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# Cognitive aspects of problem solving using dictionaries in L2 writing

## Abstract

This article reports on the use of dictionaries for L2 text production purposes by first-year ESP students. Research into dictionary use and cognitive studies of L2 writing are combined in this paper to outline the cognitive dimension of a dictionary consultation. Our objective is to focus on the situation in which an information need occurs, with a freshman ESP student as a specific user in mind.

In an attempt to guarantee the relevance of consulting a dictionary, for the purposes of our study we separated the draft stage of a composition from that of its revision. In the latter stage, external resources like dictionaries were made available. Our data suggest that our students were able to detect problems in their writing and reported having improved their compositions after having had the chance to consult dictionaries. The corrections were nonetheless implemented only in one-third of all the problems detected. It was also found that the tentative solution in L2 allowed for monolingual dictionary consultation but students often opted for generating another access key in their native language.

## 1. Introduction

The genuine purpose of dictionaries, according to their creators, is to meet punctual information needs of specific kinds of users in specific situations (Van der Merwe and Fuertes-Olivera 2014: 79, 81). However, little is known about the situations that originate these information needs, and even less when the users of dictionaries are LSP students. LSP is taught to students who vary in L2 proficiency and domain knowledge. Our focus here will be on information needs of university freshmen who need English for their degree and future career. They are not yet domain experts and their language level ranges from A2 to C1, with some occasional A1 students (as also reported in Jurković 2002), which makes them similar to other first-year students who enter their university degree just after high school.<sup>1</sup>

Knowing which situations cause our students' information needs and how our students tend to solve them is highly relevant to us as LSP teachers. Foreign text comprehension and production are two main activities where our students may need to use dictionaries, and the use of dictionaries for production purposes is the area where the most critical shortage of studies is observed. In this paper we attempt to establish the link between two hitherto independent areas of study: research on dictionaries and cognitive research on L2 writing focused on problem-solving

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<sup>1</sup> See Presas and Kozlova (2012) for differences in consultation patterns between students of Translation and Political Science/Sociology degrees.

strategies. It would be plausible to expect that this combination of approaches provides the theoretical background to study the use of dictionaries for production purposes by freshmen LSP students.

The empirical research on dictionary use aimed at creating new types of dictionaries and improving dictionary quality has commonly been oriented towards the main users of dictionaries – experts in their domain, whose consultations,<sup>2</sup> as Fuertes-Olivera and Piqué-Noguera (2013: 85) observe, are mainly successful. The same applies to linguist specialists: in the field of translation studies, especially in inverse translation, researchers have long come to the conclusion that L2 text production creates information demands and thus requires intensive use of external resources. Dictionaries are perceived by translators as “friendly tools” and used mostly for text production purposes (Gerloff 1988). Language learners, among them LSP students, often fail in their dictionary consultations for production purposes, which, as understood by dictionary compilers and language teachers, is due to their lack of dictionary skills (see Kozlova and Presas 2013 for a discussion of this point and Krajka 2007 on electronic dictionary training).

It is noteworthy that the use of dictionaries by non-experts is not clearly linked to an improvement in the quality of the text produced. Uzawa (1996) reported that using a dictionary forced language learners while writing in L2 to use words and expressions slightly beyond their threshold level, which may be positive in the learning context, but is counterproductive from the normative point of view. It was also observed that the use of dictionaries provoked immediate errors (Ard 1982) and reduced fluency. Chastain (1976: 377) as well as Christianson (1997) dissuaded students from writing “with a dictionary at hand” and Béjoint and Moulin (1987) suggested instead that writing should precede dictionary consultation. A quarter of a century later this argument seemed to be still in force: Chon (2009) argued that using an electronic dictionary for writing resulted being a problem rather than a solution, making the language learner invest time and effort in decoding the results of each dictionary consultation.

