

Mobile data-driven language learning: Affordances and learners' perception (draft version)

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abstract

Data-driven learning (DDL) is a learner-focused approach which promotes language learners' discovery of linguistic patterns of use and meaning by examining extensive samples of attested uses of language. Despite the emergence of mobile-assisted language learning (MALL) and its affordances, i.e. individualization and personalization, the potential of DDL in this context has not been widely explored. This study involved the creation of a mobile language learning app based on freely available natural language processing (NLP) tools, followed by a test of the app to gather the attitudes and perceptions of several groups of language learners across Europe. The results suggest a generally positive evaluation of DDL's instant and personalized feedback and direct access to a variety of tools. Besides, suggestions for improvement were made concerning the design of the tasks, such as the addition of further built-in tools and adaptations to hardware constraints. Analyses also showed a need for specialized learner training, so as to grasp the potential of the feedback provided. This study may be construed as a first step towards creating more fleshed-out tools and further investigating the potential of combining DDL and MALL.

1. Introduction

Data-driven learning (DDL) promotes autonomy and induction (Boulton & Cobb, 2017) thanks to its learner-centered approach and the discovery of patterns when consulting samples of texts. In the field of corpus linguistics, where the term DDL originated, these collections of texts are called *corpora*. They have traditionally been used to reveal the combinatory nature of language, the intrinsic connection and dependence between grammar and lexis, the importance of the notion of register when analysing language use, and, among other things, a more profound understanding of the impact of frequency on language. Corpora, therefore, are textual data that have been collected according to principled criteria such as the date of production, text/register typology, demographic factors, or variety of language.

When learners interact with DDL resources, they are encouraged to apply critical thinking skills that involve noticing, language awareness, hypothesis making and testing, sensitivity to linguistic variation, and data skills such as dealing with representations and implications of frequency of use. In a typical hands-on DDL task, a language learner examines a node (either a word or a string of words) and its immediate context both to the left and the right, as well as, if desired, the wider paragraph context. Each node appears on a so-called concordance line, and from there learners explore linguistic evidence and develop cognitions that will enable them to form hypotheses about the nature of language use. The software that produces concordance lines is known as a concordancer, although in web services this term is not necessarily used. Cobb and Boulton (2015: 496) carried out a meta-analysis of DDL studies from 1989 to 2012 and concluded that based on the evidence, research corpora "can be of benefit to L2 users for a range of purposes". Further analysis (Boulton & Cobb, 2017) reinforces this idea, while acknowledging the challenges that implementing DDL presents. However, the authors highlight that while the use of hands-on concordancing in language classrooms is very limited, the way in which Google and other search services are used to find language-related information is similar in many ways to how corpora are queried (Perez-Paredes, Sanchez Tornel & Alcaraz Calero, 2012). This area of inquiry has received little attention from corpus linguists as Google-like resources are perceived as less reliable than corpora, which present structured information and the possibility to use frequency of use as a mediator between "real language use" and L2 learners' cognitions about language use. Some researchers (Aguado-Jimenez et al., 2012; Perez-Paredes and Cantos, 2004) have also advocated the use of DDL skills to examine learner language and promote discourse and textual language awareness (Boulton & Cobb, 2017).

With its emphasis on the active role of learners as discoverers as well as on data, DDL has the potential to adapt well to the range of new skills sets (Pegrum, 2016), and individualization and personalization trends in mobile-assisted language learning (MALL) (Kukulska-Hulme, 2016). Given the lack of research in this area, this research sets out to fill a gap in understanding the contributions of DDL to MALL. We will discuss both the perceived affordances of mobile DDL, and the challenges for teachers and material developers. The concept of affordances was defined by Gibson (1977) and is particularly useful in terms of describing how we perceive and interact with technologies. Gibson referred to affordances as all the "action possibilities" that are latent in the environment, which can be objectively measurable regardless of whether the individual recognizes them or not, but which are always dependent on the individual's capabilities, as they exist in constant relation to the actor.

Affordances are always in relation to individuals and their capabilities, and this includes the individual's past experience, values, beliefs, skills, and perceptions. Consequently, a button may not have the affordance of pushing if an individual has no cultural context or understanding of the notion of buttons or related objects and what they are for. This research explores how

different groups of learners perceived a mobile adaptation of DDL and the range of digital literacy skills they needed to make the most of this type of learning.

2. Data-driven learning in online environments

The first attempts to use DDL in the classroom were limited by the technological constraints of the time, when desktop computing was not available to most learners (Baten, Cornu, & Engels, 1989; Johns, 1990, 1991; Stevens, 1991). Despite the fact that hands-on DDL is now a reality on desktop computers in universities worldwide (Boulton & Cobb, 2017), its use in mobile learning contexts remains underexplored.

Most research on DDL has examined software-based rather than paper-based activities (Aston, 1997; Charles, 2012, 2014; Conroy, 2010; Kennedy & Miceli, 2001, 2010; Lee & Liou, 2003; Ma, 1994; Perez-Paredes, Sanchez-Tornel, & Calero, 2012, 2011; Seidlhofer, 2000; Sun & Wang, 2003). Studies suggest that DDL approaches seem to be “most effective when using a concordancer hands-on rather than through printed materials” (Boulton & Cobb, 2017: 385). As computers become more sophisticated, the opportunities that digital technologies offer for learning multiply. These opportunities are reflected in the development of software-based tools such as, for instance, corpus annotators to aid in the managing and interpretation of corpora (Perez-Paredes & Alcaraz-Calero, 2009). Engaging with DDL activities requires a set of skills to effectively interpret and manage data through a growing range of digital communication channels (Dudeney, Hockly, & Pegrum, 2013; Pegrum, 2016). Researchers agree that learners (Stockwell & Hubbard, 2013) and teachers alike (Pegrum, 2016) need to acquire a level of digital literacy so as to benefit from the digital tools at hand (Jenkins, Clinton, Purushotma, Robison, & Weigel, 2006).

DDL shifts the focus of language teaching from the teacher to the student (Granger & Leech, 2014). DDL exposes learners to authentic language rather than simplified input; it also allows language learners to notice and identify linguistic patterns through lexical and syntactic frequency, while promoting autonomy, induction, exemplar-based learning, and constructivism, since it forces them to deal with the data by themselves (Boulton & Cobb, 2017). Constant exposure to natural language raises learners’ awareness as they become more proficient in identifying how the target language works. Using DDL is in line with the noticing hypothesis, which states that awareness is required at the time of learning (Robinson, Mackey, Gass, & Schmidt, 2012; Schmidt, 1992, 2012). Although detecting the presence of awareness at the time of learning has been challenging (Ortega, 2013), teachers in most educational contexts generally do the noticing for the learner rather than the learners themselves (Boulton, 2010).

