The Impact Of The Complex Noun Phrase In Reading Comprehension Of English Scientific Texts

El Impacto de la Frase Nominal Compleja en la Comprensión Lectora de Textos Científicos en Inglés

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Abstract

This work is a pioneering experience in educational research at the School of Exact, Chemical and Natural Sciences. The approach to the text is three-levelled: semantic, morphological and syntactic and the aim is to help students avoid word-for-word translation and overuse of the bilingual dictionary. Problems in the comprehension of complex lexical units have been identified as a major issue in the literature and also by our research team. This project is framed in the qualitative-quantitative paradigm. The population consisted of two 40-student groups (an experimental and a control group) chosen randomly. Results of this work confirm our hypothesis that students exposed to greater theoretical instruction of the Complex Noun Phrase (CNP) are more efficient readers. Although the explicit teaching of the CNP does not appear linearly correlated with the general comprehension of texts as a whole, it is reflected in a better quality of reading comprehension.

Key words: three-levelled approach; complex lexical units; explicit teaching; reading strategies; background knowledge

Resumen

Este trabajo es una experiencia innovadora en la investigación educativa en la Facultad de Ciencias Exactas, Químicas y Naturales. El abordaje al texto se realiza en tres-niveles: semántico, morfológico y sintáctico y el objetivo es lograr que los estudiantes eviten la traducción palabra por palabra y el uso excesivo del diccionario bilingüe. Se ha identificado como problema la comprensión de unidades lexicales complejas. Este proyecto se enmarca en el paradigma cuali-cuantitativo. La población consistió en dos grupos de 40 alumnos, un grupo experimental y uno de control, elegidos al azar. Los resultados de este estudio confirman nuestra hipótesis de que los estudiantes expuestos a una mayor instrucción teórica del sintagma nominal complejo (SNP), son los lectores más eficientes. Si bien, la enseñanza explícita del SNP no aparece linealmente relacionada con la comprensión general del texto en su conjunto, sí se refleja en una mejor calidad de la comprensión lectora.

Palabras clave: enfoque en tres niveles; unidades lexicales complejas; enseñanza explícita; conocimientos previos; estrategias lectoras

Introduction

This work reports on one of the experiences in educational research at the School of Exact, Chemical and Natural Sciences. Due to its pioneering characteristic, it has contributed to the institutionalization of this type of research in this School.

At our School, English is taught with a comprehensive approach based on humanistic theories and the aim is to make students avoid word-for-word translation of texts and overuse of the bilingual dictionary. The approach to the text is three-levelled: semantic, morphological and syntactic. Reading is an interactive and compensatory process (Stanovich, 1980 in Hudson, 2007) [1], in which the reader approaches the text according to their learning style The theory underpinning this project is based on the interactive approach to reading (Bernhardt, 1991; [2] Davies, 1995, [3] Carrell *et al.* 1988) [4]. We adhere to the dictum that in reading comprehension 'the whole is not equal to the sum of its parts' (Morrow, in Johnson and Morrow, 1981) [5].

The problems of the comprehension of complex lexical units have been identified as a major issue in the literature (Carrell *et al. 1988)* [6], and also by our research team through our teaching practice in English reading comprehension courses. One of the factors influencing this complexity is that from the lexical point of view, one of the difficulties in the field of science is the frequent lack

of appropriate terms to describe new concepts. Technical or scientific communication involves a highly specific content at both the conceptual and lexical levels. As scientific knowledge progresses, language also undergoes a steady change. Montero (1995) [7] explains how the developments in the scientific and technological fields has created new demands for linguistic representations due to the creation of a broad technology capable of describing new findings and discoveries. Thus, scientific discourse has acquired its own syntactic and discourse features.

Apart from the creation of compound lexical units as one possible way of creating new words, a frequent resource is the development of new terms, including modifiers indicating specific properties that represent the new concept. Nominal compounds and the Complex Noun Phrase (CNP) are thus a frequent resource to express new concepts in the field of science.