The main argument against using dictionaries for the purposes of L2 text production has been that students, especially those of lower L2 proficiency, make use of mostly bilingual dictionaries and hardly, if ever, consult monolingual dictionaries. This argument has served for promoting the use of monolingual dictionaries, on the one hand, and allowing lexicographers to offer the market specific “productive” and “learner’s” dictionaries, on the other. Rundell (1999) adheres to this tradition, though there is another point in his article which seems to be of particular interest: the author questions the very nature of production. Showing the usefulness of dictionaries in multiple choice exercises, he suggests an alternative view of text production as re-production, which implies that text production usually goes beyond mere encoding.<sup>3</sup> Developing this argument, we observe that, in fact, dictionary use is more effective in clearly re-productive tasks such as translation, mentioned above, multiple choice exercises and mistakes correction or revision.

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<sup>2</sup> We understand consultation as referring to a dictionary for specific information, which may result in a single consultation or a series of related consultations.

<sup>3</sup> Formulating one’s thoughts in a language is an encoding process while reading a text, for example, is a decoding process. This distinction roughly corresponds to the one existing between text production and text comprehension. The point we make lies in the circular and recursive nature of any linguistic activity, which becomes even more recursive when it is perceived as more difficult. In particular, text production, especially in the case of written text production in a foreign language, is rarely limited to encoding but requires support of additional decoding processes.

## 2. Alternating encoding and decoding in L2 text production

The process of L2 text production is not limited to encoding – encoding sequences are continually interrupted by other activities: “writing, rehearsing, reading, repeating and, sometimes, pausing alternated when dealing with text transcription” (Leki et al. 2008:133). Figure 1 shows L2 text production as a process that involves both encoding and decoding sequences. While the generation of tentative linguistic options (Zimmermann 2000) may be referred to as encoding, acceptance or rejection of options is the outcome of a process of decoding the text under construction to determine the suitability of the options accepted in context, a process that is also referred to as evaluation. When options are deemed unacceptable, a problem has been detected.

Contrasting previous research findings on problem-solving strategies in L2 writing (Swain and Lapkin 1995, Roca de Larios et al. 2006) allows us to speak of at least three types of problem in L2 writing (Figure 1):

Problem 1 originates in the L2 learner’s inability to retrieve an L2 option, which has probably led to the generation of an L1 option. Roca de Larios et al. (op. cit.) refer to this as a “compensatory” problem-solving strategy. Two solutions are offered by Swain and Lapkin (op. cit.): “translation (phrase or greater)” or additional “lexical search” in the L2 learner’s memory.

Problem 2 derives from the L2 learner’s awareness that the L2 option retrieved from the memory is imperfect in the sense that it does not match L2 language norms. Bearing in mind one can speak of language norms at different levels (e.g. word or sentence level) this type of problem may be one of spelling or grammar (Swain and Lapkin<sup>4</sup>) and would correspond in part to Roca de Larios et al.’s category of “upgrading” problems.

Problem 3 derives from the L2 learner’s awareness that the L2 option retrieved from their memory is imperfect in the sense that it does not match the task norms<sup>5</sup> (for example, Swain and Lapkin’s “doesn’t make sense”, “stylistic”, “doesn’t sound right”). This category would form the other part of Roca de Larios et al.’s “upgrading” problems. The degree of problem definition in this case is lower than in the previous kinds of problem and an additional cognitive effort on the part of the L2 learner would be required to define the problem better.

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<sup>4</sup> These authors do not mention grammar problems as such but instead refer to their solution: “applied a grammatical rule”.

<sup>5</sup> It could be asked how this can happen if it was the L2 writer who had generated the option in question as required by the task. This contradiction could be explained by the fact that the L2 option was activated thanks to some of its internal features meeting task requirements. However, when activated and contextualized, this option appeared to possess additional internal features (probably some unexpected connotations) that the L2 writer realized were contradictory to task requirements.

