CLIL Journal of Innovation and Research in Plurilingual and Pluricultural Education

To cite this article:

Navarro, N. (2019). The Effects of a Content-Based Language Course on Students' Academic Vocabulary Production. *CLIL Journal of Innovation and Research in Plurilingual and Pluricultural Education, 2*(2), 25-42. https://doi.org/10.5565/rev/clil.30

https://doi.org/10.5565/rev/clil.30
e-ISSN : 2604-5613
Print ISSN: 2605-5893

The Effects of a Content-Based Language Course on Students' Academic Vocabulary Production

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This study examines the effects of content-based language instruction (CBI) on the production of academic vocabulary in texts written in English by university learners enrolled in two different instruction settings, i.e. English as Medium of Instruction –EMI–, and the same programme in the students' L1 (Catalan/Spanish), over one semester. Both the materials used in class and the learner corpus were examined in order to identify the degree to which they incorporate (i.e. cover) items from three lists of interdisciplinary academic terminology, namely the Academic Vocabulary List (AVL), the Academic Collocations List (ACL) and the Academic Formulas List (AFL). The results indicate that the class material covers 5% of ACL, 32% of AVL, and 64% of AFL, which reflects the academic and pedagogical nature of its contents. In the learner corpus, both L1 and EMI learners produced more general academic and technical words after the course. EMI learners also increased their use of collocations and formulas. The benefits of CBI for acquiring academic terminology and for developing disciplinary literacy are discussed in the light of the two settings of instruction under study.

KEYWORDS:
content-based instruction; English medium of instruction; disciplinary literacy; academic formulas; academic collocations; academic vocabulary.

Este estudio examina los efectos de la enseñanza de lengua basada en contenidos (CBI por sus siglas en inglés) en la producción de vocabulario académico en una tarea escrita de clase. Los textos fueron redactados por estudiantes universitarios de primer año inscritos en dos modalidades diferentes, inglés como medio de instrucción (EMI por sus siglas en inglés) y el mismo programa en su L1 (Catalán/Castellano), durante un semestre. Tanto los materiales utilizados en clase como el corpus de estudiantes se examinaron para identificar el grado en el que incorporan elementos de tres listas de terminología académica interdisciplinaria, específicamente las listas de vocabulario (AVL), de colocaciones (ACL) y de fórmulas (AFL) académicas. Los resultados indicaron que los estudiantes, tanto de L1 como de EMI, produjeron un mayor número de palabras académicas y técnicas después del curso. Los estudiantes de EMI también aumentaron el uso de colocaciones y fórmulas. Los beneficios de CBI para adquirir terminología académica y desarrollar la alfabetización disciplinaria se discuten a la luz de las dos modalidades estudiadas.

PALABRAS CLAVE:
instrucción de lengua basada en contenidos; Inglés como medio de instrucción; alfabetización disciplinaria; formulas académicas; colocaciones académicas; vocabulario académico.

1. Introduction

In the past few decades, researchers have become increasingly interested in describing how academic discourse is constructed in different disciplines and genres. Globalization and the emergence of English as a *lingua franca*, and also as the language of science and research, has made English academic discourse a requisite for scientific communication, progress and publishing, and thus a basic skill for novel researchers and university students. This has, in fact, had a considerable impact in most European higher education (HE) institutions, in which the number of programmes and subjects offered in English has seen (and still is seeing) a steady increase. University students are often required to listen to (lectures), speak (presentations), read (literature), and write (assignments) at different levels of immersion, in English. In the Spanish context, Bologna, and the English B1–B2 requisite that most universities have set for students to be able to graduate[1] (Ministerio de Ciencia, Educación y Universidades, 2019), has in part triggered the raise of English as Medium of Instruction (EMI) programmes, and/or English for Academic or Specific Purposes (EAP, ESP respectively) courses (Pérez-Vidal et al., 2018). These requirements can pose a challenge for non-native speakers (NNS) of the language, especially if the status of English is that of a 'foreign language', i.e. not an official language in the country. English-as-a-foreign-language (EFL) undergraduate students are not only required to learn and produce 'general English' in order to be able to obtain the B1 or B2 certificates required in bachelor degrees, but also to manage 'specialized English' or the academic discourse of their disciplines, in order to succeed academically.

Academic discourse refers to the "ways of thinking and using language which exist in the academy" (Hyland, 2009b, p. 1) and "embod[ies] the social negotiations of disciplinary inquiry, revealing how knowledge is constructed, negotiated and made persuasive" (Hyland, 2004, p. 3). As an increasing body of recent research shows, academic discourse knowledge is of paramount importance for students' successful educational performance (Airey et al., 2017; Csomay & Prades, 2018; Granger, 2017; Ha & Hyland, 2017; Webb & Nation, 2017) as it allows students to create and disseminate knowledge in their field of studies appropriately. And yet, what is considered 'appropriate' may vary from discipline to discipline (Hyland, 2008; Hyland & Tse, 2007). In the particular case of academic writing, specific terminology and formulaic language play an important role in knowledge making, not only because they carry the ideational weight of the text, but also because they portray disciplinary conventions.

However, the fact that specialized vocabulary may account for 10% to 30% of the words in an academic text (Coxhead & Nation, 2001) can pose a challenge to novice EFL readers and writers: as Hinkel points out "learners will generally not pick up even more obvious characteristics of academic writing by mere exposure" (Hinkel, 2003, p. 297). An additional difficulty is the fact that academic discourse differentiates between two types of discourse: 1) *discipline-specific* discourse, that is, those words and expressions that are related to content knowledge and that differ from discipline to discipline (in the dentistry field, we could find e.g.: *enamel, partial restoration, scaling and root planning*), and 2) *general academic* discourse, i.e. terminology and expressions used across different academic contexts and that can be found in a wide range of disciplines (e.g. *evaluated at baseline, qualitative analysis, significant differences*) (Granger, 2017). The effectiveness of teaching and learning academic discourse by focusing on the former or the latter type is currently under debate.

Some studies, on the one hand, claim that academic discourse can be highly discipline-bound in nature (Granger, 2017; Hyland, 2008; Hyland & Tse, 2007) in that each academic discipline operates within very specific conventions and specialized discourses, which significantly reduces the effectiveness of learning generic academic vocabulary only. Recent efforts have been made to create discipline-specific lists of vocabulary, such as the nursing academic word list (Yang, 2015), or the medical academic word list (Lei & Liu, 2016). On the other hand, there is another line of research which claims that a generic core of linguistic devices across disciplines does exist, and that, given the cross- and inter-disciplinary nature of most studies and tasks EFL learners are exposed to, its pedagogical relevance is warranted (Durrant, 2016; Simpson-Vlach & Ellis, 2010). In fact, several lists of general academic terminology, of different lengths and breadths, have been created drawing on large academic corpora, such as the British National Corpus (BNC), and the Corpus of Contemporary American English (COCA), and have been designed using advanced methods of word retrieval (see Gardner & Davies, 2013 for a comprehensive description), as we will see in Section 3.2. There is also an increased tendency for vocabulary lists compilers to move away from the analyses of isolated words, and study longer strings of words instead, also referred to as 'formulaic language' (Cortes, 2004; Hyland, 2008; Wood & Appel, 2014), that can be more (e.g. *collocations*) or less (e.g. *formulas* or *lexical bundles*) idiomatic (Durrant, 2016; Granger, 2017; Paquot, 2017).