The occurrence of nominal compounds in scientific texts in English can be attributed to different causes:

a) Principles of linguistic economy, caused by a desire for reduction and synthesis, in which information is presented "condensed" where the message directly produces a greater impact on the reader.

b) Desire for novelty: it contributes to the formation of multilexical units. In the modern world where scientific and technological innovations are becoming more productive, the information in newspaper headlines and journals should be presented in an attractive way to draw the reader´s attention.

Scientific discourse, according to Quirk (1985) [8], differs significantly from other varieties of discourse by presenting a high occurrence of noun phrases with varying complexity. That is why most research on the CNP in this context has focused on the analysis of their internal structure. Our project was intended to go beyond the separate analysis of this lexical unit, and addressed the following issues:

a) Heaviness of the CNP, a concept that relates to the number of items comprised in the phrase and the relation to the occurrence in scientific texts.

b) Relationship observed between grammatical function of the different types of CNP and the complexity of the noun phrase.

c) Distribution of CNP types in the different text formats.

d) Relationship between the CNP type and quality of its comprehension.

The hypothesis of our work is that students exposed to the explicit teaching of theoretical concepts about the structure of the CNP, improve their overall understanding of specific texts.

Both the literature and our experience in teaching reading comprensión of scientific texts in English appear to signal the complex nominal phrase (CNP) as a problematic area. So, we set the following general objectives:

1. To determine if the efficiency in reading scientific texts in English depends on:

a) language proficiency in L2

b) classroom instruction on the composition of the CNP

c) the ability to transfer the correct theoretical instruction and correct understanding of the noun phrase and the text

To meet these general objectives we proposed the following specific ones:

1. To classify the CNP into types A, B, and C.

2. To determine strategies to define the nominal phrase and identify the noun head to achieve a correct comprehension

3. To establish the relationship between knowledge of the theoretical framework of the CNP and proficiency in reading both in L1 and L2

4. To measure the influence of the following variables:

a. students' reading ability in L2 connected to exposure to English texts in different subject areas.

b. background knowledge of the topic of the text

c. text format

These objectives aimed to:

a) improve the processes of teaching and learning of English at the FCEQyN – UNaM

b) improve students' performance in reading comprehension

c) redesign part of the teaching material of the Chair of English

d) contribute to teacher development

To the best of our knowledge, no previous studies on this issue have been carried out at our University, although the international literature on the topic is profuse.

For example, Soler (2001) [9] explored the frequency and use of adjectives in five biochemistry texts and analyzed their semantic implications. This helped to clarify the role of adjectives in scientific discourse to guide university students - mostly Spanish-speakers – in reading and writing research papers efficiently.

Also, Jullian (2002) [10] conducted a study intended to test whether participants were able to write sequences of noun phrases immediately after reading them, to see if the mental representation of these sequences was stored in the original grammar (in English) or paraphrased in Spanish. The students were Intermediate High or Advanced and the control group consisted of subjects with English as L1.

Pritchard and Nasr (2004) [11] approached the study of different reading abilities to be considered in reading comprehension. They investigated the needs of students in relation to reading and awareness of reading strategies and techniques to approach texts in English; also, they explored and clarified the current role of teachers of English for Specific Purposes in the field of engineering.

Similarly, Montero (1995) [12] addressed, in a study,

the problems of understanding multiple lexical units in scientific texts. Compound nouns are a common way to express new concepts in scientific discourse, which often lead to misunderstandings due to the problems of ambiguity involved. For the analysis of the CNP and its impact on scientific texts the classification and theoretical approaches of the following authors: Greenbaun and Quirk (1990) [13], Downing and Locke (1992) [14], Cohen *et al.* (1988) [15] and Alderson and Urquhart (1988) [16] (both in Carrel *et al.* (1988) [17], were taken into account. Biber *et al.* (2006) [18] distinguish three components of the CNP

a) head: around which other components are grouped

b) pre modification: it includes all the elements located in front of the head

c) post modification: those items located behind the head, mainly prepositional phrases, adjective clauses etc.