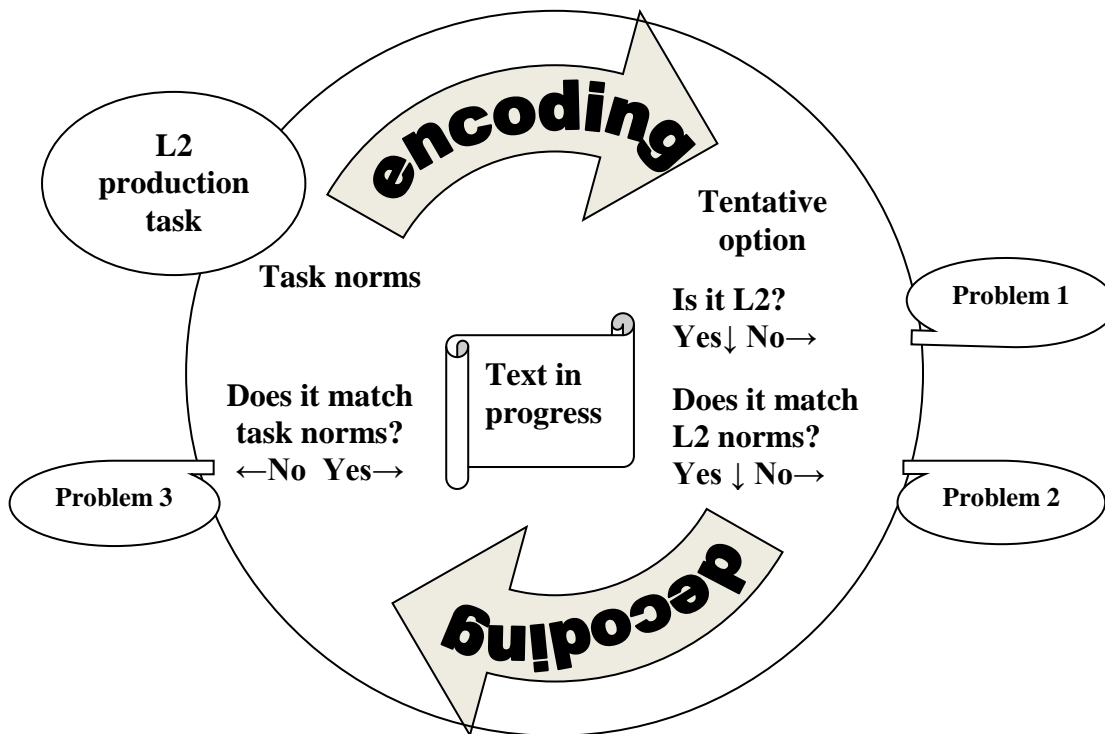


Figure 1. Problem detection in L2 production.

When the option is discarded, the process of generating options may begin again, which may later lead to the fourth problem type that consists of comparing the two options (Swain and Lapkin's "sound right", "doesn't sound right") and probably choosing between several "imperfect" options (Zimmermann 2000:86).

### 3. Use of external resources in L2 text production

Thus far we have described problems (for us, these are problematic situations with potential information needs) resulting from shortcomings in the L2 writer's memory. Although L2 writers may apply different strategies to work round these gaps in their knowledge as described in the previous section, the resulting solution will still be limited by the information existing in internal resources. While text production using only internal resources alternates encoding (generation of tentative options) with decoding (evaluation of these options in context), the use of external resources is complementary to this process. It is inextricably related to the problems that are detected during the text production process and is aimed at solving these problems. In fact, the consultation of dictionaries, and/or other external resources, is a complementary decoding activity. Writers' preconceived ideas of the expected quality of the final product will presumably make them engage in additional decoding to reduce the gap between their existing knowledge and the knowledge required to attain the expected quality of the production task.

Even so, the limited capacity of the human working memory requires a certain degree of linear progression in the production process, and this means that writers must continually make decisions about the projected outcome of their writing because, if most decisions are deferred, it would be impossible to cope with all the accumulated information at a later stage. This implies that the solutions adopted at intermediate points of the text production process need not necessarily be the best. From this point

of view, even poor solutions help advance the overall process of the production task, given that these are set aside as local problems to be solved later. In that sense, L1 lexical options, as well as L2 imperfect lexical options, would be perfectly valid. Adding to what was suggested by Béjoint and Moulin (op. cit.), Chenoweth and Hayes (2001:96) advise L2 text producers to “write it down, even if flawed, and revise it later”, thus speaking in favour of viewing L2 writing as a draft to be improved.