However, DDL also presents numerous challenges: a) most language students and teachers still feel uncomfortable when working in a computer environment; b) as corpora are composed of purely authentic native language, their comprehension is out of reach for most beginners and even intermediate language learners; and c) in spite of its usefulness, concordancing might be off-putting for untrained users as concordance lines are not designed for meaning acquisition in the traditional sense (Boulton & Cobb, 2017). This, in turn, creates a need for substantial and specialized training in digital literacies, and in the use of concordancers and corpora prior to their use (Boulton & Cobb, 2017; Götz & Mukherjee, 2006; McEnery & Wilson, 1997; Pegrum, 2016; Perez-Paredes, Sanchez-Tornel, Alcaraz Calero, & Aguado Jimenez, 2011; Perez-Paredes, Ordoñana & Aguado, 2018). In fact, studies have suggested familiarity with DDL tools to be a predictor for frequency of use (Ordoñana, Perez-Paredes, & Aguado, 2018). Lack of training could prove even counterproductive. Gilquin and Granger (2010) mention teachers’ lack of corpus skills as a possible reason for not making use of DDL approaches in the classroom. Untrained users could perceive concordancers as “ineffective” tools for learning a second language (Quan, 2016). Meanwhile, other researchers have looked at more user-friendly ways of introducing corpora to the learner, such as using Google search as a concordancer (Conroy, 2010; Geluso, 2013) or adapting research corpora for language teaching and learning through tools such as the Sketch Engine for Language Learning (Baisa & Suchomel, 2014).

Along with the rise in popularity and use of smartphones, the focus has shifted in recent years from computers to mobile devices, and the field of MALL has experienced an increase in popularity among researchers. Mobile devices may be differentiated from computers due to, among others, their ubiquitous nature and the constant, on-the-road connectivity they offer (Georgiev, Georgieva, & Smrikarov, 2004; Kukulska-Hulme, Sharples, Milrad, Arnedillo-Sanchez, & Vavoula, 2009, 2007; Traxler, 2005). These affordances create new opportunities for teachers to be in seamless contact with students, and for learners to be able to access the content and the activities they need anytime, anywhere.

The actual use of mobile devices for learning is one of the foci for researchers in order to study the real impact of MALL. Ma (2016) studied MALL usage with Hong Kong students, concluding that they mainly used their smartphones to access web content and dictionary apps. Steel (2016) claimed that students thought app development was limited and immature, and that they favored the use of mobile devices for vocabulary learning and audio-lingual grammar translation. In fact, scholars have reported a failure in the exploitation of mobile devices’ affordances, as mobile devices are often conceptualized as a replacement for computers rather than a complement to them (Burston, 2014).

Some researchers have begun to look at the benefits of using DDL in mobile devices, developing apps that make use of the learners’ written production in order to offer feedback automatically. Quan (2016) found that DDL could be effectively merged with MALL, creating an app for learners to search for academic words in authentic academic texts. Other tools such as <https://writeandimprove.com> make use of a DDL-based approach to provide feedback from the learners’ written production, or the iGE app (<https://www.ucl.ac.uk/english-usage/apps/ige/>) provides learners with exercises made up from a selection of examples from corpora.

There is a wide range of language learning-related apps, several of which make use of freely available language processing tools such as spell checkers or text-to-speech software. These can be regarded as Open Educational Resources (OER), as they can be used, shared, and modified freely by anyone through creative commons licenses (Thomas & Evans, 2014; UNESCO, 2012). Many of these apps have not reached the general public yet, making the study of such tools a priority for MALL researchers (Littlejohn & Hood, 2017; Perez-Paredes, Ordoñana Guillamón, & Aguado Jimenez, 2018; Wild, 2012; Yeung et al., 2011).

However, such a task may prove difficult due to the limited availability of some of the tools for languages other than English.

Although DDL is gaining momentum, there is still little research in the area, especially in relation to MALL. Research has suggested that training in digital literacies is essential for the proper and effective use of DDL-based tools. The literature review has also shown that learner-centered approaches fit well with contemporary learning paradigms, which involve the use of software-based tools, the promotion of pattern detection in language (Boulton & Cobb, 2017; Perez-Paredes et al., 2011), and the exploitation of the affordances of new technologies such as mobile devices. As these devices allow for complete ubiquity and constant connectivity between teacher and learner, more and more DDL-based tools are being developed to take advantage of such affordances. Thus, this paper will aim to answer the following research questions:

RQ1: How is mobile DDL perceived by language learners and what digital literacy skills do they need?

RQ2: How can DDL best seize the affordances of mobile learning?

3. Research methodology

Based on a literature review of mobile and data-driven language learning, our study first took on the development of a language learning app that relies solely on the use of freely accessible NLP tools. This app aims to improve the learners' writing skills following a DDL approach. The second step consisted of tapping into the users' attitudes and perceptions towards mobile DDL for language learning by means of an online survey and focus group interviews. Both are detailed in the following sections.

3.1. Ethics

The data was collected in February and March 2017 from undergraduate and Master's students who voluntarily registered on the TELL-OP online course and filled in the questionnaires on a voluntary basis. All data was collected via focus groups for

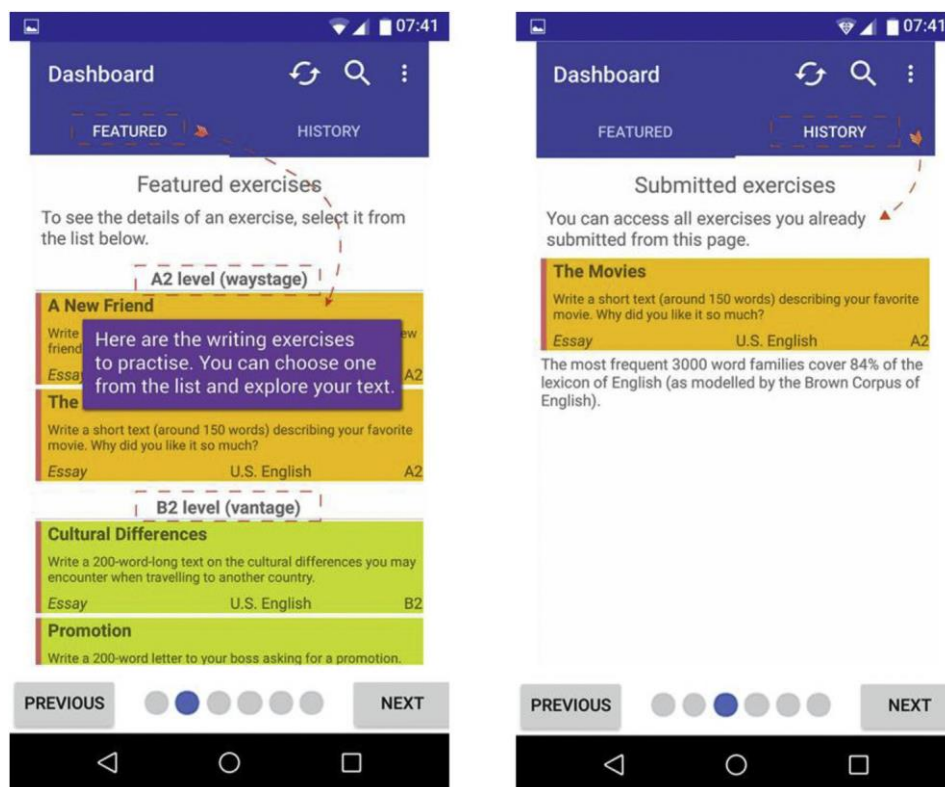


Fig. 1. TELL-OP tutorial explaining how the app's dashboard and history feature work.

qualitative data and via questionnaires sent to participants on a password-protected Moodle platform for quantitative data. Participants' names were anonymized in all publications related to the project.