Taking a corpus-based approach, the present study adopts an innovative analytical approach in that it explores the occurrence of general academic discourse, not only in terms of words, but also in terms of collocations and formulas in a learner corpus of EFL student writing over time. In order to provide a more inclusive analysis of academic discourse, it also explores lists of words, collocations, and formulas that are specific to the discipline studied (i.e. dentistry), using vocabulary lists extracted from the class materials. The objective of the present study is to measure the extent to which students incorporated academic and disciplinary discourse from the CBI materials they were exposed to during the course, by means of a pre- and post-test design.

While some educational settings usually have content teachers teaching technical terms and English teachers

focusing on general academic vocabulary (Green & Lambert, 2018), there is an approach that can provide EFL learners with opportunities to learn both *general academic* and *disciplinary* discourse in context, namely Content-Based (language) Instruction (henceforth CBI). CBI programmes, and more specifically the 'adjunct model', are parallel language courses designed by a language specialist in collaboration with content specialists (see e.g. Roquet et al., forthcoming) that go hand in hand with other content subjects in the same programme. Section 2 provides more information about this type of communicative language teaching, as it is part of the context of this investigation.

There are several studies that look into academic discourse, be it generic or technical, and explore how it is deployed in textbooks students are exposed to (Green & Lambert, 2018), by expert writers in research papers (Cortes, 2004; Hyland, 2009a), or other academic texts in EAP courses (Wood & Appel, 2014). Unfortunately, the degree to which findings and pedagogical implications that emerge from corpus-based studies are applied later on in the classroom or used by language material developers is still relatively low (Gilquin et al., 2007; Römer, 2011). Furthermore, pedagogical materials that do include corpus-based information tend to rely solely on native data (Gilquin et al., 2007). Nevertheless, in order to know what vocabulary items may cause difficulties for EFL learners, learner data should be explored. Learner corpora, i.e. naturally occurring language produced by non-native speakers of a language, can be highly relevant for EAP and L2 teaching in general, as it enables researchers, instructors, and/or material developers to identify those aspects of a language that are more difficult for L2 students (see e.g. Nesselhauf, 2005). However, few studies have explored the actual use and the development of academic discourse in texts written by EFL students longitudinally. When comparing two texts written by the same learner in any discipline over time, a more frequent and varied presence of academic terminology can indicate a developing fluency in the academic discourse (Gee, 1991) and therefore the emergence of a disciplinary voice (Hyland, 2009a).

2. Content-based language instruction

CBI is a form of communicative language teaching in which language is used as a real means of communication. In the literature, three different models of CBI have been described: 1) in the *theme-based model*, a language specialist usually focuses on different topics or themes to teach language and it is typical of language schools or courses for adult learners; 2) in the *sheltered model*, on the other hand, it is a content specialist who teaches her/his subject in a more student-centered manner to ESL students, providing comprehensive input; and finally, 3) in the *adjunct model*, a language specialist together with a content specialist develop a language course in which linguistic structures and specialized terminology are made visible to students (see Richard & Rodgers, 2014, and Stryker & Leaver, 1997 for a more detailed description of these models). The CBI adjunct model can equip students with transferable linguistic skills to perform successfully in parallel content subjects so that they can be better prepared (Römer 2009, 2011). However, while these three models use authentic material for language learning, the adjunct model integrates language and content in a more contextualized manner by using the subject as a background for language learning. As Richards and Rogers point out "people learn a second language more successfully when they use the language as a means of acquiring information, rather than as an end in itself" (2014, p. 209) and this is particularly one of the advantages CBI offers (Brinton et al., 2003).

There are three other types of communicative language teaching that have become popular and widespread practices in the past few decades –specifically English for Academic Purposes (EAP), English as Medium of Instruction (EMI), and Content and Language Integrated Learning (CLIL). The extent to which these models focus more or less on the language can vary greatly, depending on the educational level these are implemented in, the discipline, and also the instructor. In order to provide a clearer definition of these constructs, Airey (2016, p. 73) has created the "language-content continuum" which reflects the orientation of these three educational approaches with respect to their learning outcomes, as shown in **Figure 1** below:

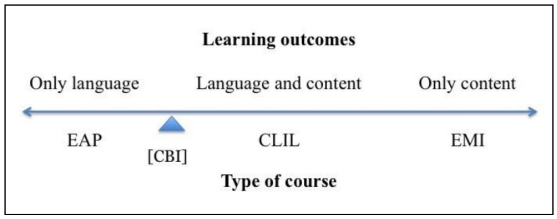

Figure 1. The language-content continuum (adapted from Airey, 2016)

CBI could be placed towards the "language-driven" side on the continuum, since it addresses specific language needs. The main difference with the other types of instruction, however, is that CBI programmes are 'parallel courses', often obligatory, closely associated with other subjects (as is the case with the course explored in this study), and they are therefore more content-oriented than e.g. EAP. In this regard, Ha and Hyland (2017, p. 35) observe that "EAP teachers (…) often lack the specific field knowledge to develop suitable teaching materials about technical vocabulary and often feel vulnerable in this area". In addition, while CLIL programmes have become very popular in primary and secondary education in recent years (see e.g. Dalton-Puffer, 2011; Lasagabaster, 2008; Pérez-Vidal & Roquet 2015; Ruiz de Zarobe, 2011), they are uncommon in tertiary education (Airey, 2018). This may be due to the fact that CLIL requires instructors to have a dual expertise in both the content and the language, and the effort required to redesign teaching materials to meet this dual objective at university level can discourage HE institutions to implement and offer

CLIL subjects in their programmes. As for the last type of course placed at the other end of the continuum –EMI–, which has gained traction in the European HE arena in recent years (Ament & Pérez-Vidal, 2015; Pérez-Vidal et al., 2018; Smit & Dafouz, 2012), a recurrent concerns is that EMI instructors usually do not feel comfortable correcting students' linguistic mistakes (Airey, 2011; Ha & Hyland, 2017), so no/little attention is paid to language learning. As a result, the impact EMI can have on the development of specific domains of the L2 competence can be rather limited.

In conclusion, the value of L2 generic and disciplinary academic discourse may not be sufficiently exploited in the abovementioned types of instructions in HE, and CBI may overcome this shortcoming. As Roquet et al. (forthcoming) indicate, CBI can help to narrow the linguistic gap between EMI and L1 students in terms of syntactic gains. There are some studies that have looked into learners' lexical and morphosyntactic gains (Roquet et al., in press) and overall performance (Dafouz et al., 2014; Hernández-Nanclares & Jiménez-Muñoz, 2017) when exposed to CBI approaches in tertiary education. However, there are few studies that analyse EFL learners' lexical sophistication through the production of academic vocabulary after a CBI course. The present study aims to address this gap of knowledge.

3. Disciplinary literacy and academic vocabulary lists

3.1 Disciplinary literacy

The development of disciplinary literacy, meaning the "ability to appropriately participate in the communicative practices of a discipline", is often one of the primary goals of any degree programme (Airey, 2011, p. 3). Finding a "credible disciplinary voice" (Jiang & Hyland, 2017, p. 14) can moreover allow students to relate to their professional community "in ways that seem familiar and engaging" (Hyland, 2005, p. 71). However, disciplinary discourses can be highly context-sensitive, and therefore, not only the language, but also the mode (e.g. written vs. spoken), the genre (e.g. lecture vs. textbook) and even the type of task (e.g. essay vs. research paper) can influence linguistic choices. The same words may have different frequencies, collocations, and different meanings in different disciplines –consider the use of *scaffolding* in education and in architecture, for example (i.e. in education, *scaffolding* refers to an instructional method in which teachers gradually reduce assistance, so that learners can develop their autonomy; in architecture, *scaffolding* refers to a temporary structure used on the outside of a building under construction). These keywords or technical words are used by specialists in the field, and their presence in academic texts can denote authors' membership and level of expertise.