Figure 2 shows how each of the three types of problem detected in the L2 text production process (presented above in Figure 1) can be solved using external resources. Depending on the access key<sup>6</sup> the learner writing in L2 is able to produce, the dictionary consultation will be bilingual or monolingual. As lower proficiency L2 writers are often unable to produce L2 options in the process of encoding, they will need to access reference sources using L1 options as an access key and extend their existing knowledge by acquiring possible L2 equivalents (thus resolving Problem 1). L2 writers with relatively high proficiency will certainly be able to produce L2 options, although they may have problems with spelling, grammar or usage norms. These norms may be consulted using the L2 option as an access key (thus resolving Problem 2). Finally, high-proficiency L2 writers will be able to produce L2 options and will know how to spell them and use them in context. Nonetheless, they may have higher demands regarding the final quality of their writing and thus detect subtle inconsistencies in meaning that could make them engage in looking for alternative L2 items with slightly different meaning or connotation (thus resolving Problem 3).

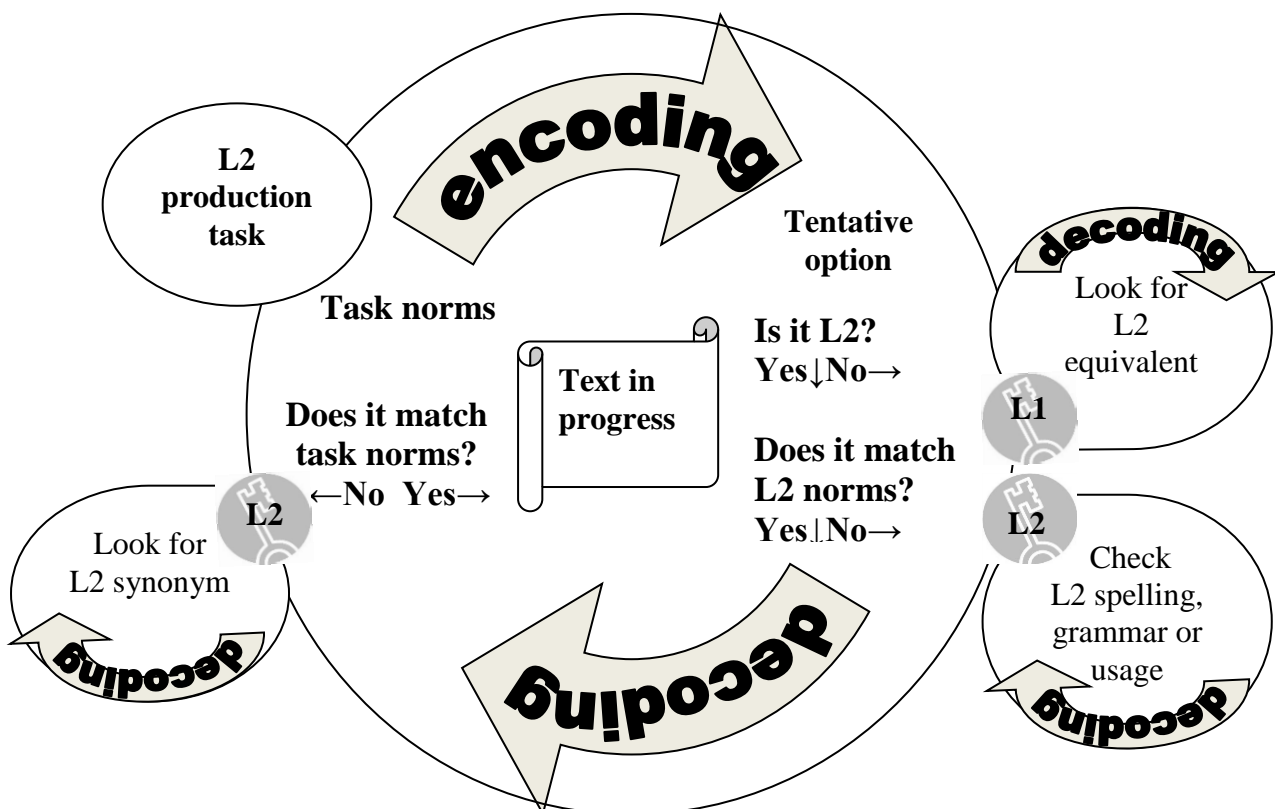


Figure 2. Solving lexical text production problem with reference sources.