3.2. Implementing mobile DDL: the TELL-OP app

The study was designed within the framework of the two-year TELL-OP Erasmus+ project.¹ After a review of the literature investigating mobile learning and data-driven language learning in adult and higher education, the research team, made up of

IT specialists and applied linguists, designed a language learning app in order to explore the opportunities and challenges of mobile DDL for language learners, teachers, and developers. Given the lack of research in mobile DDL, the evaluation of the app offered some interesting insights into the users' perceptions and use of such technology. The tool was a language learning app that processed learner language input following a DDL inquiry methodology through learners' engagement with language data. It set out to improve the writing skills of learners of English, German, or Spanish who were aiming at an A2 or a B2 level of proficiency (according to the Common European Framework of Reference (CEFR) standards) by offering context-driven information through word frequency and vocabulary analysis, as well as providing lexical alternatives to further help improve writing. The freely accessible app featured openly available NLP tools, among which we find a text analyser, a vocabulary profiler, and a part-of-speech tagger¹ all of them integrated in *Lextutor* (Cobb, 2002; Heatley, Nation, & Coxhead, 2002) for English. After the analysis of the text, the learner could explore and improve the input via corpus-based resources. Three reference tools, the *Collins Dictionary*, *Netspeak*, and *Stand4*, were available in beta format and offered access to definitions, synonyms, and example sentences. It was paramount that the features be completely open and available for use, reuse, and modification, so the free nature of the app would not be compromised. Although it was initially destined for learners of the three languages mentioned above, some NLP tools could not be integrated in the Spanish and German versions due to a lack of availability of application programming interfaces (API) in those languages. In this study, only the English version was tested.

The first feature that users found on the app was a bespoke tutorial on how to navigate the tool (Figs. 1e3). The app dashboard (see Fig. 1) was the starting point of the writing activity. It displayed a series of essay topics classified into A2 and B2 CEFR level tasks, the expected number of words, and a short description of the task. These topics were selected based on

¹ Transforming European Learner Language into Learning Opportunities (TELL-OP) is a KA200 Higher Education Strategic Partnership funded by the EU.

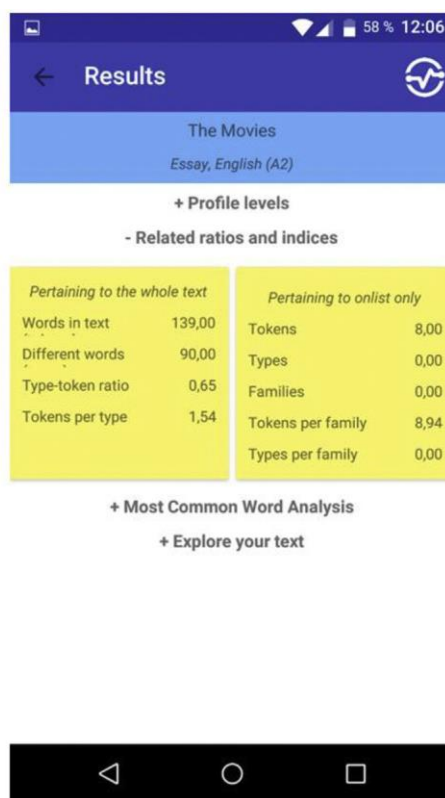
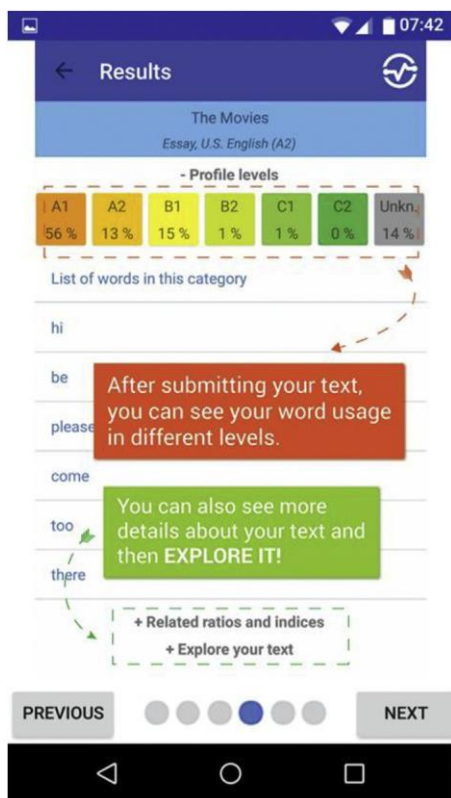


Fig. 2. TELL-OP tutorial explaining how to navigate the results section of the app.

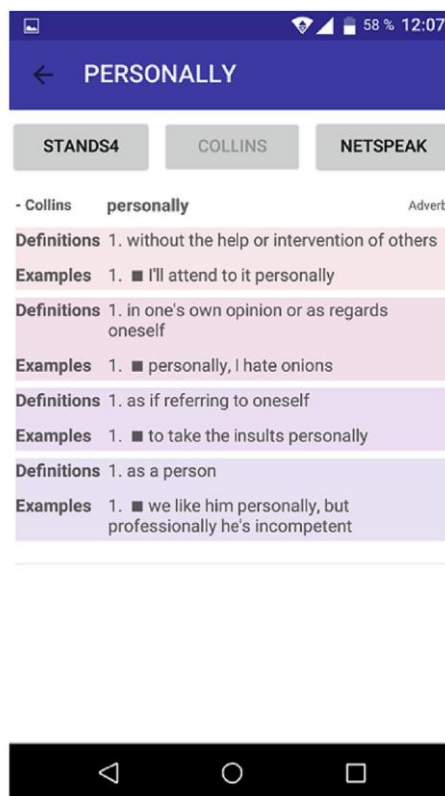


Fig. 3. TELL-OP tutorial shows the app's personalized access feature to various corpus-based OER, such as monolingual and collocation dictionaries.

the four domains listed in the CEFR framework, i.e. public, personal, occupational, and educational (Council of Europe, 2009) and the various lexical fields recommended by German and French-speaking Belgian curricula (Hessisches Kultusministerium, 2010; Ministère de la Communauté Française, 2011). These were summarized into the following fields: people, places, everyday life, culture, and society. The app dashboard also displayed a *history* tab, under which the users could access all their completed tasks (see Fig. 1).

Once the users had input their text, the app automatically analyzed it via multiple NLP tools and presented quantitative and qualitative information on their text and its components, as shown in Fig. 2. With the profile levels feature, the learners could check the percentage and the list of words they used distributed across CEFR Levels (from A1 to C2), as well as check the percentage of verbs, nouns, adverbs, and adjectives in their text. The TELL-OP app also allowed users to explore and improve their text by clicking on a word of their choice and accessing context-sensitive information from diverse monolingual and collocation dictionaries (see Fig. 3).