While it is true that "successful academic writing is more than just using a thesaurus and filling a paper with fancy sounding words" (Csomay & Prades, 2018, p. 108), using terms and expressions (e.g. *dental anxiety, we explore, on the other hand*) that are used in a particular discipline, and in the academia in general (interdisciplinary), can help EFL learners increase the sophistication of their texts. Some studies have shown that expert writers tend to rely more on collocations than novice writers, and that this use of fixed expressions is often considered a marker of proficiency and fluency in academic writing (Granger, 1998; Nesselhauf, 2005). For this reason, measuring the degree to which EFL learners produce academic vocabulary can determine: 1) their proficiency level and 2) their linguistic development. The present study explores writing sophistication in a learner corpus by analysing the number of academic words in a collection of texts. Both the fact that students need general academic vocabulary due to the interdisciplinary nature of their programmes, but also discipline-specific vocabulary to fully develop their disciplinary voice has motivated the author of the present study to investigate the extent to which students draw on general academic vocabulary on the one hand, and more specific vocabulary of their discipline on the other hand.

3.2 Academic vocabulary lists

While there is an ample range of corpus-based studies that have performed lexical analyses using academic vocabulary lists (Coxhead, 2017; Durrant, 2016; Laufer & Nation, 1995), the study of academic collocations and formulas is yet to be exploited. As Granger points out "phraseology is now recognised as a major component in general L2 learning and teaching. In the specialised field of academic literacy, however, the phraseological dimension has yet to establish itself as a core facet" (Granger, 2017, p. 22). Academic language can be highly patterned (Römer, 2011) and thus analysing EFL learners' phraseological devices can also help to uncover new learner writing features. In fact, Cortes (2004) found that the university students in her study rarely used target bundles (i.e. recurrent word combinations such as *the use of*) in their texts, compared to professional writers in biology and history, even though they were exposed to these expressions in their readings.

There are three corpus-based lists that have recently been developed using large academic corpora, text analysis tools, and different statistical tests to retrieve 1) words, 2) collocations, and 3) formulas:

1) **The Academic Vocabulary List (AVL)** (Gardner & Davies, 2013) draws from a 120 million words academic subcorpus of nine disciplines (mostly research papers) from the COCA corpus, and contains 3,015 lemmas (e.g. *system, social, however*). I support the authors' view that the AVL reflects academic words more accurately than the Academic Word List previously developed by Coxhead (2000), since it pulls from a larger and more recent corpus; also, the fact that the list is lemma-based,

and part-of speech tagged makes it more relevant for EFL teachers and learners. The full list is available at: *https://www.academicvocabulary.info*

2) **The Academic Collocation List (ACL)** (Ackermann & Chen, 2013) comprises 2,468 cross-disciplinary academic collocations extracted from the 25 million words Pearson International Corpus of Academic English (PICAE) (e.g. *academic writing, brief overview, crucial factor*). The list is available at: *https://pearsonpte.com/organizations/researchers/academic-collocation-list/*)

3) **The Academic Formulas List (AFL)** (Simpson-Vlach & Ellis, 2010) draws from different corpora, such as the Michigan Corpus of Academic Spoken English (MICASE), and BNC for spoken academic English, and Hyland's 2004 corpus of research articles for written academic English, totalling 4.2 million words. The AFL contains 607 most frequent formulaic sequences of 3-, 4- and 5-grams, subdivided into academic spoken English (e.g. *be able to, this is the, you can see*), academic written English (e.g. *on the other hand, due to the fact that*), and a core list with formulas that are common in both academic written and spoken English (e.g. *in terms of, at the same time, from the point of view*). Combining Mutual Information (MI) scores, frequency, and manual scoring by experts, Simpson-Vlach and Ellis (2010) also created a metric called "formula worth teaching" and included formulas organized into discourse-pragmatic categories (e.g. 'contrast and comparison': *as opposed to*). The AFL can be found in Simpson-Vlach and Ellis' (2010, p. 37).

Nowadays there are useful software packages such as the 'AntWord Profiler' (Anthony, 2014), the 'Web Vocabprofile' (Cobb, 2002), the 'Wordandphrase' (Davies, 2012), or the 'Lexical Complexity Analyzer' (Ai & Lu, 2010) that can help to identify academic language and measure sophistication in a given text; these tools, however, look at isolated words, very often classifying them according to their frequency band, calculating type/token ratios, or using one pre-set list of academic words. In the present study, however, not only single words from the AVL, but also academic collocations and formulas from the ACL and AFL respectively have been tracked to analyse the proportion of academic vocabulary compared to non-academic vocabulary in the learners' texts (see Section 3 for more information about the analytical procedure). **Table 1** summarizes tokens and types of each list, and the total number of words.

	AVL	ACL	AFL
No. Lists	1	1	3
Tokens	3,015	2,468 (entries); 4,963 tokens	607 (entries); 2,025 tokens
Types	3,015	1,302	330
Total tokens		9,976	

Table 1. The AVL, ACL and AFL, tokens and types

With the aim of measuring the extent to which students have incorporated academic and disciplinary discourse from the CBI materials they were exposed to during the course, two research questions have been formulated:

1) To what extent do the materials used for the CBI course include general academic vocabulary? a relatively high coverage would be expected due to the academic nature of the subject.

2) What effect does the CBI course have on students' academic vocabulary production?

It is hypothesized that there would be a higher production of both general and discipline-specific academic vocabulary in the texts written after the course (T2) as a positive effect resulting from the instruction received in the CBI course. When comparing the EMI and L1 subcorpora, EMI texts are expected to show a somewhat higher production of academic vocabulary than L1 texts, due, in part to a higher exposure to the target language in an academic context in their studies.

4. Data and methodology

4.1 Context

The study took place at the Dentistry Faculty of a Catalan university. The Dentistry bachelor degree is a five-year degree programme that offers two parallel instruction settings called the "English track" and the "L1 track". In the former, all courses in the first two years of the degree are taught through EMI, equalling 600 EMI hours per academic year. On the other hand, in the latter setting, courses are taught in Catalan or Spanish throughout the degree. Regardless of the instruction setting, there are three courses, namely *English for Dentistry 1* (first year), *English for Dentistry 2* (fourth year), and *English for Dentistry 3* (fifth year) that are taught in English. We will focus only on *English for Dentistry 1*, since this is the course in which the research was carried out.