We expect that the result of this additional decoding will be a change in internal resources that will allow for better encoding immediately after the dictionary

<sup>6</sup> Access key is the term referring to the element that would allow one to find the dictionary article containing the information to fill in the information gap.

consultation is over. Apart from this, provided that the dictionary consultation was preceded by a conscious problem formulation, such a cognitive investment may lead to vocabulary retention in the long term (Jurković 2002: 26).

## 4. Study design

The objective of our study was to examine the cognitive implication of using reference sources in L2 text reproduction. A text production task was set based on our conceptualization of dictionary consultation as a problem-solving strategy. Our study was designed to answer the following research questions: First, we wanted to know whether L2 learners were in fact able to detect problems in their own writing that could be later solved using external resources. Second, we wanted to know if consultation helped students to solve these problems, at least from their own perspective. We hoped that the results obtained from this study would help to design an appropriate training programme for the use of reference sources in L2 text production.

### 4.1. Methodology

In contrast to previous studies adopting a mainly normative perspective (Ard op. cit., Christianson op. cit., Chon op. cit.) our intention was to focus on students' own approaches to their use of resources, thus discarding such variables as correctness or acceptability from the teacher's normative point of view. Instead, we operated with the concept of a doubt, or problem, and analysed students' list of doubts as compared to their draft and the final version to draw conclusions on whether students solved their problems or not. These types of data were compared by the two researchers in order to define action types. A customised questionnaire was used to complement the data obtained from students' actions (published in Kozlova and Presas 2013).

### 4.2. Study group

Data was collected from a population of first-year university students taking degrees in Political Science and Sociology (N=42) at a Spanish public university. The students (with an almost equal proportion of men and women,  $\pm$  20 years of age) had enrolled in a compulsory course in English for Social Sciences in two successive academic years: 2009-2010 (14 students) and 2010-2011 (28 students). All students had studied English at school and their language level ranged from A2 to B2.1 of the European Common Framework of Reference for Languages, judging by the results of the Computer Adaptive Test taken at the Campus Language Service.

For the purposes of this study, we refer to the two languages spoken in Catalonia, where the study was carried out, Catalan and Spanish, as L1 and English as L2. As far as the use of external resources was concerned, students normally had a computer with internet access available in their homes, in the university library, or in the university computer rooms. This ensured regular access to online resources both for academic and social purposes. Students also possessed, and were accustomed to using (as advised by their secondary and high school English teachers), printed dictionaries at home or in class.



### 4.3. Data collection

On the first day of English class, students were asked to write a composition explaining the reasons for their degree choice; the group included Sociology and Political Science majors. This task was carried out in a traditional classroom and the time was limited to one hour. Students had to write a composition by hand and the use of external resources was not part of the task. When the students finished writing, the teacher suggested that they create their own doubt list (understood as the list of situations in which the information need occurred and students were not able to resolve it or were not sure of their solution). The compositions handed in at the end of this first part of the class were photocopied by the teacher and these photocopies were regarded as the draft.

The second part of the task, which took place after a short break and lasted for 40 minutes, included the use of reference sources to allow students to improve their drafts. Now, the students had internet access and a number of printed dictionaries available to them in the classroom. They received their compositions back and were encouraged to complete their doubt lists, solve those doubts using resources and introduce corrections into the draft thus producing the final version. At the end of the task, students were asked to hand in their final version and their doubt list and fill in a questionnaire. In this way four kinds of comparable data were obtained from the students' texts:

- a Doubt elements as they appeared in the doubt list (DL)
- b Doubt elements as they appeared in their draft (DD)
- c Doubt elements as they appeared in the final version (DF)
- d Questionnaire responses (here we analyse only Q1).

## 5. Results

In relation to our first research question, whether students were able to detect problems in their own drafts, we calculated the number of doubts in each subject's doubt list. All students who participated in the study identified one or more doubts,<sup>7</sup> the maximum being 11. The mode was set at four doubts per doubt list (nine students).

In relation to our second question, whether consultation helped students to solve their doubts, we first analysed the corresponding data from the questionnaire, in particular, response to Q1: "Do you think having access to resources improved the quality of your composition?" All the subjects who answered this question except for one responded positively (97 per cent) while for two other respondents the response was left blank.