3.3. Research design and instruments

With the design and testing of this app by higher education learners aiming at an A2 or B2 level (see Table 1), we set out to look into the language learners' perceptions of mobile DDL and the digital literacy skills needed to use the app (RQ1), and explore how DDL can best seize the affordances of mobile learning (RQ2). The study was conducted in the second semester of the academic year 2016e2017 in Belgium, Spain, and the United Kingdom.

The sampling of the participants was carried out based on the app's main target users, that is, A2 and B2 English learners. In both Spain and Belgium the subjects were selected in English as a foreign language (EFL) classes, while in the UK the sampling was made by approaching foreign students pursuing an English degree.

In Belgium, 70 language and business students studying English in formal settings and following an undergraduate course of advanced English skills aiming at a B2 level attended a ten-minute presentation of the app during one of their classes and received instructions on how to test the tool. These instructions included information about the sign-up process, the navigation on the app, the results that were available and the type of data the researchers expected to collect from them. The students had three weeks to perform at least one writing task on the app and to explore the different types of results linked to their texts. As an incentive for the participants to complete the task successfully, they were informed that their texts would be marked by their English teacher. All of these experimentations were to take place in their free time. After having tested the tool, they were asked to fill in an online questionnaire. Additionally, they were asked to write a one-page essay discussing their experience. This set of assignments constituted the first type of qualitative data.

In Spain, a class of 55 first-year students in English studies with a B2 English level were selected as subjects. The app was introduced during class via a presentation. They were asked to perform several TELL-OP tasks for a week. Among them, five students were invited to be interviewed as a focus group. This set of oral data complemented the written feedback from Belgium.

In the UK, students were convenience sampled on campus to test the app. They received some face-to-face guidance on navigation within the app, tested the app, and were then asked to fill in the previously mentioned online survey. Qualitative data was also collected as three undergraduate students were randomly chosen for a focus group interview. All the subjects were expected to use their own devices to perform the app test. However, due to the unavailability of the app on iOS devices, students from the UK had to complete the tasks on the researcher's personal device.

An interpretive approach was taken when designing the present study, characterized by both the use of meaning-oriented methodologies and the production of "an understanding of the context and the process whereby information science influences and is influenced by the context" (Cohen, Manion, & Morrison, 2013: 22; Thomas, 2010: 300). A non-sequential mixed-methods survey research design was chosen in order to explore the learning process and to address the users' perceptions. As shown in Table 1, the research included the collection of quantitative data. An online questionnaire was administered to investigate the learning process of the participants and their language awareness through the use of mobile DDL. A sample of the questionnaire can be found in Appendix A. After a first set of questions providing information on the participants' profile, the perceptions and attitudes were measured with twenty-one 1 to 5 Likert scale items selected from various studies in similar fields of research (McQuiggan, Kosturko, McQuiggan, & Sabourin, 2015; Palalas and Ally, 2016). These items addressed elements from the literature review such as the learners' awareness of the combinatory nature of

Table 1
Research design and instruments.

Country	Target group	Introduction	Test phase	Quantitative data (see Appendix A)	Qualitative data (see Appendices B & C)
Belgium	70 B2 ENHE students	TELL-OP presentation	app testing (3 weeks)	online survey (53)	written feedback (55)
Spain	55 B2 ENHE students	TELL-OP presentation	app testing (1 week)	online survey (27)	focus group interview (5)
United Kingdom	60 HE students	face-to-face briefing prior to TELL-OP use	app testing (10 min)	online survey (50)	focus group interview (3)

language (how vocabulary and grammar combine to form a consistent text), the exploitation of MALL affordances, and the autonomy of the learner when examining the data. The questions dealt more precisely with the usefulness and ease of use of the app, the satisfaction of the users, and the extent to which the app gave them the possibility to better understand how language works and how richer expression could be achieved. Descriptive statistics were used to analyze the results.

This exploratory research calls for qualitative research methods that complement the first set of information on the learners' experience. Feedback was collected both in written and oral forms with a view to addressing the users' perceptions not only of the technological aspects of the app, but also of the type of tasks available and the results provided. After having performed their task on the app, the Belgian participants were asked to hand in a one-page assignment within the framework of their *Advanced Writing Skills* course, giving their opinion on their use of the app and making suggestions for improvement (Appendix B details the essay instructions given to the Belgian students). The participants from Spain and the UK contributed to this report by means of focus groups (see Appendix C), which were conducted to obtain a user perspective on the affordances of the app and the perceived usefulness of DDL in mobile contexts.

The interviewers used a set of core open questions relating to three general themes: task, results, and technology. This qualitative approach allowed us to explore the learners' perspectives on the interactions between DDL, mobile learning, and language learning. The Spanish interviews were recorded, transcribed, and translated into English. In the UK, notes were taken during the interviews. The written and oral data was annotated, and patterns, which emerged from the qualitative data, were identified and categorized into core variables and subcategories following Glaser and Strauss's *grounded theory* (Cohen et al., 2013). The use of such a varied qualitative approach is appropriate for this interpretive study since it aims to gather suggestions and detailed information from the language learners on their perception of DDL on mobile devices. The combination of both a quantitative and a qualitative approach allowed us to gain further understanding of learner perspectives on the use of mobile DDL (RQ1) and how it can best be combined with mobile learning (RQ2), since their cognitions further illustrated and elaborated on the quantitative data from the questionnaires.

4. Results

In this section we will present the feedback that we collected from the users of the DDL app. After describing the profile of the participants, we will outline the results from the questionnaire analysis based on four criteria, i.e. (a) general satisfaction with the app, (b) user-friendliness of the app, (c) improving the learning of the target language, and (d) autonomous vs. in-class learning. The following paragraphs will detail the users' impressions captured during the focus group discussions and essays under five categories that emerged from the data: (a) the task performed, (b) the text analysis provided through the app, (c) language awareness, (d) mobile learning, and (e) suggestions.

