Using the Dictionary for Improving Adolescents' Reading Comprehension of Short Scientific Texts

Uso del diccionario para mejorar la comprensión lectora de textos científicos cortos en inglés con adolescentes

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This paper reports on an innovative and action research project which focused on the use of the dictionary and the prior knowledge of Colombian high school students to improve their reading comprehension of short scientific texts. Data collection instruments included students' work gathered during two workshops, field notes, and a questionnaire. Findings showed that searching in the dictionary and activating prior knowledge seem to facilitate the use of the text to answer reading comprehension questions. Students experienced less difficulty answering questions that required literal information than those that required establishing relationships among elements of the text. They equally valued the prior knowledge of the subject and the use of the dictionary in the resolution of science workshops in English.

Key words: Dictionary use, prior knowledge, reading comprehension, scientific texts.

En este artículo se reporta un proyecto de innovación y de investigación acción centrado en el uso del diccionario y el conocimiento previo adquirido de estudiantes colombianos de secundaria para mejorar la comprensión lectora de textos científicos cortos. Los instrumentos de recolección de datos incluyen el trabajo realizado por los estudiantes durante dos talleres, notas de campo y un cuestionario. Los resultados mostraron que la consulta del diccionario y la activación de conocimientos previos parecen facilitar el uso del texto para responder preguntas de comprensión de lectura. Los estudiantes encontraron menor dificultad en la resolución de preguntas que requerían información literal que en aquellas que implicaban el establecimiento de relaciones entre los elementos del texto. Ellos valoran por igual el conocimiento previo y el uso del diccionario en la resolución de talleres de Ciencias en inglés.

Palabras clave: comprensión de lectura, conocimiento previo, textos científicos, uso del diccionario.

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Introduction

Saludcoop Norte School is part of the pilot public schools selected by the Secretary of Education of Bogotá, Colombia, for the implementation of a bilingual program (Spanish and English). Educational policies argue that in times of globalization, Colombia needs to develop the capacity of its people to handle at least one foreign language. Hence, the National Ministry of Education has formulated the National Bilingual Program 2004-2019. Command of a second language means, among other things, understanding other contexts and appropriating knowledge as to generate new knowledge and have access to more opportunities (Ministerio de Educación Nacional, 2005).

Taking into account the previous statement, I as a science teacher have been designing and applying some workshops in the foreign language related to the science issues that I have been teaching in Spanish—my students' mother tongue. Workshops include the presentation of short scientific texts in English and activities that involve their reading comprehension, encouraging ninth graders to engage in the exploration of data, searching for specific information, and the establishment of general ideas.

However, despite the belief that scientific vocabulary is easily understood because many words are very similar in the mother tongue, students have difficulties understanding the text so they easily stop paying attention to the rest of the task. Students have difficulties in finding the information needed to carry out these tasks due to their lack of proficiency in the foreign language as well as lack of accuracy in scientific vocabulary. Therefore, it is important to guide students in using strategies to improve their reading comprehension. Among the strategies recommended to achieve this goal we have the search for meaning of words within the text and the use of a dictionary for scientific vocabulary (Díaz de León, 1988).

In order to fulfill the goals of a teacher development program I took in 2010—the PFPD *Red PROFILE*[1]—I decided to dig into the said problematic situation by engaging in an innovation and action research project. I opted for encouraging ninth graders at Saludcoop Norte School, in Bogotá, to work on the decoding of unfamiliar words using the dictionary as well as their prior knowledge. This strategy aims to improve reading comprehension of short scientific texts through the establishment of relations within the knowledge acquired in the mother tongue.

Context

Although the implementation of the bilingual program at the school is just beginning, there are many language and cultural difficulties that are very hard to overcome, especially due to social and economic characteristics surrounding the student population. However, students' interest in bilingual education exists.

The School is located in the Usaquén neighborhood, in the north of the city. Ninth grade students range from 14 to 17 years of age and live mostly in extended families (parents, siblings, uncles, grandparents, cousins). A good number of students reported the absence of either their fathers or mothers mainly because of abandonment, disappearance, or death. Most of their families belong to the second and third socioeconomic strata.[2] Many of the students are left alone at home and have to take care of their siblings and do the housework; hence, reading does not play an important role within their daily routine.

These students are therefore commonly immersed in the following situations:

1 PFPD stands for "Programa de Formación Permanente de Docentes" (Permanent Professional Development Programme). The *Red PROFILE* is a PFPD for schoolteachers. It is run at Universidad Nacional de Colombia, in Bogotá, and motivates teachers to engage in action research and innovation projects.

2 Colombian socioeconomic strata are a classification of households from its physical characteristics and its environment, categorized into six groups with similar social and economic conditions. Strata 1 and 2 correspond to people with fewer resources and strata 5 and 6 correspond to people with ample resources.

