionally been neglected by SLA research (Tarone et al., 2009; Van de Craats et al., 2015; Young-Scholten, 2015). Faced with this lack of academic research and growing numbers of low-educated adults immigrating to highly literate countries, LESLLA teachers are urgently seeking innovative and effective ways to support the L2 learning process of LESLLA learners.

Acquiring simultaneously oral and literacy skills is an enormous challenge for LESLLA learners. Their learning process is slower compared to literate learners with at least an intermediate or high level of compulsory education and LESLLA learners' L2 development is at risk of fossilization at an earlier stage (Van de Craats et al., 2006: 10). LESLLA learners also struggle to attain "a reasonable level of oral proficiency in L2 classes" (ibid.). It is important to bear in mind that L2 oral skills alone are not sufficient for LESLLA learners' successful integration in the highly literate societies LESLLA learners reside in. Literacy is seen as one major component in successful functioning and active participation preventing social exclusion (Van de Craats et al., 2006: 13).

Teaching LESLLA learners basic literacy skills can, nevertheless, be very challenging as LESLLA learners cannot benefit from native language (L1) academic and literacy skills. Further traumatic experiences, family responsibilities and worries might slow down their literacy progress (Tammelin-Laine & Martin, 2015: 53). Young-Scholten and Strom (2006: 50) highlight that weak L2 competence in general is detrimental for reading development, slowing down development of decoding skills and phonological awareness of LESLLA readers.

Previous research has established that due to their reciprocal relationship oral skills are indispensable for literacy development and must be enhanced accordingly (Lesaux & Geva, 2006; Young-Scholten & Strom, 2006; Tarone & Bigelow, 2005). This is highlighted by Birch (2011: 490) stating that "reading always recruits phonology". However, due to the lack of research, little to date is, known about LESLLA learners' alphabetic literacy development (Kurvers, 2015: 58).

In Finland, Tammelin-Laine (2014) investigated the development of oral and written L2 skills of non-literate adult immigrants. It was found that none of the participants achieved consistent emerging literacy skills during their first Finnish language and literacy course including 1400 hours of instruction over a period of ten months (Tammelin-Laine & Martin, 2015: 53). The insufficient provision of literacy training of LESLLA adults compared to L1 literacy training of children has further been pointed out by Van de Craats and Young-Scholten (2015: 130). A provision of more teacher-lead instruction time or an increase of educational staff seems, nevertheless, due to current and possibly future expenditure cuts in adult education, highly unlikely.

In the light of the challenges learners face, and in order to enhance the learning experience, LESLLA teachers are calling for new efficient and enjoyable methods and ways to speed up learning development and prevent learner frustration and language fossilization. Tarone and Bigelow (2005: 89) call for efficient teaching strategies providing oral and contextual support for developing grapheme/phoneme and other linguistic segmentation skills. Can CALL answer this call? Studies on Computer-assisted language learning (CALL) published since the 1990s have highlighted the potentials specifically in L2 learning, e.g. Dunkel, 1999. Computer technology has further been developed and used as a tool to help enhance language learning and academic skills as well as develop progressive learner behaviour. In addition, previous research showed positive effects on learning instruction for students with mild and moderate disabilities (Fitzgerald & Kory, 1996).

The following section introduces (CALL) for LESLLA learners and discusses its benefits for LESLLA learners.

2. EXPLORING LANGUAGE LEARNING THROUGH CALL

2.1. Benefits of CALL for LESLLA learners' beginning literacy skills

There are many advantages of CALL applications: the computer is patient, motivating and self-pacing, providing the learners with immediate feedback and enabling them thus to notice and learn from mistakes (Brown, 2007: 270). The stress-free CALL environment allows learners to practice at their own pace as often and long as they want (Cucchiarini et al., 2013: 97). According to Pennington (1996: 5), CALL input is more focused and individualized than many other learning media. This in turn increases and diversifies the learning opportunities for learners. Finally, CALL has also been found to enhance the learning experience, as learners tend to find CALL activities enjoyable (Luke, 2006: 31).

In addition to the individualized instruction provided by the CALL system itself, CALL also facilitates more individualized support for struggling students by freeing the teacher from tasks the CALL application can take on. Teachers can thus focus on "what only a teacher can do, for example involve learners in the interaction with other learners" (Van de Craats & Young-Scholten, 2015: 2). CALL seems therefore a liable solution for meeting the increasing demand for individual learning support of LESLLA learners, preferably in a blended learning approach.