4.1. Questionnaire results

Our sample was composed of 130 informants, 105 female and 25 male, 117 in the 18e30 year-old range and 13 aged over 31. 80 informants had finished non-compulsory secondary education, 33 had a Bachelor's degree, and 17 a Master's degree. Around 40% were following a language course, another 40% were learning a language on their own, and the remaining 20%

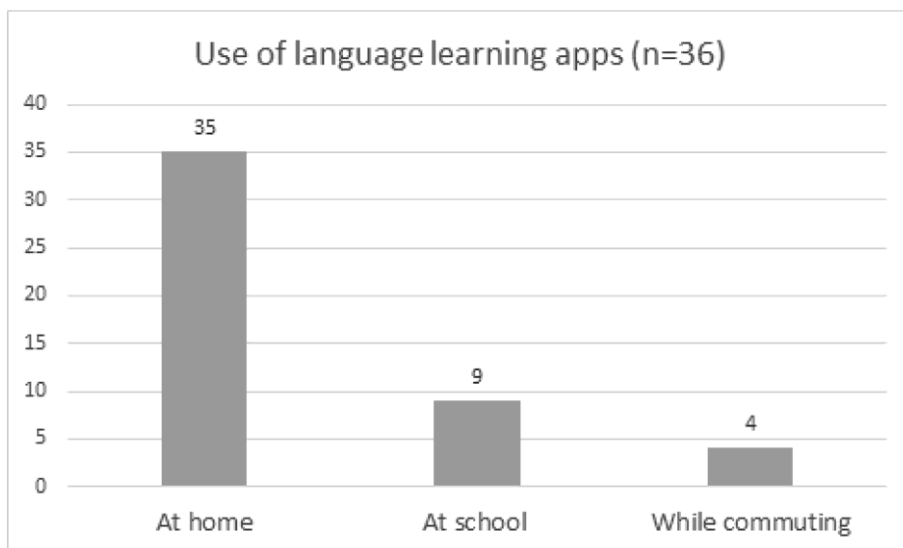


Fig. 4. Preferred place of use of language learning apps (multiple answers were allowed). N = 36 (the total number of subjects answering the question).

Table 2 Percentages and mean score of Frequency of use calculated over 36 participants in age group 18e30 who stated they used language learning apps.
* is used to mark the highest percentage.

Frequency of use of language learning apps	never	rarely	sometimes	often	all the time	Mean	
SD Users (N ¼ 36) %	11.1%			38.9%*	30.6%	16.7%	
	2.8%	2.61		0.99			
BE (N ¼ 23) %	17.4%	34.8%*	21.7%	21.7%	4.4%	2.61	1.16
SP (N ¼ 13) %	0%	46.2%*	46.2%*	7.7%	0%	2.62	0.65
UK (N ¼ 0) %	0%	0%	0%	0%	0%	N/A	N/A

combined autonomous and in-class language learning. Approximately 28% (10/36) of the participants, all of them in the 18e30 age range, stated they used apps for language learning purposes. As shown in Fig. 4, among the 36 users, the vast majority (n 35) used language learning apps at home, 9 used them at school, and 4 used them while commuting.

When providing examples of apps, they did not differentiate between web services and mobile apps, citing among others *Duolingo*, *Google translate*, *Wordreference*, *Babbel*, and *Tandem*. Regarding their frequency of use, the majority (38.9%) stated they only rarely resort to language learning apps, with a significant number of Spanish respondents only sometimes (46.2%) or rarely (46.2%) practicing languages on their mobile. Interestingly, none of the UK respondents declared using apps for language learning purposes (see Table 2).

All the participants were requested to test the TELL-OP app on their tablet and/or smartphone. 93.85% of them used a smartphone, 4.62% used a tablet, and 1.54% used both devices. After having tested the app, they answered a 5-point Likert scale questionnaire, from 1 (*strongly disagree*) to 5 (*strongly agree*). To ease the analysis of the data, the results have been sorted into negative perception (1 and 2), neutral perception (3), and positive perception (4 and 5). The standard deviation and mean can be found in Appendix D.

4.1.1. General satisfaction with the app

As shown in Fig. 5 below, most of the respondents adopted a neutral point of view as to their satisfaction with the app (NEUT: 50.77%) while about a third (POS: 34.62%) were satisfied. While 36.15% would recommend the app to a friend, 24.62% would not. According to 32.31% of the respondents, the app offered a meaningful and interactive learning environment. Only 25.38% would continue using it whereas 40% would not. An equal number of participants (POS: 42.31%) agreed on the fact that the app provided useful information and that its purpose was clear.

4.1.2. User-friendliness of the app

Fig. 6 displays the respondents' answers regarding the user-friendliness of the DDL app. Almost half of the users remained neutral about whether the app worked the way they wanted (NEUT: 46.15%). Most of them found information easily (POS: 43.08%) and considered that the app worked properly that is, it could be used without experiencing technical issues (POS: 40.77%). More than a third of the respondents did not find the app particularly attractive or user-friendly (NEUT: 40.77%) while 39.23% did. Finally, most of the users found the tutorial useful when they were learning to navigate the app (POS: 46.92%).

4.1.3. Improving the target language

Fig. 7 shows the respondents' attitude towards the DDL app's capacity to improve their proficiency in the target language. 30.77% stated that they became more sensitive to how texts are constructed, and 35.38% believed that the app was useful and might help them to improve their knowledge of the target language. According to 53.83% of the participants, their use of the



Fig. 5. Percentages of TELL-OP app questionnaire answers on the users' general satisfaction with the app.

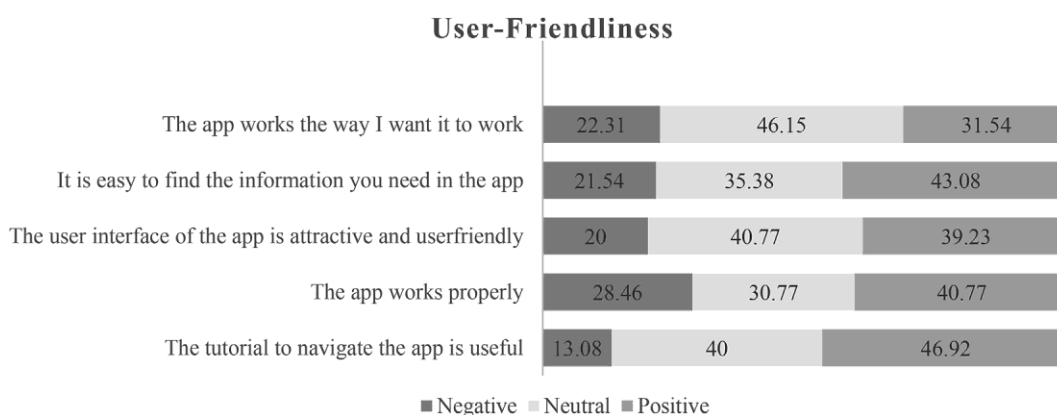


Fig. 6. Percentages of TELL-OP questionnaire's answers on the users' perception of the app's user-friendliness.

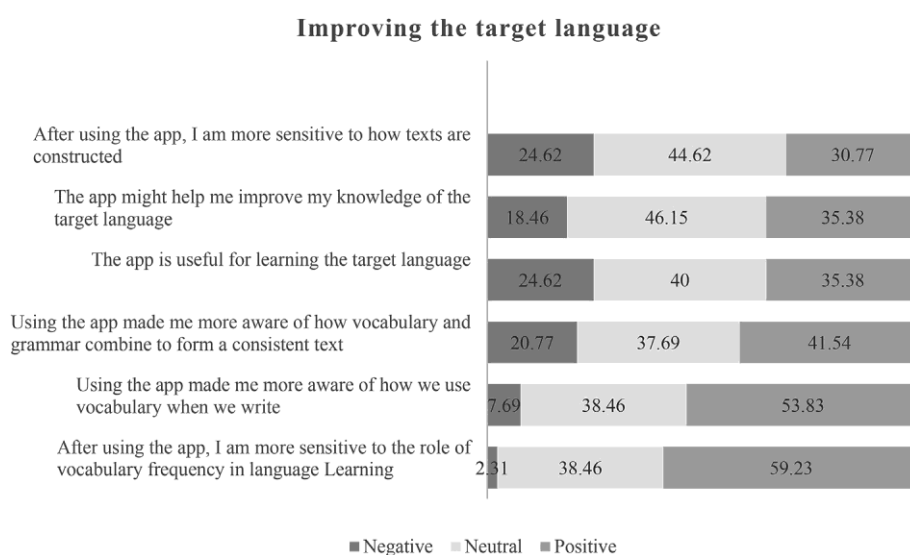


Fig. 7. Percentages of TELL-OP questionnaire answers on the users' perception of the app's capacity to help them improve the target language.