To be able to contrast the students' beliefs with their actual performance we decided to see whether corrections were introduced as a result of each problem-solving sequence because if they were not, one could not really speak of any composition improvement. To do so, it was necessary to compare the draft and the final version in reference to those elements stated as doubts in the doubt list. It was found that the text element regarded as a doubt was only corrected (COR) in 37 per cent of cases as

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<sup>7</sup> Still, it is worth mentioning that there was one student (especially fluent in English) who appeared at the beginning bewildered by the task of creating her personal doubt list: in her opinion, she had already solved her doubts by reformulating.

opposed to 47 per cent of cases when it was not corrected (NOCOR).<sup>8</sup> To gain a deeper insight into the students' cognitive processes of reference we decided to analyse those cases when the process of reference apparently did not result in a correction. We distinguished between three sub-actions of NOCOR action: NOCOR CONF (when the tentative element was confirmed as correct), NOCOR SOL (when the solution to the problem was found but no correction was introduced) and NOCOR NOSOL (when the problem was not solved). It was found that the share of 47 per cent of the doubts that were not corrected (NOCOR) was split into 16 per cent of doubts that were confirmed in their initial variant (NOCOR CONF), 18 per cent of doubts that were nonetheless solved in the doubt list (NOCOR SOL), and 13 per cent of those that remained unsolved (NOCOR NOSOL) (Figure 3).

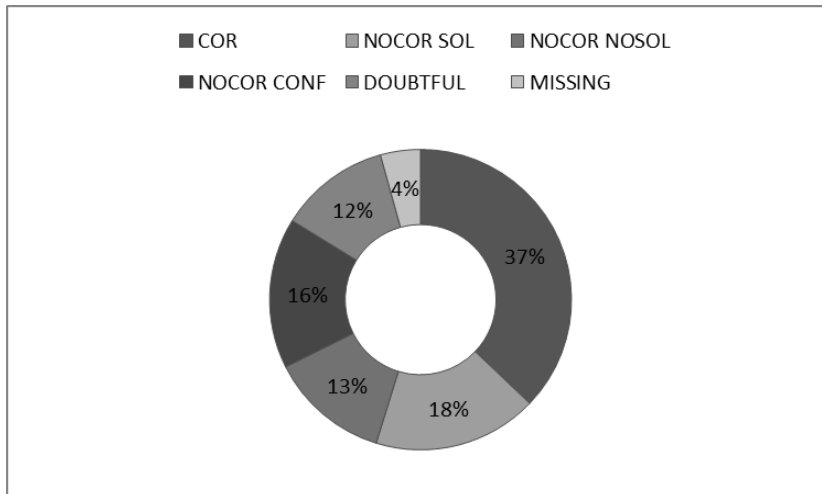


Figure 3. Frequency of action types.

When the students' actions were triangulated with their responses to Q1, a statistically significant relation between the two was found ( $p$ -value < 0.0001), which, however, simply confirmed that the only student who had responded negatively to Q1 was consistent in his answer: he was responsible for 5 out of the total of 19 instances of NOCOR NOSOL.

Action	Q1		
	Yes	No	Total
<b>COR</b>	77 100.00	0 0.00	77
<b>NOCOR SOL</b>	34 100.00	0 0.00	34
<b>NOCOR NOSOL</b>	14 73.68	5 26.32	19
<b>NOCOR CONF</b>	33 100.00	0 0.00	33
<b>Total</b>	158	5	163
<b>Frequency Missing = 13</b>			

Table 1. Bivariant analysis of Actions by Q1.

<sup>8</sup> The two researchers were unable to reach an agreement on the classification of 12 per cent of doubts (DOUBTFUL) and 4 per cent of doubts did not appear in the draft or the final version although they were listed in the doubt list (MISSING).



To test our model of L2 text production with reference sources (Figure 2) we had a look at the examples of what we defined above as Problems 1, 2 and 3 in L2 text production with resources. To see whether our approach provided a new perspective beyond the above mentioned studies that did not consider any use of reference sources, we additionally checked whether our data supported the distinction between "compensatory" and "upgrading" problem-solving strategies (Roca de Larios et al. op. cit.) based on the criteria of the language of the tentative option that students were able to produce (L1 or L2).