Previous studies found a remarkably positive correlation between CALL training and LESLLA learners' oral test results (Strube, 2014: 269). Similarly, a study on LESLLA learners' literacy development by Kurvers and Stockmann (2009) discovered that time allocated to individual computer activities correlated positively with the participants' reading scores. Whole-group activities, on the other hand, were seen to have a negative influence on individual literacy development (Kurvers, 2015: 73).

For emerging literacy, systematic instruction in connecting sounds with letters, blending sounds, and identifying patterns in words is crucial to develop the necessary skills for making grapheme-phoneme correspondences and for identifying word boundaries. Usually explicit instruction is necessary (Tarone et al., 2009: 117). A CALL application could provide this essential instruction with plenty of opportunities to practice, ideally fostering both the development of literacy and language skills.

One innovative practice environment for the very first steps in learning to decode the alphabetical code is provided by the Digital Literacy Instructor (DigLin), an online literacy training system. DigLin, a multilateral European project, ran from 2013-2015 and included five partners from four European countries.[1] DigLin's main aim was to advance literacy training for adult immigrants learning to read for the first time in a language other than their L1. For this purpose L2 literacy material was developed and tested in English, Finnish, German and Dutch.[2]

DigLin's phonics-based structure method aimed to provide the beginning reader with an understanding of the structure of the spelling system and to foster connections between phonemes and graphemes. The seven different exercise types were designed to enhance different decoding sub-skills necessary for analysing words and their parts,

1 For more information, see www. diglin.eu.

2. Approximately one out of ten immigrants in Europa is non- or low-literate (Cucchiarini et al., 2013: 96).

blending graphemes and phonemes as well as to enhance the process of automatization necessary for reading development. In addition, DigLin also aimed to enhance vocabulary learning by providing visual cues for all words that could be practised, amounting to a total of 210-300 words depending on the exercise type.

The DigLin software was tested by LESLLA learners in different settings and countries by the participating partners in the UK, Finland, Germany and the Netherlands. The participants' use of DigLin was tracked by log-files during the whole field-testing which lasted four to six months. The log file database provided the data from the LESLLA participants in Finland for the study of Malessa (2016). Filimban (in progress) obtained the DigLin log file data from participants tested in the United Kingdom. The following section introduces log files and illustrates their value as a research tool in tracking student behaviour.

2.2. Log files – an innovative tool to track learner behaviour

One way to track learner behaviour in a CALL environment is to employ log files. Log files provide a precise and continuous interaction record between the user and the CALL environment in question. As log files are automatically created by the computer system, relevant events in a CALL environment are consistently and objectively documented in fine detail. Further log files provide temporally highly accurate information, as they are constantly time-stamped (Bodnar et al., 2016: 199). As a result, log file data analysis enables a very detailed post-activity investigation of learner behaviour. Chapelle (2007: 98-99) highlights that based on log file information learners' knowledge, strategies and processes can be examined and assessed. This in turn provides a holistic overview of learner behaviour pre- and post-production. In addition, Chun (2013: 256) emphasized that log file research can provide "valuable insights into both second language acquisition and pedagogical design", as log file data can serve as a way of confirming what learners actually do in CALL contexts.

Surprisingly, far too little attention has to date been paid to the fact that log files provide a great research tool to investigate students' learning behaviour in depth, as they are "temporally accurate and can log at a detailed level and with consistency and objectiveness" (Bodnar et al., 2016: 199). Bodnar et al. (ibid. 204) suggest that system logs can be employed to (1) evaluate reliability of learner self-report data, (2) cross-check what learners report with what they actually do, and (3) search for links between practice events and motivational outcomes.

Up to now, tracking data, such as log files, haven't been employed and analysed sufficiently even though tracking user behaviour can significantly contribute to SLA research (Chun, 2013: 256). It is remarkable that Bodnar et al. (2016: 200) found only one study investigating autonomous CALL practice. This study by Heilman et al. (2010) employed computer logs to examine learner behaviour during vocabulary practice. No published studies investigating CALL and LESLLA students have been found. To our knowledge, no previous study has investigated log files of LESLLA learners. This paucity of empirical research might originate in the extensiveness of the collected interaction record, being one reasons why "log file data is more often collected than analysed". (Bruckman, 2006: 1449). This is illustrated by the log file excerpt provided in Figure 1, showing a user-computer interaction in the DigLin environment, lasting 34 seconds.