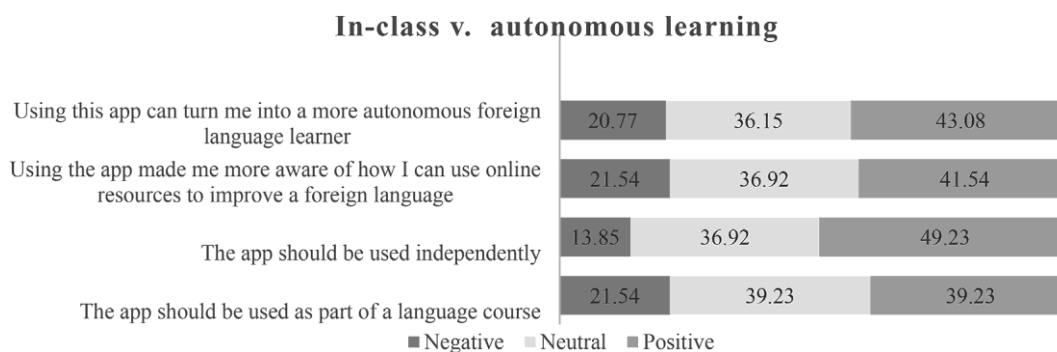


Fig. 8. Percentages of TELL-OP questionnaire answers on the users' perception of the app's potential as an in-class or autonomous tool.

app made them more aware of how vocabulary is used in writing, and 41.54% were more mindful of “how vocabulary and grammar combine to form a consistent text”. Finally, 59.23% believed they were more sensitive to the role of vocabulary frequency in language learning after using the app.

4.1.4 *Autonomous vs. in-class learning*

Fig. 8 below shows questions relating to the relevance of the TELL-OP app as a self-learning tool. 43.08% of the users agreed that the app could contribute to turning them into more autonomous foreign language learners, and 41.54% said that they became more aware of how they could use online resources to improve the target language. 49.23% of the respondents believed that the app should be used independently, whereas 39.23% believed it should be used as part of a language course.

This survey data offers a general overview of learners' perceptions of how DDL and MALL were streamlined through the TELL-OP app. In the next section, we will probe the users' reactions to using the app in the focus groups.

4.2. *Focus group results*

4.2.1. *Task performed*

Many of the focus group members appreciated the fact that they were presented with varied and numerous topics as well as interesting writing tasks:

"It is an application which has many advantages. It allows the user to write about a wide range of topics, so everyone can find something they are interested about."

(Student 2, 20-year-old B2 learner, Belgium)

The fact that they could produce an entire essay instead of words or chunks was positively perceived as well:

"It was the first time that I tried such an application. In general, when an app is designed to help people to learn a foreign language, it mainly focuses on vocabulary, but here we really have to write small essays."

(Student 34, 20-year-old B2 learner, Belgium).

However, the majority of the focus group members would have appreciated different types of exercises such as rewritings, which is something learners "usually do in class, and it would be great if [they] could practice on [their] own with the app" (Student 59, 18-year-old B2 learner, Spain). Other focus group members simply suggested adding "a 'free' section where the user could try out texts for academic assignments" (Student 1, 20-year-old B2 learner, Belgium).

Some focus group students highlighted the fact that the writing task established a routine of writing for learners at a very early stage in their language learning experience while helping them systematically practice in the areas they did not excel at. Nonetheless, it was pointed out repeatedly that the app should not be used by beginners: they considered that the tasks were more appropriate to reinforce and complete knowledge than to create it. A1 and A2 learners, in their view, would have a difficult time creating full texts from which to improve their writing, or "evolv[ing] with such exercises because of the basic vocabulary they would use" (Student 12, 20-year-old B2 learner, Belgium). According to the respondents, the DDL app was able to provide support for vocabulary learning and writing structured texts, whether it be in a class context or autonomously, provided the user had a minimum background in the language and grammar:

"To start learning a language I don't think it's very useful, but if you already possess some basic knowledge, you can strengthen your skills by writing assignments without having to hand them to a teacher."

(Student 59, 18 year-old B2 learner, Spain)

When discussing their feedback about the application, many participants emphasized the personalized assessment as very positive:

"This learning technique [is] very efficient [...] because it gives [them] the opportunity to improve [their] language skills on basis of [their] own language outputs." (sic)

(Student 44, 20-year-old B2 learner, Belgium)

Furthermore, many respondents valued the fact that the tasks provided feedback after completion; they considered that:

"Even if [the teacher] explains grammar before, when you write the assignment you are going to make the same mistakes [...], depending on your level, that's why [...] the app is better, because you notice the mistakes better after having made them."

(Student 58, 18-year-old B2 learner, Spain)

4.2.2. *Text analysis*

Regarding the type of feedback provided through the app, most participants appreciated the fact that they could access dictionaries, collocations, and synonyms when clicking on words from their own essays:

"The addition of both a 'built-in' dictionary and Netspeak is a significant plus as they are quite intuitive and seem like a good way of building vocabulary and making sure we understand the words we use."

(Student 13, 20-year-old B2 learner, Belgium)

The breakdown of the vocabulary used into CEFR levels was also perceived positively, as was the indication of word repetition within each written production:

"To my mind, the fact that the app organizes the words according to their language level contributes to the main strength of the app. Indeed, when writing, we do not always realize how basic our vocabulary can be. Thanks to TELL- OP, we are encouraged to go and search synonyms and by doing this kind of research, we not only raise our text level but we also apply and perfect our vocabulary."

(Student 33, 20-year-old B2 learner, Belgium).

On the whole, the users felt the app provided them with information they would not have received otherwise, except from a teacher in a classroom. Nonetheless, the students who were interviewed by the UK team characterized some of the feedback as unclear. This feeling was shared by many users across Spain and Belgium, who thought that further detailed information and interaction were needed to fully understand why they made some mistakes:

"Personally, I haven't understood all the findings given in the section 'Most Common Word Analysis' and 'Related ratios and indices'. It is necessary to understand all the information provided by the app if we want it to be effective."