What we found, however, especially in the case of lower proficiency students, was a continuum between L1 and L2, where the main tendency was the use of *interlingua* (Nemser 1971): an "approximative" or deviant linguistic system actually employed by the learner attempting to utilize the target language. Lower proficiency students in fact did not know whether the element recalled by their memory was L2. When they were not sure, they opted for additionally generating an L1 option which was consequently used as an access key (Examples 1, 2 and 3 below) to find an L2 language equivalent. When they believed their tentative option was close enough to L2 they stopped treating it as Problem 1 and instead dealt with it as Problem 2 using this element as an access key to check its spelling (Examples 4 and 5 below).

Example 1: DL = *edifici* : building, DD = DF = building (NOCOR CONF)

Example 2: DL = *comportament* = behavior, DD = DF = *comportamento* (NOCOR SOL)

Example 3: DL = *simpáticos*, DD = DF = *simpathics* (NOCOR NOSOL)

Example 4: DL = Magic? V, DD = DF = magic (NOCOR CONF)

Example 5: DL = *lawer* -> lawyer, DD = DF = *lawer* (NOCOR SOL).

We also found that higher proficiency students who were able to generate an L2 option did not always use it as an access key to retrieve grammar/usage details (Problem 2) but sometimes generated an L1 option to use as an access key (Examples 6 and 7 below). The same happened when our subjects regarded the L2 option they generated as not adjusting to the task norms (Problem 3), they either used this L2 option as a key or generated an additional L1 access key (Examples 8 and 9).

Example 6: DL = "interest for" -> *crec que es* "interest to" -> era "My interest in",  
DD = my interest for, DF = my interest in (COR)

Example 7: DL = *pocas* : few, DD = low, DF = few (COR)

Example 8: DL = *likewise* -> in this way, DD = likewise, DF = in this way (COR)

Example 9: DL = *experimentar* : to undergo, DD = experiment, DF = undergo (COR).

## 6. Discussion and conclusions

The present study was designed according to our conception of the text production process as a combination of encoding and decoding. We are aware of the fact that encoding and decoding alternate within the production process and that our attempt to sequence them may appear somewhat artificial. In our experimental study the students first produced a text using only internal resources. This supports Leki et al. (2008:133), who state that writers rely on internal resources to generate content. Having used their internal resources to their full potential our students were required to determine and define a number of doubts in their text production that they were unable to resolve using internal resources only. This guaranteed the relevance of future consultations when they were finally given a chance to improve their writing using external resources. Dictionary consultation was deferred until the end of the

production process according to the suggestions listed earlier (Béjoint and Moulin op. cit., Chenoweth and Hayes op. cit., Chastain op. cit., Christianson op. cit.). We observed that this approach is useful for the overwhelming majority of students and allows them to focus on specific text elements.

The validity of such an approach is also confirmed by the fact that students reported improvement in their compositions after they had had a chance to consult reference sources. Even taking into account that corrections were introduced only for one-third of all the doubts, this speaks in favour of allowing students to use reference sources. However, finding a solution to a problem did not necessarily lead to a correction. This was not only because students confirmed their initial draft version after having consulted resources. Certain students systematically forgot (or preferred not) to introduce corrections in the final version even though they had found a new solution. This may be due to the fact that students use external resources, among them dictionaries, not only for the purposes of perfecting their final draft but also to back up their provisional solutions, which highlights the importance of viewing students' writing as a learning process.

Finally, our examples of students' problem-solving sequences show the importance of the concept of *interlingua*. Generating an option internally often leads to neither L1 nor L2 options, but instead a student's personal *interlingua* option. This option can be directly used as an access key assuming it is close enough to L2, or an additional L1 option can be generated to be used as an access key. The variety of cases observed in our study suggests it should not be taken for granted that the tentative option generated by internal resources is necessarily the one to be used as an access key. This implies that the study of L2 text production involving the use of external resources requires a specific approach. In the light of our findings, Figure 2 should be changed with regard to the access key used for consultation. Lower proficiency students have to decide whether their tentative option is close enough to L2 and, if not, they have to generate a corresponding L1 option. Higher proficiency students who are able to generate an L2 tentative option can proceed in two ways: use this L2 option as a key or additionally generate an equivalent L1 option to be used for this purpose. This makes them more flexible in their choice of resource.

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