1. Students lack a cultural and academic environment at home that enables parents to support their academic work.
2. Many of their homes do not offer the conditions that ensure stability in the emotional aspect and provide the educational resources necessary for optimal performance in school.
3. The surrounding area is primarily an environment of degradation (drugs, thefts, and assaults are local situations affecting their welfare per manently), which has an impact on their motivation for schoolwork and their development of a life plan.

It is therefore a great challenge faced by teachers to foster an appropriate learning environment that allows motivating students for academic work. In this case, providing them with opportunities for effective interaction with texts and guiding the use of resources to enable them to take advantage of reading and to acquire language for the appropriate interpretation of information both become real challenges.

Literature Review

This section is intended to provide theoretical support on reading comprehension, reading scientific texts, vocabulary enrichment, and the use of the dictionary. Here we concentrate on the meaning of reading comprehension, the characteristics of scientific texts, the possible types of reading, as well as some recommendations to improve understanding and deal with the lack of vocabulary by using the dictionary.

Reading Comprehension

I based my work on Grellet (1981), who states that "understanding a written text means extracting the required information from it as efficiently as possible" (p. 3). Therefore, Grellet mentions that it is essential to take the following elements into consideration: *What do we read?* In this case, we are referring to science text books; *Why do we read?* We are reading for information (in order to find out something or in order to do something with the information); and *How do we read?* We are doing intensive reading: reading shorter texts, to extract specific information.

Scientific Texts

Most of the information provided in schools has a documentary source: books, articles, scientific journals, notes, among others. Therefore, it is very important that students know how to handle these documentary sources and how to make their reading profit them because academic work is largely based on written communication. Thus, the acquisition of skills related to reading comprehension and management of scientific and technical texts allows the scope of better academic achievements (Díaz de León, 1988).

Given that some limitations are present for handling documentary information that is used to inform students of the various advances in science and technology, this innovation and action research project was intended to develop exercises through which students could acquire skills that would enable them to achieve a better text understanding. The scientific literature provides data about reality. These data have to be judged to be accepted. Also, in science the documentary sources serve as methodological, practical, and experimental guidelines, therefore, those who read them should know how to use them for those purposes (Díaz de León, 1988).

Starting from an appropriate source material the students can carry out various types of reading according to their needs: browsing, data search, and reading for general ideas. Reading comprehension requires bringing into play those skills (Díaz de León, 1988). To do it properly, it is necessary that the confrontation with the text is done through a constant awareness of their own capabilities and limitations. This reading process also requires the use of the elements that the text provides as clues. The student facing a scientific reading must know what prior knowledge he or she possesses about the terminology

contained in it; if s/he does not understand it, s/he has to use the same text or a different one to learn it. The texts can be used in many ways:

- To follow a sequence of content that progressively becomes more complex.
- To obtain specific information.

Understanding a scientific text may be difficult because of the lack of sufficient knowledge of the subject. Hence, the importance of choosing texts that have an appropriate level according to what is known about the issue (Díaz de León, 1988).

According to Alderson and Urguhart (as cited in Calderón, Carvajal, & Guerrero, 2007), the reading comprehension process focuses on three elements: the text being read, the background knowledge possessed by the reader, and contextual aspects.

In everyday language a word differs from a scientific word, because the first appears in phrases that can be replaced by different words with the same meaning (synonyms). The phrase made up of scientific terms cannot admit synonymous substitutions (Díaz de León, 1988). Given a new text the reader may discover that language is unknown to him/her due to vocabulary or terminological difficulties. Vocabulary difficulties concern the fact s/he does not know the meaning of the word in everyday language. The terminological difficulties are related to the lack of special significance that a term in a scientific discipline has (Díaz de León, 1988). However, if the reader does not understand a word of ordinary language, s/he can continue to read and extract meaning from the general context of the sentence and, although there are times in which the context does not help him, s/he will need to go to the dictionary. The most common situation is that the meaning of new words from everyday language is made apparent in the same course of reading. When there are unknown scientific terms the reader must necessarily find the corresponding definition.

Enrichment of Vocabulary and Use of the Dictionary

The dictionary is used when the context does not permit extracting the meaning. So it is very important to insist that students get used to infer from context the meaning of the vocabulary as much as possible. They should be advised to resort to the dictionary, but only in cases where it is really necessary (Fernández de Bobadilla, 1999).

The acquisition of scientific terms is achieved through the study of the subject area itself. Introductory texts as well as dictionaries of technical terms can provide definitions when the context is not enough to get the meaning of scientific terms. In relation to these terms, students do not usually need to find them in the dictionary, since they are mostly from Latin or Greek roots and therefore very similar to those used in their native language (e.g. *polychloroprene-policloropreno*, *butadiene-butadieno*, *spectroscopy-espectroscopía*). The failure to understand the content of the term because of its specificity is not necessarily a foreign language problem, but a problem of understanding in their own language (Fernández de Bobadilla, 1999).