(Student 52, 20-year-old B2 learner, Belgium)

In fact, "[You need] to have a pretty high knowledge in the language, but generally we [as language students] don't have any difficulty in understanding the terminology" (Student 58, 18-year-old B2 learner, Spain). The terminology used was seen as too academic and some respondents raised the question of how to actually interpret the results and put them to good use. Several participants also lacked feedback on a higher level; only words were taken into account, whereas compounds, phrasal verbs, syntax, grammar, register, style, etc. were not analyzed. Some users therefore found it "regrettable that expressions ('Travel broadens the mind') and grammatical structures ('Excited as I may be') of a certain level [were] not taken into account even though they have an impact on the language level of a text just as single words do" (Student 24, 20-year-old B2 learner, Belgium). A need for a grammar or spell-check feature was also mentioned several times.

4.2.3 *Mobile learning*

Apart from purely technical comments, the participants found the concept behind the app in tune with modern technologies, were satisfied with the idea of the app and its potential, and appreciated the fact that it made it "possible to study anywhere or anytime you want. [T]his accessibility on phone is more conducive to make young people addicted to it, which is a positive thing" (Student 40, 20-year-old B2 learner, Belgium). The opportunity for autonomous learning was also considered to be a motivating factor:

"I really enjoy the fact to have a self-evaluation at home without having to ask for advices. [...] The ability to practice my English skills without being dependent on my teacher motivates me even more."

(Student 47, 20-year-old B2 learner, Belgium)

Still, more than half of the users across all three countries believed it would be more appropriate to perform the task on a computer with a full-sized keyboard, highlighting issues such as "writ[ing] on average 200 words with thumbs [or] hav[ing] a global view on [y]our text and to properly scroll down the page (sic)" (Student 28, 20-year-old B2 learner, Belgium). Also, they reported that the smartphone didn't allow for simultaneous multi-app usage, so they had to close the window to access another tool. Default settings on the phone such as language and keyboard were other issues raised by the users.

"I had to download the app in my mother's phone, and she doesn't use an English keyboard [...]. When you have to write a contraction [...] is way easier to find [certain symbols] in an English keyboard. Besides, autocorrect doesn't work properly when writing in another language."

(Student 58, 18-year-old B2 learner, Spain)

4.2.4 *Suggestions for improvement*

Finally, the respondents made several suggestions for improving the DDL app. Interestingly, despite their appreciation of the opportunity to write an essay, they voiced a need for shorter structure exercises such as "some quiz in order to improve [their] vocabulary" (Student 14, 20-year-old B2 learner, Belgium). They would have welcomed examples of sentence and paragraph construction, and they proposed to add a graph view of the CEFR levels used in their text, which would evolve with each submission. Many users also put forward the concept of an appreciation system to reward their progression in time:

"[...] in order to learn correctly, it is necessary to see our progression[...]. I would suggest adding a comprehensive chart with our different texts so that we can become aware of the progress we have made."

5. Discussion

Our results suggest that mobile DDL for language learning was perceived positively, mainly due to the instant and personalized feedback and the access to the various tools that were implemented. There is still ample room for improvement in terms of the design of the tasks, adaptation of the proposed hardware, and the inclusion of further built-in tools. Specialized training on how to interpret the feedback provided is perceived as necessary by the users to fully understand and take advantage of the affordances of mobile DDL. The data collected shows that there is still a number of challenges to overcome before delivering mobile DDL successfully, namely: (a) taking into account hardware constraints, (b) improving and expanding the open educational features provided, and (c) taking into account the availability, or lack thereof, of the tools included in the app.

DDL has been found to increase language awareness, sensitivity to linguistic variation, the detection of linguistic patterns (Aguado-Jimenez et al., 2012; Boulton & Cobb, 2017; Cobb & Boulton, 2015; Perez-Paredes & Cantos, 2004), and the acquisition and application of a new set of data skills dealing with word frequency and language learning in texts (Pegrum, 2016). The app discussed in this study sought to take advantage of such affordances, and it seemingly succeeded in doing so as around half of the respondents claimed to be more aware of how they used vocabulary when writing (POS: 53.83%), of how vocabulary and grammar combine to form a coherent text (POS: 41.54%), of how to use online resources for language learning (POS: 41.54%), and to be more sensitive to the role of vocabulary frequency in language learning (POS: 59.23%). The extent to which the said effects will persist remains to be explored, however, as a more longitudinal study would be necessary. A more neutral perception was found regarding sensitivity to how texts are constructed (NEUT: 44.62%). This increase in language awareness could be explained by two specific features in the DDL app: the access to collocation, synonym, and regular dictionaries by clicking on any word in the user's own text, and the classification of each word into CEFR levels. Both were seen as positive affordances within the focus groups. The users added that they would not have gotten such information otherwise and that it helped them improve their language skills. After using the DDL app, there seems to be a consensus among the subjects regarding the increased awareness of the role of individual words and their frequency. These results therefore support the academic community's advocacy of using DDL skills to promote language awareness and further understanding of the L2 language system (Aguado-Jimenez et al., 2012; Boulton & Cobb, 2017; Perez-Paredes & Cantos, 2004).

The app was designed with the aim of supporting on-the-go, personalized, autonomous learning instead of in-class, structured courses, thereby following recent trends in the field of MALL which advocate the individualization and personalization of the learning process (Kukulska-Hulme, 2016). The respondents were satisfied with the ubiquity of the mobile app, although the results suggest that their mobile language learning practices mostly took place at home. This detail does not affect this particular affordance, as they are still able to learn on the go, to be autonomous, and to work at their own pace. The learners appreciated the varied essay topic assignments to choose from according to their personal preferences, and highlighted the advantages of a task that prompted them to write an entire text, as opposed to words or single sentences. They reported an interest in establishing an "essay-writing" practice, even suggesting the addition of a "blank assignment topic".

Regarding the notion of autonomy, almost half of the subjects thought that the app should be used independently from a structured language course (POS: 49.23%), and 43.08% felt that using the app made them into more autonomous learners. The response was more neutral when they were asked whether the app should be used as part of a language course (39.23% for both POS and NEUT). Thus, both options seem appealing to the users. The responses from the focus groups showed that, generally, the subjects felt the app should be used by intermediate or advanced language learners. They claimed that although the feedback on their texts was perceived as useful, it was sometimes too specific for them to grasp its meaning (e.g. *type-token ratio*). This use of linguistic terminology might prove difficult to understand. A tutorial focusing on the interpretation of the results might have been useful as a complement to the app guided tour. However, they thought that such tasks may require the users to possess minimum target language skills to be able to produce entire texts on their own. Studies have pointed out that very little research in corpus linguistics has been carried out outside the university setting (Boulton, 2008; Boulton & Cobb, 2017), restricting their reach to people who are likely to have higher understanding of the instrument at hand than the average user. Perez-Paredes (2010) points out that learners are faced with a very high cognitive demand when asked to use corpora, since concordance line use may be rather overwhelming for someone not familiar with the analysis of such information (Boulton & Cobb, 2017). This does not mean that DDL is necessarily restricted to advanced learners; in fact, the specialized literature has stressed the importance of hands-on training in DDL (Götz & Mukherjee, 2006; McEnery & Wilson, 1997; Pegrum, 2016; Perez-Paredes et al., 2011, 2018), stating that a lack of training could even prove counter-productive (Quan, 2016), leading to a negative perception of DDL. These issues call for the adaptation of the feedback provided depending on the user's level and a need for further education of language learners in data literacy.