7632;"[""04FIN""314""]";"FIN";"2014-10-30 09:21:20";"2014-10-30 09:23:58";"Drag the letters 4a";"[{""type"":""play_word_sound"" data"":""sauna"" timestamp"":""2014-10-30 09:21:20"" data_extra"":""""} {""type"":""hide_word_picture"" data"":"""" timestamp"":""2014-10-30 09:21:21"" data_extra"":""""} {""type"":""show_word_picture"" data"":""sauna"" timestamp"":""2014-10-30 09:21:21"" data_extra"":""""} {""type"":""letter_drag"" data"":""s"" timestamp"":""2014-10-30 09:21:26"" data_extra"":""""} {""type"":""letter_drag_right"" data"":"""" timestamp"":""2014-10-30 09:21:28"" data_extra"":""""} {""type"":""letter_drag"" data"":""a"" timestamp"":""2014-10-30 09:21:32"" data_extra"":""""} {""type"":""letter_drag_right"" data"":"""" timestamp"":""2014-10-30 09:21:34"" data_extra"":""""} {""type"":""letter_drag"" data"":""u"" timestamp"":""2014-10-30 09:21:34"" data_extra"":""""} {""type"":""letter_drag_right"" data"":"""" timestamp"":""2014-10-30 09:21:42"" data_extra"":""""} {""type"":""letter_drag"" data"":""n"" timestamp"":""2014-10-30 09:21:44"" data_extra"":""""} {""type"":""letter_drag_right"" data"":"""" timestamp"":""2014-10-30 09:21:45"" data_extra"":""""} {""type"":""letter_drag"" data"":""a"" timestamp"":""2014-10-30 09:21:49"" data_extra"":""""} {""type"":""letter_drag_right"" data"":"""" timestamp"":""2014-10-30 09:21:49"" data_extra"":""""} {""type"":""play_word_sound"" data"":""päivä"" timestamp"":""2014-10-30 09:21:52"" data_extra"":""""} {""type"":""show_word_picture"" data"":""päivä""timestamp"":""2014-10-30 09:21:54""49"" data_extra"":""""}

Figure 1: Example of a DigLin Log File Extract in the Finnish Dataset.

In order to assess DigLin, the software was tested with the help of literacy teachers and their students. The learners' use of the software was tracked by log-files during the whole field-testing. The computer system documented all mouse and keyboard movements as well as microphone recordings. As shown in Figure 1, DigLin log file entries contain a log file ID (7632) followed by the user's personal (04FIN, 314) and language code (FIN). Each log file contains the exact start date (30.10.2014; 09:21:20) and end date (30.10.2014; 09:23:58). Further the individual user's actions are stored in the workload including details on the type of exercise involved (Drag the letters 4a), the type of actions taken (play word sound, show/hide word picture, letter drag) , the data provided by the user (letter drag "s", "a", "u", "n", "a"), the feedback given by DigLin (Malessa 2016).

The following section presents the background of the two studies by Malessa (2016) and Filimban (in progress) that set out to discover what log-files can reveal about learner behaviour in DigLin, a CALL application developed to enhance LESLLA learners' individual literacy development.

3. INVESTIGATING LESLLA LEARNERS' LOG-FILE INFORMATION

3.1. Set-up of the studies by Malessa (2016) and Filimban (in progress)

Malessa's study (2016) investigated the learner behaviour of non-literate and low-literate adult L2 learners learning to read for the first time in Finnish. The research focus of this pedagogically-motivated study was on the learning process of establishing phoneme-grapheme connections and developing decoding and recognition skills. This study was motivated by previously attested benefits of CALL in literacy development of LESLLA learners (see Kurvers & Stockmann, 2009).