4.2 The CBI course

English for Dentistry 1 is a one-semester course (60 hours of class time) for first-year students enrolled in the Dentistry degree. This course follows an CBI *adjunct model* approach, in which the instructors, native and non-native speakers of English who are certified language specialists, have been trained in the content of the course through collaborations with the dentistry department and pursue language learning objectives, which are intrinsically linked to the disciplinary content of other subjects taught in the same year. The course includes reading and listening activities aimed at providing students with the linguistic knowledge necessary to understand and present basic aspects of dental research in English. In terms of content, the course explores

different types of research (e.g. experimental vs. non-experimental), as well as common study design features (e.g. randomized, controlled, blinded trials), and pays attention to high-frequency dental terminology related to oral health conditions, dental instruments, and the most common treatments. Apart from quizzes and exams, one of the main projects consists in replicating a population study in which students carry out a survey, compare the results with the original study, and present it orally to the class. As for materials, the language specialists developed a student dossier that contains readings (e.g. academic abstracts from published articles, texts on dental conditions and different types of research, practical explanations on how to write academic abstracts, dental histories, or present research orally), activities that were regularly done in class (e.g. comprehension questions on the abstracts, exercises to practice writing the sections of an abstract, turning informal language into formal and more appropriate expressions, dental vocabulary matching exercises, etc.), and finally lectures on different topics related to dental health with the support of PowerPoint slides (e.g. dental anxiety, differences between *abfraction, abrasion* and *attrition*, a randomized controlled trial on the effects of herbal tea on enamel, etc.). These classroom materials, i.e. the student dossier and the PowerPoint presentations, have been used in the analysis.

4.3 Participants

The participant sample comprises 56 first-year students enrolled in the Dentistry degree. There are two different groups: 1) students enrolled in the "English track"–we will refer to these as the EMI group (N=26)–, and students who have most courses in Catalan or Spanish (except for the *English for Dentistry 1* course, which is taught in English in both settings) –we will refer to these as the L1 group (N=30). This sample reflects the internationality of the university: data comes from both male (N=18; 32.1%) and female (N=38; 67.8%) students, aged 18-23, from seven different mother tongue backgrounds: Spanish-Catalan (46.4%), French (23.2%), Arabic (10.7%), English (8.9%), German (7.1%), Greek (1.7%), and Russian (1.7%). All participants (with the exception of native speakers of English) were given a level test (the SIMTEST developed by Universitat Autònoma de Barcelona)[2] at the beginning of the academic year to assess their proficiency level in English according to the Common European Framework of Reference (CEFR). Three different levels were found: A2 (N=6, 11.7%), B1 (N=14, 27.4%), and B2 (N=32, 62.7%). The two settings of instruction had similar spreads of proficiency levels.

4.4 Instrument and data collection

With the intention of collecting data to analyse students' academic writing performance before and after the CBI course, a writing task was developed and included as a classroom activity (see **Appendix A**). It comprised four questions:

> Look at the following image, and respond to the questions about it below:
>
> 1. **Describe the scene shown in the image. What do you think has just happened?**
> 2. **Write a possible dialogue among the people shown in the image.**
>
> Answer the following two questions (write in paragraph style):
>
> 3. **What would you do in this situation?**
> 4. **How could you determine whether your approach is the best one for this situation?**

These questions were formulated in order to prompt the use of different types of academic language; for example, questions 1 and 2 could make the student use more descriptive and discipline-specific language such as clinical vocabulary, dental conditions, and/or doctor-patient communication, while questions 3 and 4 could make the student use more cross-disciplinary academic language to show critical thinking, stance, and/or refer to scientific evidence.

This study has adopted a longitudinal pre-test post-test design over one semester, including two data collection times: the exact same writing task was done in class twice, i.e. at the beginning (week 1=T1) and at the end of the *English for Dentistry 1* course (week 17=T2). The instructors allowed 20 minutes for the task completion. The texts were then collected and manually typed in order to create the learner corpus. Only those texts present at both T1 and T2, and that contained more than 150 words, were included for the analysis.

4.5 The corpus

For the purposes of this study, two corpora were compiled:

1) The learner corpus: it consists of 112 texts written by first-year dental students (33,854 total words) collected before and after the course. These texts fall into three main subcorpora: EMI students' writings (n=42), L1 students' writings (n=60), and English native speakers' (NS) writings (=10). The NSs are first-year dental students enrolled in the EMI setting; since these students have attended the *English for Dentistry 1* course, and, at the time of the study, had been exposed to the same academic input for two semesters, their texts have been included in the analysis for comparative purposes.

2) The class material corpus: three subcorpora were created in order to differentiate between pedagogical

(instructions) and more discipline-oriented language (readings and lectures), as has been done in previous studies (O'Loughlin, 2012; Wood & Appel, 2014)[3]. The class material corpus represents a substantial part of the content and language input students have been exposed to. The procedure to create the class material corpus involved two important steps: (1) converting the student dossier and the PowerPoint slides, together with the instructors' notes, into raw txt. files, in which tables, figures, images, etc. were removed from the text; and (2) classifying these materials manually in order to create three different subcorpora: *the reading input* subcorpus, which consists of all the abstracts, academic texts, theoretical concepts and explanations present in the students' dossier; the *supplementary input* subcorpus, which contains all the exercises, comprehension questions, and instructions that are also included in the dossier; and finally, the *listening input* subcorpus, which consists of the PowerPoint slides used in class and the instructors' notes used for these PowerPoint presentations[4]. This class material corpus contains 56,708 words in total. **Tables 2** and **3** show the total number of texts, tokens, and types in each corpus.

4.6 Dentistry-specific lists

Additionally, and in order to see to what extent students drew on the discipline-specific vocabulary they were frequently exposed to through the class materials, three additional lists were generated: first, a *vocabulary* list was created using Voyant (Sinclair & Rockwell, 2016) to identify the most frequent words in the class material corpus. Second, Collocate 1.0 (Barlow, 2004) was used to automatically extract the most frequent collocations in the corpus by means of the Mutual Information (MI) test. Third, AntConc (Anthony, 2018) was used to identify recurrent word combinations (i.e. formulas) of 3, 4 and 5 words, with a minimum frequency of 10 hits, in order to create a *formulas* list. A manual screening of these lists was required in order to merge plural words (e.g. *patient, patients*), and to eliminate overlapping formulas (e.g. *the case of, in the case of)* so as to prevent inflated results. For the creation of these lists no distinction was made with regards to the *reading, listening* or *supplementary* part of the materials, as these were naturally integrated in the course –in other words, in a normal class, the professor would use a PowerPoint to present the content (*listening*), after that, students would often read an abstract (*reading*), to later answer comprehension questions (*supplementary*). Nevertheless, and as it could be anticipated, there were some items from the class material lists that coincided with items from the general academic lists, specifically 139 items: 86 words (e.g. *condition, abstract, anxiety*), 2 collocations (*experimental research, increased risk*), and 51 formulas (e.g. *associated with the, the relationship with*). As previous studies have pointed out, the boundaries between general and disciplinary academic discourse are difficult to operationalize and often overlap (Green & Lambert, 2018; Paquot, 2010). In the analysis, however, only 45 of these duplicated items were found in the learners' texts (i.e. 27 words and 18 formulas); since they represent both general academic and discipline-specific discourse, I decided to keep them on –and count them for– both lists. **Table 4** indicates tokens and types and total number of words for the vocabulary (VL), collocations (CL), and formulas (FL) lists derived from the class material corpus (see **Appendix B** for the top-50 entries in each of these lists).