Our subjects felt that the app worked properly (NEUT: 30.77; POS: 40.77%), that the tutorial offered useful information (NEUT: 40%; POS: 46.92%), and that information could be found easily within the tool (POS: 43.08%), but they leaned towards a more neutral stance on whether that information was useful (NEUT: 43.08%; POS: 42.31%), whether it offered a meaningful learning environment (NEUT: 39.23%), or whether the interface was user-friendly (NEUT: 40.77%; POS: 39.23%). While the latter may be further analyzed by app designers, the former should concern the DDL expert community as it poses challenges in terms of putting together successful mobile applications.

Hardware constraints played an important role in the feedback collected. The preferred devices for the respondents testing the mobile app were smartphones (94%), while 4% of the participants downloaded the app on a tablet, and the remaining 2% downloaded the app both on a tablet and on a smartphone. Even though these learners used the app on different devices, the subjects stated a clear preference for a computer environment to perform the essay-writing task. According to the focus group respondents, the limited size of the smartphone screen made it difficult for them to obtain a global view of the text, forcing them to scroll up and down constantly when they wanted to modify different parts of the text. Generally, the users felt that a full-sized keyboard would be more convenient and comfortable for producing long texts. However, using a Spanish keyboard to write in English, for instance, was reported as difficult due to the different layouts of the symbols. Neither the use of multilingual keyboards nor the use of the learners' voice to input text emerged explicitly during the focus groups. Other features such as autocorrect sometimes got in their way when trying to write a certain word, changing the spelling automatically to a similar one in the base language. As scholars have reported, the affordances of the hardware must be taken into account when designing tasks to facilitate the users' work, so they can function easily and intuitively on any device (Stockwell & Hubbard, 2013). Mobile devices should also be seen as a complement to computer environments rather than a substitute for them (Burstion, 2014; Pegrum, 2017). The learners also commented that they would have preferred more variety in the tasks proposed, preferably making them easier to complete on a smartphone, such as adding vocabulary-focused exercises. The literature shows that as the respondents reported, users favor vocabulary learning and audio-lingual grammar translation when using mobile devices for language learning (Steel, 2016).

Overall, the usefulness of the app for language learning received a rather neutral response (NEUT: 40%, POS: 35.38%). There are two factors that might play a role in the perception of the app as an effective tool for language learning. On the one hand, the responses to the functioning of the app suggest that there were potential problems with its design, which could affect the overall perception of its actual usefulness. On the other hand, the responses also suggest that there could be different views on whether language awareness is integral to language learning. The results seem to indicate that many learners are used to being taught what to look for or to getting corrective feedback, instead of being prompted to explore their own input and notice language constructions by themselves. The participants even reported a need for grammar or spell-check tools in the app that could correct them while writing. This concurs with Boulton (2010) in that the focus in instructed classroom settings is on doing the noticing for the learners, rather than having the learners notice and identify linguistic patterns by themselves. As DDL seeks to facilitate exposure to language in order to build awareness inductively, noting and awareness might be perceived as alien to the participants who claim to be familiar with a more teacher-centered, deductive approach. Therefore, they may have not developed a strong appreciation of the links between increasing language awareness and more effective language learning. This may need further exploration in future research.

They also pointed out a lack of interaction during the feedback process, which the users felt they needed in order to understand the rationale behind their "errors". According to the subjects, these features would help them to avoid mistake reinforcement. While the initial project for this OER-based app included the implementation of such tools, no grammar or spell-checking OER API was available in languages other than English at the time. This would be definitely be an important limitation for non-commercial developers who need to rely on existing OER. Finally, the subjects suggested the addition of a reward system tied to their progress over time. They would have appreciated features that showed their progress, which relates to the notion of longitudinal corpora (Myles, 2008). According to Reinhardt and Thorne (2016), adding a "gamified" layer on top of the learning activity helps motivate users by engaging them in a balance of reward and challenge. Certainly such a feature was expected by our users, and interestingly enough it has not been developed in standard DDL desktop applications that tend to prime individual, cognitive factors over more social, possibly collaborative, language learning.

A portion of the data collected could be subject to the Hawthorne effect, given that the tests were carried out within a short period of time and the interviews were performed in the presence of the researchers. A longitudinal study would provide data of interest to the DDL community. However, this by no means diminishes the importance of the results discussed above, as there is no conclusive evidence as to how and to what extent the Hawthorne effect takes place (McCambridge, Witton, & Elbourne, 2014).

6. Conclusion

This study has been developed with the intent of offering further insights into the affordances of DDL in mobile language learning. Given the lack of research in this area, this work may be considered as an original and preliminary step in building up further knowledge and establishing more grounded guidelines as to how to develop and, particularly, how to use DDL in MALL. In order to answer the research questions, a mobile app was designed within the framework of the European project TELL-OP. This app was distributed among test groups, whose perceptions were then analyzed through a questionnaire and focus groups.

DDL and mobile devices have the potential to allow learners to learn languages anytime and anywhere by, among other things, obtaining personalized and immediate feedback on their own production. Within the framework of this study, the users appreciated the personalized feedback they were provided straight away after the completion of the task and the possibility to retrieve their writing and the corresponding feedback whenever and wherever needed. This 24/7 access to reference tools and automatic assessment of their writing is seen as beneficial by the learners and should be further investigated in a more longitudinal study.

The specialized literature has shown that extensive training is necessary for the user to fully understand the possibilities of DDL as a learning approach and to use DDL tools effectively (Götz & Mukherjee, 2006; McEnery & Wilson, 1997; Pegrum, 2016; Perez-Paredes et al., 2011). A new set of skills related to data awareness is becoming a more central element of the language curriculum with the increasing popularity of mobile devices (Pegrum, 2016). The subjects in the present study did not report problems when navigating the app, or when using embedded features such as online dictionaries. However, the interpretation of the feedback on their text was seen as more challenging, especially for the least experienced users who might not understand the feedback provided or how to use it to their advantage. In such cases, previous research recommends that specialized training should be implemented, either to instruct users in how to manage the feedback data or in how to use more complex tools in the app. However, we wonder about the extent to which another DDL is possible that integrates pedagogy in the design of the querying system (Perez-Paredes, 2010).

Were this study to be replicated, it would be advisable to take into account the limitations encountered when designing it. These should prove useful to both researchers and curriculum designers: a) a multidisciplinary approach is necessary for the researchers to have a good understanding of both the theoretical aspects of language learning and the technical intricacies of app development. During the creation process of the app, it was important for the researchers to possess certain notions of some of the technical constraints of app development; b) the hardware limitations of smartphones and the existence of a wide range of different handheld devices must be considered when designing the tasks so that the users take full advantage of MALL; and c) the inclusion features, such as a reward system and a more graphic interface, so users maintain their interest and keep coming back to the tool.

Acknowledgement

This work was supported by the EU e ERASMUSp [grant number 2014-1-ES01-KA203-004782].

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.system.2019.06.009>.

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