These authors recognized as pre modifiers: b.1) adjectives; b.2) present and past participles; b.3) genitive case; b.4) nouns and b.5) adverbs.

Post modification may consist of: c.1) present participle clauses; c.2) past participle clauses; c.3) infinitive clauses and c.4) prepositional phrases.

They acknowledge that the high frequency of cataphoric reference in academic prose and news reportage is connected with the complexity of noun phrases in these registers (Biber *et al.* (2006) [18].

The population consisted of two 40-student groups with an elementary level of English belonging to the different courses. One of them was the experimental group (EG) and the other the control group (CG), both randomly chosen.

Being that our interest is the influence of understanding the CNP in reading comprehension, our literature review has to do with both issues, namely the composition of the CNP and the reading comprehension process.

Materials And Methods

This project was framed in the qualitative-quantitative paradigm. The first and second data collection instruments were essentially quantitative. Data collected with them were triangulated with the End of Year Survey.

Measuring instruments consisted of authentic texts related to the students' field of studies. The material used as instruments was the same for both groups, and it was drawn from different sources (see Appendix for an example) and selected according to the following parameters:

1. students' subject areas
2. extension and linguistic possibilities of the texts, and complexity of the CNP
3. paratextual elements to facilitate information transfer through inference and deduction

Five different texts of approximately 250 words each, comprising comprehension and grammar activities were used for the first data collection. All questions

and responses were phrased in L1 and similar exercises were presented to students beforehand to assure familiarity with test type. This instrument was meant to measure comprehension of the CNP. Grammar exercises tested morphology (identification of prefixes, suffixes, inflexions, compound words, plurals of nouns and adjectives) and CNP identification.The texts were of similar length, same number of noun phrase types, in search of validity. We followed these criteria following Alderson and Urquhart (in Carrell *et al*, 1988) [19], who posed in their study 'This Test is Unfair: I'm not an economist' that students performed better when working with texts of their own discipline rather than with texts of other fields of study. They concluded that prior academic knowledge affects reading comprehension.

The distribution of different types of CNP in the texts used for the first data collection is shown below:

Table 1. Distribution of the CNP

Types of cnp	Text n° 1 Ethanol	Text n° 2 Causes of disease	Text n° 3 Units of memory	Text n° 4 Malaria	Text n° 5 Human factor engineering	Text n° 6 The law of the lever
Type A	3	3	1	2	1	3
Type B	1	1	2	1	1	1
Type C	1	1	2	1	2	1

Type A: Core + Postmodification. **Type B:** Premodification + Core . **Type C:** Premodification + Core + Postmodification.

The second data collection instrument consisted of five different texts of similar length (350 words). In addition, five noun phrases of different types were selected and a multiple choice exercise was prepared to test comprehension and translation of noun phrases. The objective of this exercise was to detect if the EG students, after having been exposed to a more detailed theoretical explanation on the structure of the CNP could detect and identify the noun head, pre- and post-modifiers and make a correct comprehension of the nominal phrase. In the third data collection stage, different texts were also used. In this case, we sought to measure the correct comprehension of the CNP through various exercises and the impact of this comprehension in the overall understanding of the text. Students had to make use of their knowledge about the noun phrase to be able to answer questions, to transfer information to design diagrams, and to solve true/false exercises. There were three piloting instances. The first was required from colleagues in the Chair to solve the tests used as measuring instruments. This provided information about the clarity of the instructions, grammatical acceptability of items to be tested, time allotted for testing, and marking key. The remaining two piloting instances were required from students attending the subject in other groups not involved in this investigation.