	EMI		L1		NS	
Time	T1	T2	T1	T2	T1	T2
No. Texts	21	21	30	30	5	5
Tokens	8,297	8,405	7,406	5,935	1,884	1,927
Types	1,089	1,161	1,010	890	570	585
Mean text length	395	400.2	246.8	197.8	376.8	385.4
Total tokens	16,702		13,341		3,811	

Table 2. The learner corpus

	Reading input	Supplementary input	Listening input
No. Texts	1 (dossier)	1 (dossier)	21 (presentations)
Tokens	19,789	20,570	16,349
Types	3,382	3,226	2,452
Total tokens	56,708		
Total types	5,484		

Table 3. The class material corpus

	VL	CL	FL
No. Lists	1	1	1
Tokens	279	454 entries/ 908 words	499 entries/ 1,597 words
Types	279	300	349
Total tokens	2,784		

Table 4. Lists from class material corpus

4.7 Tools and analysis

The web-based text reading and analysis environment Voyant tools (Sinclair & Rockwell, 2016) was used to calculate the number of tokens and types of the different corpora. Subsequently, an R package –Quanteda[5]– (RStudio, 2012) was used in order to track the occurrence (i.e. frequency and range) of items from the various lists explored (i.e. AVL, ACL, AFL) in the corpora, determining 1) whether the class material corpus includes items from these vocabulary lists, and 2) the proportion of both general and discipline-specific academic vocabulary in the learners' text. Finally, two statistical non-parametric tests, i.e. Mann Whitney U and the Wilcoxon signed rank test, were performed in order to detect if there were significant differences across groups (EMI, L1) and times (T1, T2) respectively. The analyses that follow are based on mean usage (%) per text, which means that text size does not affect the results.

5. Results and discussion

In this section the coverage of academic vocabulary in the class material corpus is first explored, to later examine the proportion of general and discipline-specific academic vocabulary in the learner corpus across times and instruction settings. All the examples given have been taken from the various corpus analyses. Results show significant links between time and an increased used of academic words and other items from the lists. The effects of the CBI course on students' academic writing according to their setting of instruction are then discussed.

5.1 Academic vocabulary coverage in the class material

The class material (CM), considered as a single corpus, offers different levels of coverage for the academic vocabulary (AVL), collocations (ACL) and formulas (AFL) lists, which range from 5.5% to 64.7%. As **Table 5** shows, the list that is more extensively represented in the CM corpus is the AFL core (i.e. formulas that are frequent in both spoken and written academic English), which may confirm the blend of pedagogic and disciplinary discourse included in the materials. In particular, the listening input subcorpus –that is, the PowerPoint presentations used by the instructors and their notes– contains a slightly higher number of items from the AFL lists in general than the reading and supplementary input subcorpora: the speaking notes have allowed instructors to deliver student-centered explanations, mostly through formulas (e.g. *this type of, in other words, an example of*), while the slides display written disciplinary content more often (e.g. *evidence, the effects of, factors such as*). Additionally, the second most broadly covered list in the CM corpus is the AFL written (45.5%) (e.g. *to determine whether, with regard to, carried out by*) followed by the AVL (32.8 %) (e.g. *study, research, data*) and the AFL spoken (21.5%) (e.g. *as you can see, let's look at, this kind of*). Curiously enough, the CM only includes 135 of the 2,468 collocations present in the ACL (e.g. *collect data, experimental research, casual relationship*).

	AVL	ACL	AFL		
			Core	*Written*	*Spoken*
Reading input	22.1%	2.7%	38.2%	24.0%	10.0%
Listening input	17.5%	2.0%	39.1%	25.0%	11.5%
Suppl. input	22.7%	2.2%	38.6%	17.5%	10.5%
Class material[6]	32.8%	5.5%	64.7%	45.5%	21.5%

Table 5. Coverage of AVL, ACL, and AFL in the class material corpus

In terms of frequency, the materials as a whole offer variety and repetition: the results show that almost 20% of the total words (tokens) in the CM could be classified as academic (i.e. belong to any of the lists explored). In other words, a student who has read the texts, listened to the lectures, and performed the tasks in the supplementary material, would have encountered 1,392 different interdisciplinary academic words, at least 10,171 times, over the one-semester course. This input is richer in items from some lists (e.g. AFL core, AFL written, AVL) rather than others (e.g. ACL), but it still shows that there can be a useful set of academic vocabulary frequent across disciplines, which somehow contrasts with what other studies have suggested (Ha & Hyland, 2017; Hyland & Tse, 2007). This input to academic discourse would be even greater if we took into account the technical vocabulary typical of the dentistry field (e.g. *gingiva, maxillary, temporomandibular joint syndrome*), and also words of general meaning that may have academic meaning in the corpus (e.g. *pain, patient, tooth*). Whether this exposure has been sufficient to make students use more academic words and expressions in their texts after the CBI course will be analysed in the next section.

5.2 Academic discourse in the learner corpus

In general terms, academic language represents between 20.1% and 26.9% on average of the tasks written by learners, which could be considered between the normal range for academic texts (10%-30%) described by Coxehead & Nation (2001). In addition, the extent to which items from the general academic lists (AVL, ACL, AFL) and from the discipline-specific lists (VL, CL, FL) have been used varies depending on the instruction setting and the time of the task, as can be seen in **Table 6** below; the texts written by English native speakers (NS) have been included for comparative purposes. Results show that texts written by EMI and NS students contain a higher percentage of academic language

	EMI			L1			NS		
	T1	T2	Var.	T1	T2	Var.	T1	T2	Var.
AVL	3.6%	3.8%	7.1%	2.5%	2.5%	0.6%	5.0%	6.0%	19.2%
ACL	0.1%	0.0%	-66.2%	0.0%	0.0%	-100.0%	0.0%	0.2%	inf
AFL core	0.7%	0.6%	-17.4%	0.7%	0.6%	-20.8%	1.0%	0.2%	-74.6%
AFL written	0.2%	0.2%	4.4%	0.2%	0.2%	-22.4%	0.3%	0.6%	79.3%
AFL spoken	0.6%	0.6%	5.6%	0.5%	0.3%	-34.2%	0.6%	0.6%	-6.9%
Vocabulary	8.3%	9.2%	11.8%	7.8%	8.2%	5.0%	8.7%	9.6%	10.5%
Collocations	7.7%	8.5%	9.9%	7.9%	7.4%	-6.8%	8.5%	8.6%	0.6%
Formulas	0.9%	1.0%	15.1%	0.8%	0.8%	-0.8%	1.1%	1.1%	0.1%
TOTAL	**22%**	**24.1%**	**9.1%**	**20.6%**	**20.1%**	**-2.6%**	**25.3%**	**26.9%**	**6.4%**

Table 6. Academic language usage in the learner corpora at T1 and T2

at T2, whereas the opposite tendency occurs in the case of L1 students, in which the average decreases slightly at T2. Interestingly, results also show that the use of academic language in general increases by 9.1% at T2 for EMI students, which is even greater than the increase found in the NS texts (6%). As can be seen, L1 texts at T2 contain slightly fewer words that pertain to the academic lists (-2.6%) however.

Regarding the production of specific items from the eight lists explored, discipline-specific vocabulary (max. 9.6% NS at T2 – min. 7.8% L1 at T1) (e.g. *dental, pain, examination*), collocations (max. 8.6% NS at T2 – min. 7.4% L1 at T2) (e.g. *dental treatment, oral cavity, oral hygiene*), and words belonging to the AVL (max. 6% NS at T2 – min. 2.5% L1 at T1 and T2) (e.g. *approach, important, need*) represent the most popular academic items used by learners, regardless of their setting of instruction, their speaker status, and the time of the task. The AVL was the second most represented list in the CM; the exposure provided by the CM may explain why students have included some of these items in their texts, while it also supports the usefulness of the AVL for pedagogical purposes.