The heterogeneous participant population of this case study included six female and one male participant. The age range was large, with the youngest participant being 18 years old and the oldest learner being 60 years old. Three participants stated Iraq and two Somalia as their country of origin. The individuals from Iraq identified Arabic, Turkmen and Kurdish as their first language. The Somalian participants stated Somali as their L1. The only male Arabic-speaking participant came from Egypt. One Arabic L1 participant emigrated from Syria to Finland. The participants' L1 literacy backgrounds varied from non-literate and low-literate to fully-literate. It is important to note that the participants' L1 literacy proficiency was only estimated by their L2 literacy teachers and the participants themselves, and was not tested (Tammelin-Laine, 2016). It is therefore possible that the participants' L1 literacy levels have to some degree been inadequately assessed.

The L2 Finnish oral skills of all but one participant were estimated to be below A1 according to the Common European Framework of References for Languages (CEFR). The L2 oral skills of the youngest participant, who had arrived to Finland almost four years prior to the DigLin testing, were reported to be A1 (CEFR). One reason for the weak L2 oral skills might be the fact that a remarkable discrepancy between the length of residence and length of education was found particularly for participants residing in Finland for longer than two years, whereas participants that arrived more recently to Finland were more likely to start language and literacy instruction in due course.

The data analysis in Malessa's (2016) study was carried out by employing a mixed-method approach to obtain a comprehensive account of student behaviour in the online environment of the Digital Literacy Instructor (DigLin). Log files were seen to provide empirical evidence for LESLLA learner behaviour in DigLin and have been for the first time analysed by Malessa (2016). The exact timestamps in combination with the consistent record of interaction were seen to provide an extensive and accurate documentation of the learners' actions in this CALL environment. In Filimban's (in progress) study, a mixed method approach was also employed and data was then analysed using MAXQDA (a qualitative data analysis software program; MAXQDA 11,Verbi Software 2011). The data was coded thematically according to the different behaviours learners displayed.

Filimban (in progress) investigates the effectiveness of the use of DigLin on the development of decoding on low-literate adult learners learning English as a second language. The research focused on whether the use of computer-assisted instruction can help learners enhance the development of phonological awareness and decoding. Sustained and systematic research is needed to (1) identify instructional approaches that show promise of maximizing adults' literacy skill gains, (2) develop scalable instructional programs and rigorously test their effectiveness, and (3) conduct further testing to determine for whom and under what conditions those approaches work.

This study consisted of a group of 10 immigrant adults from a variety of countries. They were all enrolled in classes at the lowest level of English for Speakers of Other Languages (ESOL), namely pre-entry (sub-CEFR A1 level). This heterogeneous group included participants whose L1's were Arabic, Urdu, Russian, Dari and Tigrinya; and their age varied between 25 to 55 years. Despite long-term residence, some learners still had a limited English knowledge and were therefore placed in pre-entry classes on the basis of their sub-A1 oral proficiency and literacy.

In the next section results and observations made by Malessa (2016) and Filimban (in progress) are given and discussed.

3.2. Revealing observations

3.2.1. *Revealing learner engagement and learner preference*

An initial quantitative analysis found that a total of 2497 event log files were stored in the Finnish DigLin database for the seven participants in Malessa's (2016) study.[3] The UK database, employed by Filimban (in progress), stored 1609 log files for the ten participants in the field testing. Compared to the Finnish participants, the UK participants' testing time was far less.

Quantitative analysis showed further that log files contain valuable information about the actual time spent on-task due to their precise time-stamps. Malessa's (2016) total testing time results indicate that the users were actively engaged with the exercises. The total time spent off-task, so-called no event data, was insignificant. Only three users spent 10 to 30 minutes off-task during the entire field training testing. This study observed that students were very engaged with DigLin throughout their interaction. It was found that student engagement, as an indicator of student motivation, can be elicited from the log file information by studying the amount of on-task time and number of letter drags and word drags in DL and LF (cf. Cocea & Weibelzahl 2007, 2009).

There was, nevertheless, a great variation between the participants. The most active user, spent almost 40 hours testing the Finnish DigLin system, more than twice as much time then the least active tester (16 h 30 min). None of the participants achieved, however, the expected training time of 50 hours (see Deliverable 5.1, 2015). The log files showed that the users tested DigLin very regularly, typically twice a week, sometimes even more often. Particularly at the beginning of the field-testing DigLin was used up to five times a week. Based on the time-stamps it was concluded that DigLin practise was almost entirely limited to classroom time. Even though participants were encouraged to use DigLin in their leisure time, Malessa's (2016) study found only two occasions in which DigLin was used outside the classroom. In Filimban's (in progress) English data, there were only three out of the ten learners who completed 10 hours which was far less than the Finnish data. The log files also showed that the learners mostly used DigLin in the classroom with very few exceptions.