Results

Results of the systematization and analysis of data collected in the first stage showed that 77% of the students in the EG were able to identify the noun head of the CNP and translate it correctly as opposed to only 38% of the students in the CG, as shown below.
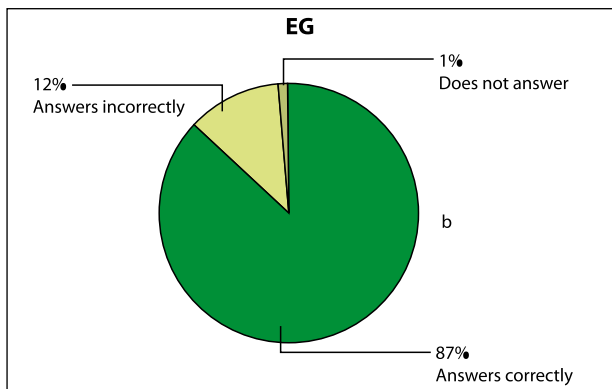
Table 2. Students' responses in the EG and the CG (first data collection)

Experimental Group	
Identifies the noun head and translates de CNP correctly	77%
Translates the CNP but does not identify the noun head	13%
Identifies the noun head but does not translate the CNP correctly	5%
Does not identify the noun head or translate the CNP correctly	2,50%
Does not answer	2,50%

Table 3. Students' responses in the CG (first data collection)

| Control Group	
Identifies the noun head and translates the CNP correctly	38%
Translates the CNP but does not identify the noun head	40%
Identifies the noun head but does not translate the CNP correctly	13%
Does not identify the noun head or translate the CNP correctly	8%

In the second data collection phase, each type of the CNP (A, B, and C) was analyzed separately. As an example, we present the results of the resolution of the CNP type B.

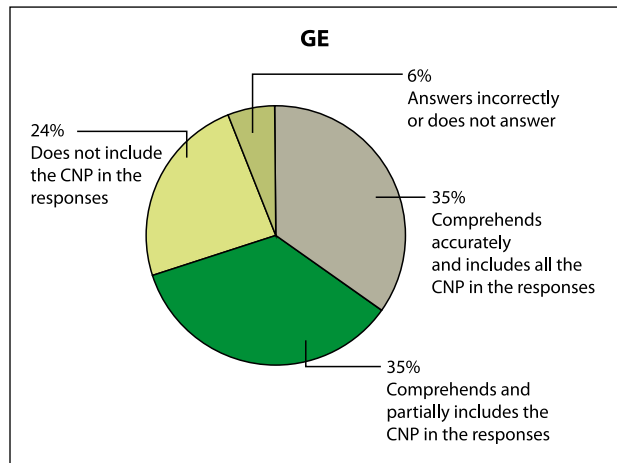**Graph 1.** Students responses in the EG (second data collection)

As can be seen, most of the students in the EG answered correctly, only a 12% answered incorrectly and the number of those who do not answer is negligible.
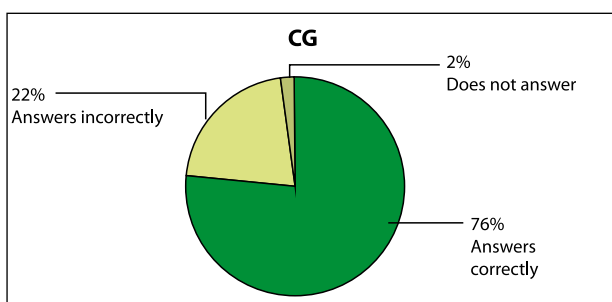
Graph 2. Students responses in the CG (second data collection)

As different from the EG, a smaller percentage of students from the CG answered que questions correctly, while 22 per cent answered incorrectly; in this case, the number of students who did not answer increased to a 2 %.

In the third stage, each type of the CNP was analized separately in order to obtain data about the degree of difficulty of the CNP, their comprehension and inclusion in the responses. The graph below shows the results of the systematization and analysis of the CNP type A.