As for the remaining lists, there seems to be no or very low frequency of items from the CM formulas list (max. 1.1%) (e.g. *to the dentist, to make sure, to assess the*), the AFL lists (max. 1%) (e.g. we can see, you need to, in order to), or the ACL (max. 0.2%) (e.g. *facial expression, clearly identified, positive impact*). **Figure 2** illustrates the presence of the eight lists in the learner corpus, according to setting of instruction and time. As can be seen, vocabulary and formulas extracted from the CM, and items from the AVL are the most frequent ones in the texts on average, and also the ones that present greater variability at T2 (a more noticeable increase). Items from the remaining lists that have been scarcely produced by learners in the writing task appear at the bottom.

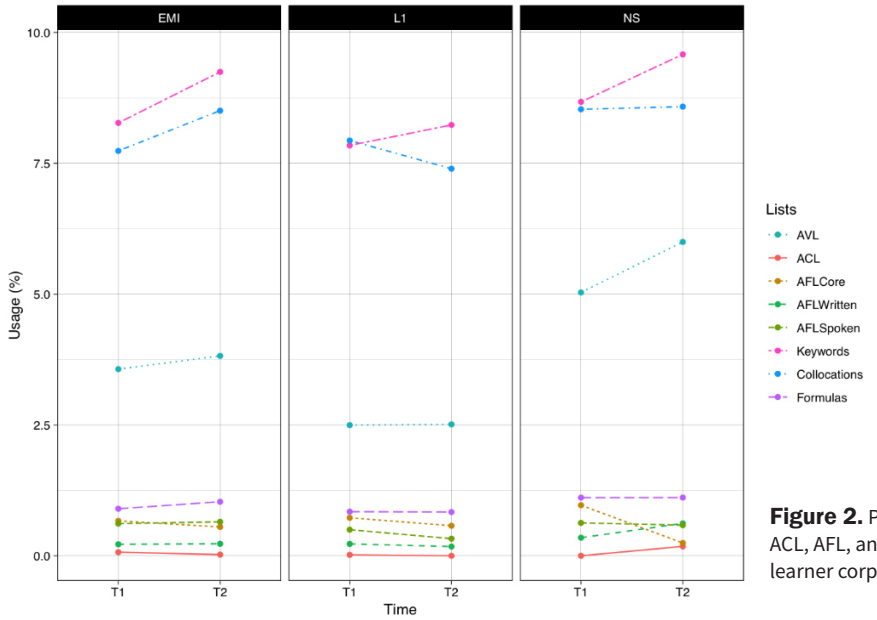

Figure 2. Presence of the AVL, ACL, AFL, and CM lists in the learner corpora at T1 and T2

As has often been reported in the literature, it is not the technical vocabulary but the general academic words that pose greater difficulties for learners (Durrant, 2016; Granger, 2017). In this study, learners have used words and collocations that were more technical and were present in the materials more often than interdisciplinary academic vocabulary (except for the AVL), which corroborates the previous statement. This finding supports previous studies that emphasise a high degree of specificity and technicality in the vocabulary of the disciplines (Ha & Hyland, 2017). On the other hand, the results show that the frequent exposure to academic formulas provided by the materials has not been enough for students to use them in their texts, which is in line with Cortes' (2004) and Wood and Apple's (2014) findings on high exposure and low production of formulas by university students. Even though the AFL core list was the most represented list in the CM (it covered almost 40%), these items have been barely used by the learners (max. 1%). Therefore, these findings stress the need for more explicit pedagogical attention to the use of academic formulas in general, and to dentistry-specific formulas in particular (e.g. *risk factor for, tooth surface loss, oral health care*). On the other hand, collocations from the ACL were barely used by the learners (only 4 items); these collocations were also very scarcely covered by the class materials (max. 2%), which may explain the low presence of these items in the learner corpus. The ACL seems to be, at least in the case of this CBI course in dentistry, less pedagogically relevant than other lists of interdisciplinary academic vocabulary (such as the AVL).

In terms of improvement, i.e. an increased number of academic words, collocations, and formulas in the texts written after the course, **Table 6** above shows how more discipline-specific words have been produced at T2 on average by all groups of learners (EMI, L1, NS). The average production of these keywords seems to be even higher for the EMI group –almost 12% more keywords on average than at T1. This general increase of discipline-specific vocabulary production for all groups could be due to the emphasis given to those words throughout the materials, and to the explicit teaching of vocabulary in the CBI course, which may be pointing as well towards an important short-term benefit of the CBI adjunct model. In addition, the reiterated encounters with this specialized lexicon EMI learners may have had in other subjects of the degree during that semester may explain the greater increase we see in this group. Another list that seems to be present in all texts, and with a greater presence at T2, is the AVL. This can indicate that all learners, regardless of their setting of instruction, have improved their academic lexicon, and have started to use interdisciplinary academic words in their texts, shaping their conceptual knowledge, and starting to develop their academic voice.

In order to know if the differences found are significant across times and groups, two non-parametric statistical tests were performed: i.e. Mann Whitney U test and Wilcoxon signed rank test, as shown in **Table 7**. In terms of inter-group comparison between EMI and L1 groups at T1 and T2, statistically significant differences regarding the use of AVL items, both at T1 (p= .04) and T2 (p= .01), the AFL spoken items at T2 (p= .00), and vocabulary and collocations from the CM at T1 (p= .00) were found. On the other hand, the intra-group comparisons showed no statistically significant differences between T1 and T2, except for the decrease in collocations in the L1 group (p= .01).

	Mann Whitney U test				**Wilcoxon Signed Ranked test**			
	EMI vs. L1 (T1)		**EMI vs. L1 (T2)**		**EMI T1 vs. T2**		**L1 T1 vs. T2**	
	Z	*p*	*Z*	*p*	*Z*	*p*	Z	p
AVL	421	.04*	447	.01*	84	.28	223	.85
ACL	368	.09	345	.09	20	.35	3	.37
AFL core	295.5	.71	339	.65	137	.47	274	.40
AFL written	330	.76	371	.19	50	.77	69	.62
AFL spoken	364	.34	464	.00*	97	.53	149	.10
Vocabulary	491	.00*	555.5	4.2	60	.09	274	.10
Collocations	469.5	.00*	566	1.6	70	.19	335	.01*
Formulas	432	.02	517	9.3	44	.39	221	.11

Table 7. Inter- and intra-group comparisons across time (tests for significance value)

Note: value is significant if p< .05

***Significant**

5.3 CBI course effects

In general, EMI students seem to have benefitted the most from CBI instruction, as they show a greater production of general academic (AVL) and discipline-specific words, collocations, and formulas at T2, which are statistically significant. In order to observe the use of academic vocabulary at T1 and at T2 from a more qualitative perspective, three sample answers to question four of the writing task were extracted from the learner corpus. The nomenclature indicates students' identification number, mother tongue, setting of instruction, and time of task:

In examples (1) (2) (3) we can see how students have used new words and expressions at T2 (highlighted in bold) that were not present in their T1 and that belong to some of the lists explored. It is interesting to note, for example, the use of connectors to structure the answer at T2 in (1) and (2), the reference to evidence-based literature to contrast approaches to dental practice in (2), or a more elaborate and reader-oriented answer that includes examples and recommendations, as well at T2, in (3).