3. The event log file dataset excluded no event log files. Log files were grouped as no event when a new task was started, but immediately ended, resulting in NULL session, session_end or session_stop data.

These findings indicate that the issue of availability of both CALL tasks and hardware needs to be emphasized. The tested CALL application runs only online on computers systems. Its availability and thus its usage should be increased with an off-line version and/or applications for other electronic devices such as tablets or smartphones. It is also possible that the studies' participants were not able to see the connection between the CALL tasks and their L2 tasks outside the classroom.

The log file amount of a user clearly indicates exercise preference, as a new log file is created for each new exercise the user starts. Malessa's (2016) study found that ,out of seven exercise types, users clearly preferred the vocabulary exercise 'Words' (W) followed by the drag-and-drop-exercise 'Drag the letters' (DL). Similarly, Filimban's (in progress) study has shown comparable results with log files showing a strong preference for both W and DL. However, while the Finnish users preferred W, the UK users favoured DL (see Table 1 below).

	'Words'	'Drag the letters'
Finnish log file dataset (% of the total database)	915 (36.64%)	649 (25.7%)
UK log file dataset (% of the total database)	397 (24.67%)	452 (28.09%)

Table 1: Participants' Exercise Preference as Revealed by the Log File Database.

3.2.2. *Observing learner performance and the learning process*

Every single log file contains a work load that can vary significantly from another log file's workload, regarding the time spent on the exercise in question and the interaction with the CALL system (see Figure 1). Accordingly, user preference cannot be equated with user activeness. Based on the quantitative data analysis alone, conclusive statements regarding the users' activeness can, thus, not be made. For this reason, 103 log files created for DL were additionally analysed by Malessa (2016) also qualitatively. The qualitative data analysis included, moreover, 30 log files tracking the computer-user interaction in the 'Listen and form the words' (LF) exercise task. These two exercise types, DL and LF, were chosen for further qualitative analysis as they both focus on the very initial decoding steps, the creation of visual/aural grapheme-phoneme correspondences.

In addition to learner engagement and preference, Malessa's (2016) results, based on logged information for learner output, also provided insights into learner performance which was unexpectedly successful. In addition to learner performance, tracking learner behaviour with log files further enables the investigation of the learning process. Malessa's (2016) study found that learner performance and productivity were not automatically related as successful decoders were not necessarily the most productive ones. The same applied to weaker decoder. However, a correlation between productivity (activeness) and proactiveness (help tool usage) was detected. More successful decoders were apparently able to make use of provided help tools, in the form of letter and word sounds, whereas weaker users were found not to use help tools in an efficient way. This might be possibly due to a knowledge gap or the learners' inability to learn autonomously. The final section presents concluding remarks of this current paper.

4. LOG FILE REVELATION = LESLLA REVOLUTION?

There are still many unanswered questions about LESLLA learners' L2 development, however, CALL and log files can help identify answers that have not yet been revealed. This paper identified log file analysis as a reliable research method to obtain more knowledge about CALL of LESLLA learners by examining post-activity learners' online movements while practising in a CALL context. It is clear that, without sufficient evidence, researchers and teachers should abstain from assuming learners to follow instructions and act in an intended way. It is, therefore, crucial to obtain reliable knowledge regarding learners' real-time actions and log files represent a reliable research tool to verify both what students do in CALL environments and whether specific CALL applications and designs enhance students' learning as intended. This is particularly important in order to design and develop CALL activities targeted at specific language learner individuals and groups. Based on the empirical evidence gathered by Malessa (2016) and Filimban (in progress), CALL activities have shown to enhance LESLLA learners' decoding development and learner motivation during the learning process.

Log files provide unique and innovative research data for CALL, L2 and LESLLA research. Currently log file analysis is, however, very time- and work-intensive requiring expertise knowledge of computer systems and log file coding. In a modified format, log files could provide LESLLA teachers with valuable information about individual learner performance and progress. They also indicate what teachers need to focus on showing whether/ how learners use resources they are presented with. CALL has the potential to facilitate individual learning, thus lessening the teaching load and this is believe to support teachers to focus on learners who may require more assistance.

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