Graph 3. Students responses in the EG (third data collection)

As can be observed, in the EG a similar percentage showed they comprehend accurately and include the CNP in the responses; a 35% include all the CNP in the responses and another 35% include only partially the CNP in the responses. If we consider both groups together they reach a 70% showing the understand accurately the CNPs.
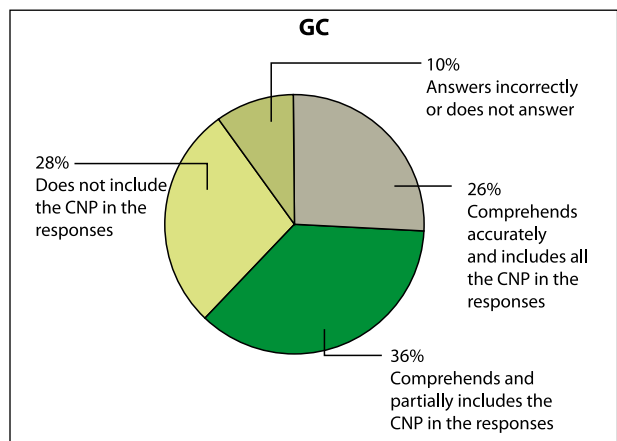
Graph 4. Students responses in the CG (third data collection)

Whereas in the CG only a 26% comprehends accurately and includes all the CNP in the responses; a 36% comprehend but only partially include the CNP in the responses. If we add both group, we have a 62%, which is lower than in the EG. The percentage of students who do not include the CNP in the responses is slightly higher (from 24% to 28%) but the group of those who do not answer increase to a 10%.

The preparation and subsequent implementation of this

project enabled us to:
a. encourage the team to continue researching in areas related to the topic of this work.
b. access to a vast literature on the teaching methodology as well as linguistic aspects involved in the process of reading comprehension of scientific texts.
c. relate students reading efficiency to their language skills
d. reframe the parameters used in the Chair of English to define a good reader

Discussion

If we re-read the General Objectives considered in relation to the factors that influence the efficiency of reading scientific texts in English, it appears that we achieved the goal of determining if the efficiency of reading scientific texts in English depends on language proficiency in L2. Previous studies of English does not seem to have a direct correlation with the reading ability shown by the students of the two groups in the first two data collection stages. On the first hand, students who informed they had studied English during three to five years at secondary school (even some years at a private institute) did not have an outstanding performance. On the other hand, those students who said they had studied another foreign language (French, Portuguese or German) in the formal educational system, however, did quite well during the year. We infer that these students, being aware of their disadvantage studied more during the year. Data were obtained from the students' registration form the first day of class and their final examination grades.

Considering the objective whether efficiency depends on the theoretical instruction on the composition of the CNP, we could be in condition of stating that:
1. The explicit teaching of the structure of the CNP produced a positive impact on students' performance.
2. When we added up the results of the third data collection, again we noticed the impact of explicit instruction. This was represented by the number of students that provided an acceptable answer, while including information contained in the CNP more extensively

Our specific objective was to determine CNP types and our students' comprehension of them. We can state that this objective was accomplished. This also gave us the opportunity to deepen our awareness and analysis of this important issue: heavy noun phrase subjects and objects - according to the latest trend in grammar approaches, as stated by Cohen *et al.* (in Carrel,1988) [20]. We could also achieve a better conceptualization about teaching and learning strategies for the delimitation and identification of the noun head for the correct comprehension of the noun phrase.