(1) [11_FR_L1_T1]: I think that if my approach is good, the baby won't cry or won't look afraid/stressed/sad; he will not move as if he was in danger and he would be calm; so I think that my approach will have an immediate impact on the baby and he will respond (in a good or bad way) to what I do to him and the way I do it; usually a parent is present so the mother or father will see what you do and maybe give you clues to approach the baby positively;

[11_FR_L1_T2]: **Firstly**, I think that body language and also face expressions are a very good way to **analyze** other people's feelings, so in this situation, if the baby stays calm, relaxed, if he is not breathing super quickly, not sweating or anything else and if moreover he is observing [sic] me with attention [sic], I will know that my approach is not so bad. **Moreover**, I would try to talk with him and so I can see how he answers to me, if he is still shy or not, if he says positive things. Obviously, if the baby is crying or shouting. [sic] I will know that I didn't do enough to make him feel good-at-ease, and it's a failure, because as a **health professional**, you are supposed to **be able to** use **psychology** with young **patients** and one of the **technique** [sic] that can be used to **evaluate** my approach is definitively using **questionnaires**; for young children.[sic] I would use a questionnaire very simple, with a few words, and smileys to evaluate their feelings, and for the parents a more **complete** questionnaire.

(2) [08_GR_EMI_T1]: To determine that my approach is the most appropriate one I would ask for a follow up appointment after the initial visit. I would evaluate if the instructions and the treatment method were effective for the patient, if they weren't then I would change the plan of action and request another follow up appointment. If the treatment was successful however I would ask the patient or the guardian if the patient is young to call me and report any complications that might arise.

[08_GR_EMI_T2]: In order to determine if my approach is the correct one I have to do some things. **Firstly** I would ask other dentists that I know what is their approach and then compare it to mine. If mine is very far off from all their approaches then I must be doing something wrong. Then I would read **dental literature**, **case studies** and **experiments** on what isthe correct wayto illustrate to the child and parent how the child should brush his teeth. The **articles** need to be **peer-reviewed** in order to get transparent and **rigorous results** that I can then trust.Trustworthy articles and **techniques** are really **important otherwise** my **dental work** wouldbe compromised. Furthermore I could go to conferences and **observe** techniques from educated and well known [sic] dentists that will improve my technique and approach.

(3) [02_NS_EMI_T1]:There is no quantifiable way of judging which approach is the best. If at the end of the day the tooth is fixed and the child is as calm and happy as he can be in a dentist's office, I would say that it was a successful approach.

[02_NS_EMI_T2]: There is no definitively correct way of teaching someone, especially someone from an age group as characteristically versatile as children, how to brush their teeth. **However**, what should be present in all dentists is that they should not use **medical** vocabulary, **instead** substituting them with child-friendly words so that the patient doesn't get overwhelmed. **Also**, the dentist should be warm and welcoming, so that the child doesn't feel stressed or afraid, will be receptive to what the dentist is saying, and will look forward to dentists' visits as much as possible.

Furthermore, if we look at the data sample through individual variation plots, interesting results arise. In **Figures 3 and 4** each line represents one student in the sample; red lines in the left column show students whose texts include fewer academic words and expressions from the lists explored at T2; green lines in the right column represent on the other hand students who have produced more academic vocabulary at T2. The distance between lines represent the percentage these academic words have with respect to the total number of words in their texts.

As can be seen in **Figure 3**, there is a notable difference between EMI and L1 texts in terms of increase. In EMI, 14 out of 21 students (66%) produced more academic words at T2, and the ones who did not, remained almost the same as in T1 (all except one, whose use of academic words dropped considerably). In the L1 group, only half of the students improved, more specifically 16 out of 30 (53%), and the other half seem to have produced noticeably fewer academic words than in the T1. Regarding the distance between the lines, the EMI group shows a greater heterogeneity, whereas students in the L1 group seem to have performed more similarly in terms of percentage of academic discourse. As can be seen in **Figure 4**, NS texts contain a higher percentage of academic discourse at T2 overall (note how the usage percentage is higher) and this production is greater in 4 out of 5 students. These individual variation plots clearly display a greater improvement for the EMI group.

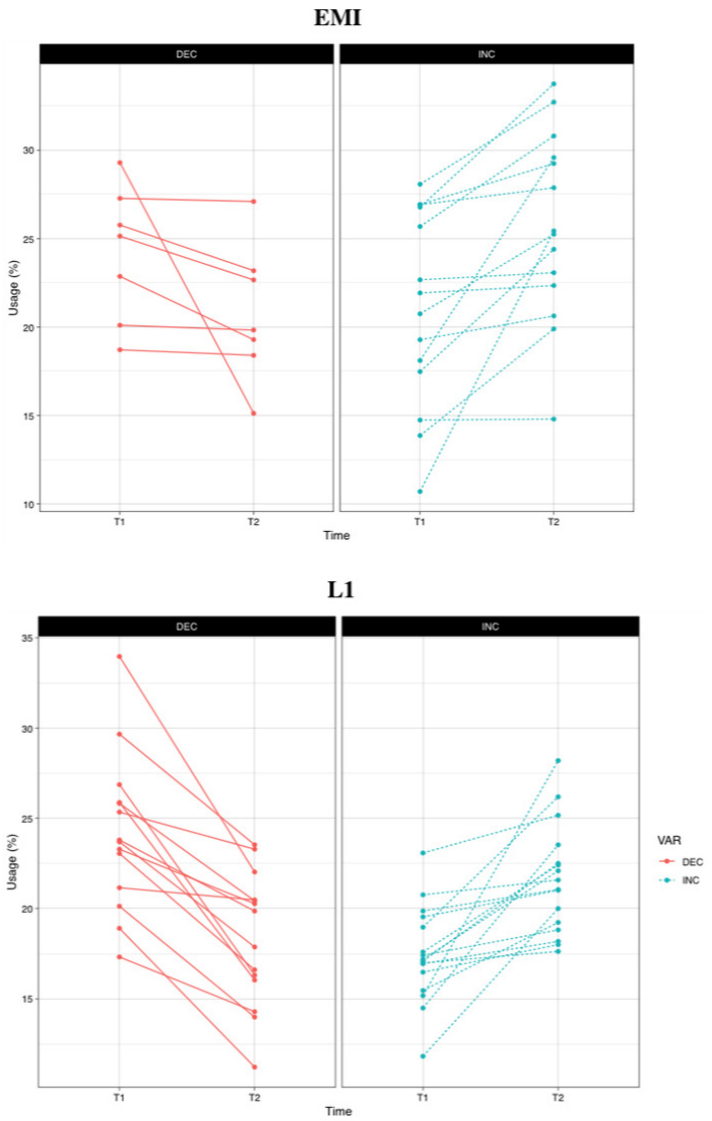

Figure 3. Individual variation in EMI and L1 at T1 and T2 (decrease vs. increased use of academic language)

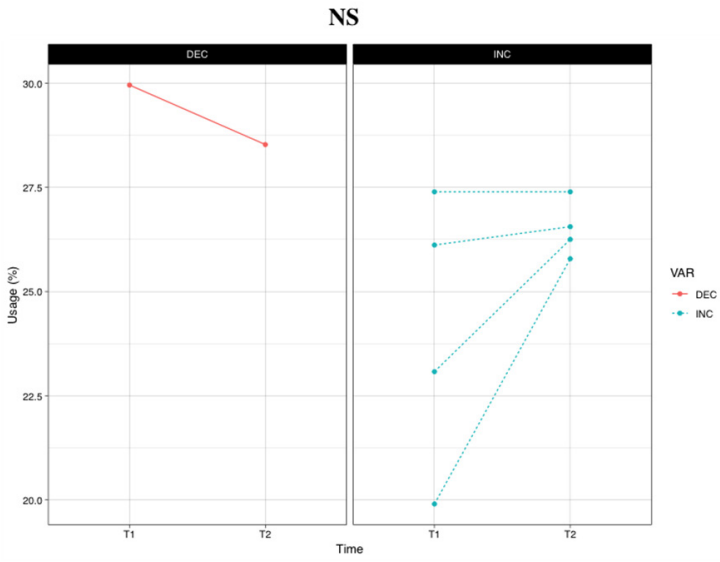

Figure 4. Individual variation in NS at T1 and T2 (decrease vs. increase)