We also decided to determine the influence of the following variables:

Variable a) students' reading ability in L2 related to exposure to English texts in different areas/discipline fields. Gordon (in Hudson, 2007) [21] mentions three different sets of skills that a student develops to be an efficient reader: developing reading skills, reading comprehension and learning strategies. In this sense, we were able to see how background knowledge operates in reading comprehension. This means that students who attended at least the first year of the content subjects of their courses, were ready to read specific texts, situation which facilitated the tasks of teaching and learning. This decomposition into three parts corresponds conceptually to what would be called decoding strategies (lower-level skills) and understanding and metacognition (higher-level skills). According to Carrell (2006) [22] research on reading comprehension among native speakers of English has shown that the ability to understand texts is based not only on the reader's linguistic knowledge, but also on their general knowledge of the world and the extent to which that knowledge is activated during the mental process of reading. The author then poses that adult native English research has shown that the better a reader is able to access background knowledge about either the content area of a text or the rhetorical, formal structure of a text, the better he or she will be able to comprehend, to store in long term memory, and to recall the text.

Variable b) refers to prior knowledge of the subject of the text. This variable is directly related to background knowledge, and the various activities planned by the Chair of English to activate prior knowledge before, during and after reading (Paris in Hudson, 2007) [23]

As regards the influence of variable c) text type, decisions were made about the types of texts, according to Kaufman and Rodriguez (1993) [24], ruling out journals and popular science texts, for example. However, we could not go deeply into the reading comprehension influence of different types of texts used in teaching and in the instruments for data collection.

Also, we had set goals estimated as 'added value' to the results expected from the research work itself. There would be evidence that they helped to improve the teaching and the learning processes, and the performance of students from the different courses. This idea follows the preliminary data collected by Mayol *et al.* (2007) [25] submitted at the Scientific-Technological Sympsioum of the FCEQyN - UNaM which shows the students opinion on the

Subject during the period 2003-2006.

In the four years considered, students' satisfaction can be gathered re the four categories analyzed: teaching material, methodology, class dynamics and evaluation, as in the four
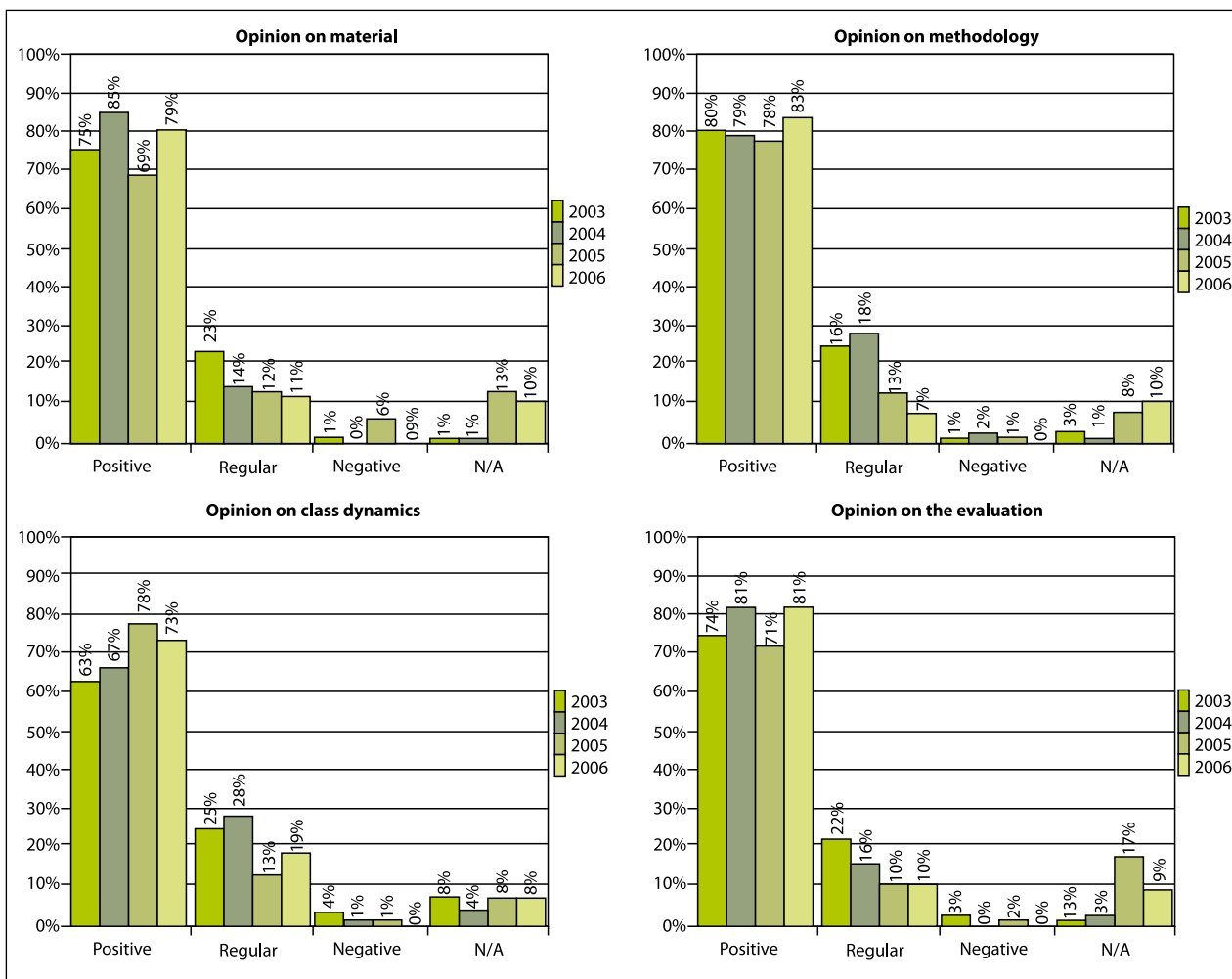
Graph 6. Students' opinions on some aspects of the suject. Period 2003. 2006.

years a positive opinion prevails, which is always above a 60%. Only in the year 2004, a 28% expresses classes dynamics was regular.

Table 4. Academic performance of students 2003-2006.

Year	Students enrolled at Students´ Dptmt.	Students enrolled in different groups	Nº of Students who accredited the subject	Regular Sts. for Final Exam	Free Sts.	
					Do not comply with regultions	Never attended
2003	204	169	87	8	32	41
2004	208	175	120	13	15	27
2005	258	189	149	1	8	31
2006	135*	155	121	3	19	12

* Many students did not comply with requirements according to change of Curriculum of courses

The above table shows the academic performance of students in the same period. In the year 2003, although 204 students enrolled to attend the subject, 41 of them never showed up, while 32 did not comply with the regulations. If we add to these, those who had to sit for a Final exam, we can appreciate the difference between those enrolled and those who accredited the subject.

It can be observed that in general the number of students enrolled in the Students Department was steady; however,

this number diminished notoriously in 2006. Changes in the curriculum prevented many of them of complying with the required subjects to attend English.

At the same time, the number of students who had to sit for a Final Exam together with those who did not comply with the regulation, added to those who never showed up, diminished gradually, at the same time that those who accredited the subject was on the rise.

Conclusion

In summary, we conclude that the results of this study confirm our initial hypothesis that students exposed to greater theoretical instruction of the CNP are more efficient in reading scientific texts. However, from the data collected, we deduced that the explicit teaching of the CNP does not appear as linearly correlated with the general comprehension of texts as a whole. Rather it is reflected in a better quality of comprehension of the various CNP, as long as students were able to include more information appearing in the CNP in their general process of comprehension.

We believe that this exploratory study has provided

important information about the occurrence of CNP in scientific texts and reading strategies for its comprehension. At a more specific level, the project contributed to improve the processes of teaching and learning of English at our School.

The results obtained from this study provided our team opportunities to explore further into the teaching of reading as a process, which eventually, will mean better practices for the benefit of our students. This is so because in the light of the new experiences, we have reconsidered issues like implementation of the curriculum, unlearn conceptualizations of our teaching strategies to learn new ones, review the criteria for selection of texts and the design of the activities for the students. Last but not least, it constituted a positive step in our professional development, as we firmly believe in lifelong learning.

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