6. Conclusion

This study has sought to measure the effects of a content-based instruction course on students' academic discourse production, and has examined two research questions. First, the coverage of academic vocabulary from three different lists (namely the academic vocabulary –AVL–, collocations –ACL–, and formulas –AFL– list) has been calculated for the materials used in the course. The results show that the class material (CM) offers substantial coverage of the academic language present in these lists. Almost 65% of the formulas included in the AFL core are provided by the CM, which highlights the academic and pedagogical nature of these materials: this partially confirms the initial hypothesis, which was that the CM would provide a substantial coverage of the academic terminology included on the lists. However, the author did not expect to find such a limited presence of items from the ACL, which certainly affected students' exposure, and could explain the low presence of these items in the learners' texts.

Secondly, the effects of the CBI course on students' academic language production were measured by performing a pre-/post-writing task. Results show that texts contain more discipline-specific vocabulary at T2 on average, and also more items from the AVL. This finding might suggest that

CBI instruction, and the adjunct model in particular, could be beneficial for both generic and discipline-specific vocabulary learning and production in the short term (one semester). Finally, academic discourse improvement according to two settings of instruction (i.e. EMI and L1) was also analysed. The findings show that EMI have produced more discipline-specific vocabulary, collocations and formulas than their counterparts in the L1 group, and also more general academic vocabulary; this difference has been statistically significant. This confirms the hypothesis that a higher exposure to the target language in an academic context would have created more opportunities for direct/ incidental learning of academic terminology for the EMI group; the more widely spaced input of the L1 group may account for the differences found. These findings corroborate the need for more pedagogical attention to academic collocations and formulas in particular, adapted to the needs of different learner populations.

A potential limitation of the present study is that the data collected represent six months of exposure to CBI. Repeating the study at the end of the next academic year would allow us to explore these learners' academic vocabulary development and retention more accurately. Even though the CBI course materials covered a high percentage (in some cases) of items from lists of general academic terminology (e.g. AVL, AFL), exposure alone did not have much effect on students' production of those items (especially for the production of formulas or lexical bundles), which corroborates the need for explicit instruction and the inclusion of writing tasks so students can improve their academic writing abilities.

This study would have also beneffited from the use of parallel corpora (i.e. texts written in the students' L1) to compare the amount of academic vocabulary that transfers from L1 to L2 and vice versa. In addition, this study has investigated the use of academic words, collocations and formulas from validated corpus-informed lists, and from the materials used in class. However, compiling a corpus of expert writing in dentistry and measuring the most frequently used academic vocabulary in actual research papers could also be pedagogically relevant. Finally, analysing the extent to which a higher or lower proportion of academic terminology in a text correlates with higher or lower syntactic complexity or with higher or lower scores would also be something worth investigating.

Corpus-informed resources could help instructors of CBI programmes to select and prioritize certain vocabulary items, and this selection might include both, or progress from, more general (interdisciplinary) academic vocabulary to more technical, discipline-specific vocabulary. Academic vocabulary is just one aspect of the quality of writing, but it can provide a foundation for schemata development and knowledge creation: if students are able to understand and use the terminology of a particular subject, they will very likely understand its theoretical concepts as well. This is of particular importance for EFL instructors and learners, since being aware of the different forms and usages of academic terminology in the disciplines can help them face the challenge of teaching and developing academic literacy in an L2. ■

Notes

1 For some specific programmes, the B1/B2 English certificate is even an entrance requirement.

2 *https://simtest.uab.cat/simtest/*

3 This was motivated by the intention to explore both generic and more specific academic discourse in EFL learner writing. At first, using an already compiled and validated academic list of discipline-specific terminology such as Lei and Liu's (2016) 'Medical Academic Vocabulary List' (MALV) was considered, as it had been done for the general academic discourse. However, this wordlist is based on specialist areas and journals that do not include dentistry, and was therefore discarded.

4 This division was made for comparative purposes only so that coverage of the generic academic lists could be looked at separately.

5 *https://quanteda.io*

6 The percentages of the three categories (reading, supplementary and listening) shown in the first three rows of the table do not total that of the class material; this is because these subcorpora were looked at separately (as separate texts). For example, if the collocation *additional information* appears in both the Listening Input subcorpus and in the Reading Input subcorpus (no matter how frequently –only types are taken into account in order to calculate coverage) these are counted separately, and this is what the first three rows show. On the other hand, when looking at the class material as a whole, even though *additional information* appears in both the reading/listening input subcorpora, it counts as one type, so the percentages in this last row represent the exposure of general academic vocabulary the CM as a single corpus (reading, supplementary, listening) provides students with.

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Appendix A

The writting task

Name and surname:
First language:

Look at the following image, and respond to the questions about it below:

1. **Describe the scene shown in the image. What do you think has just happened?**

2. **Write a possible dialogue among the people shown in the image.**

Answer the following two quetions (write in paragraph style):

3. **What would you do in this situation?**

4. **How could you determine whether your approach is the best for this situation?**

Image source https://northseallledds.com/fear-anxiety/

Appendix B

TTop-50 most frequent words (VL), collocations (CL) and formulas (FL) in the class material corpus

	VL	CL	FL
1	dental	lateral incisor	of dental anxiety
2	study	conventional black	of the study
3	oral	root canal	according to the
4	research	carried out	the patient's
5	health	diabetes mellitus	type diabetes mellitus
6	treatment	tuc counseling	a case report
7	teeth	attachment loss	have respiratory problems
8	patient	lung cancer	the patient was
9	intervention	surface loss	what are the
10	group	black tea	the number of
11	pain	herbal tea	the prevalence of
12	anxiety	respiratory problems	to determine the
13	case	data collection	in order to
14	tooth	common way	in this study
15	information	risk factor	of oral cancer
16	dentistry	case report	the relationship between
17	evidence	tooth surface	the results of
18	results	case reports	as well as
19	population	use cessation	in a population
20	use	tobacco use	more likely to
21	clinical	comprehension questions	risk factor for
22	based	relationship between	the control group
23	subjects	caused by	years of age
24	used	periodontal disease	cross sectional study
25	groups	association between	non experimental research
26	data	at least	based on the
27	caries	increased risk	how would you
28	abstract	over time	in other words
29	disease	based on	of the tooth
30	age	oral cancer	the development of
31	care	oral cavity	this type of
32	report	other words	a cross sectional
33	studies	more likely	conventional black tea
34	factors	oral hygiene	risk factor for periodontitis
35	related	smoking status	the proportion of
36	survey	university students	the purpose of
37	dentists	control group	there is a
38	mean	cohort studies	tobacco use cessation
39	objective	risk factors	common way to say
40	control	associated with	in the dental
41	dentist	research project	is associated with
42	researchers	non-experimental research	the aim of
43	cancer	oral health	the majority of
44	common	health care	tooth surface loss
45	medical	dental anxiety	type of research
46	periodontal	compared with	dental anxiety in
47	design	dental fear	of the following
48	examination	research design	one of the
49	practice	cross-sectional study	oral health care
50	risk	cohort study	prevalence of dental