In relation to the information provided by the dictionary, Fernández de Bobadilla (1999) states that the student must know how to use it, especially in relation to two main aspects which tend to cause major difficulties in reading comprehension: the division of entries for meaning and grammatical category.

Division of Entries by Meaning

A lexical unit has several meanings. Students tend to associate each lexical unit with a single meaning. That would not be a problem because the scientific terms often have a single, precise, and definite meaning. But in some cases we find more than one entry for a scientific term.

Division of Entries per Grammar Category

A formal unit can belong to several grammar categories. Students tend to associate each word with a single grammatical category. The formal unit belonging to various categories is not appropriate for scientific terms, but those belonging to general language.

In data search reading, the dictionary review is aimed at seeking a term. It is not necessary to read whole paragraphs; students should be explained that we can just take a general look at the page of the book to see if the term we want to find appears there. At this point we have to stop and start with other reading comprehension strategies (Díaz de León, 1988). Díaz de León adds that the techniques of speed reading (skimming and scanning) should be applied to the search for entries, so that the search is carried out quickly.

According to the literature review, it is clear that reading comprehension of scientific texts requires intensive reading to extract specific information to resolve academic problems. Consequently, it is important to develop a methodological process that assures better understanding while taking into account previously acquired knowledge, use of context to face unfamiliar foreign and scientific vocabulary, and the proper use of the dictionary.

Method

Markee (1997) states that "curricular innovation is a managed process of development whose principal products are teaching (and/or testing) materials, methodological skills, and pedagogical values that are perceived as new by potential adopters" (p. 46). The project reported here is an innovation because I wanted to improve the students' reading process by guiding them in the use of the dictionary. This involved the implementation of a methodological process that we had not done before.

Taking into account the some considerations about investigation expressed by Calderón (2000), another reason to recognize this project as an innovation is because it is a reflection that takes place on a real practical problem that becomes known because of the teaching task. Innovation in this approach not only involves providing new knowledge and establishing laws and theories; it also allows us to establish relationships, formulate hypotheses and dilemmas. In this case, it starts from the difficulty observed in students in the understanding of short scientific texts in English.

This innovation also involved carrying out a research exercise with a students' group in order to take advantage of the results of investigations that recommend the use of the dictionary to face scientific texts and discuss their use in the classroom while taking into account scopes and limitations within a local context. The processes followed in the innovation matched the ones that characterize action research because they implied monitoring its development. To this end, Burns (1999) emphasizes that the reflexive nature of action research means that analysis occurs over the entire investigation. Burns (2010) also explains that action research "involves taking a self-reflective, critical, and systematic approach to exploring your own teaching contexts . . . it means taking an area you feel could be done better, subjecting it to questioning, and then developing new ideas and alternatives" (p. 2).

Closely related to the alternatives we have to engage in with innovation projects are the stages claimed in the literature about action research. In Burns (2010), in particular, we find that action research processes "involve many interwoven aspects—exploring, identifying, planning, collecting information, analysing and reflecting, hypothesizing and speculating, intervening, observing, reporting, writing, presenting (Burns, 1999, p. 35)—that don't necessarily occur in any fixed sequence" (p. 8). As can be seen, action research provides a framework for systematic innovation implementation. All these processes were taking into consideration and

experienced by the teachers participating in the teacher development program within which this project was carried out.

Alfonzo (2008) claims that understanding educational innovation as a process requires certain steps for their uptake and application; these stages are: planning, diffusion, adoption, implementation, and evaluation. *Planning* of an innovation is a decision-making process whereby objectives and procedures are set. *Diffusion* is one in which an innovation is made known to its users for their adoption and use. In the *adoption* phase the teacher and the educational community decide whether or not to start educational innovation. *Implementation* is a series of processes to adapt and implement the innovative plan in specific situations and, *evaluation* consists of getting the value of the whole process in order to come to know the weaknesses and strengths, the resistance and supports.

According to the previous statements, in this project, planning meant making decisions about literature recommendations to face reading comprehension of scientific texts and how to deal with the dictionary, context, and needs of ninth grade students to implement the innovation. Diffusion involved creating an appropriate environment at School for the innovation process. Adoption included adjustments based on the guidance given by the tutors of the *PFPD Red PROFILE* who advised me along the development of the project, the School schedule, and the availability of time and resources, among others. Implementation involved the selection of appropriate short scientific texts according to the level of the students and the design and application in the science class of two workshops with activities specially designed for them. The evaluation included analysis of the applied workshops. The data were collected—using a questionnaire and field notes—in order to identify progress and difficulties and to evaluate the process.

Finally, it should be noted that the students were asked if they wanted to be part of this innovation and action research project, and their parents were asked to sign a consent form in a meeting. This helped me decide which students could be observed and which evidences from them could be collected and analyzed. Hence, I gathered data collection from 34 students.

Instruments

As has been said, data were collected from different instruments: two workshops, a questionnaire, and field notes.

Workshops

In view of time available, two workshops were designed and developed in class. They included the same organization: one short scientific text (a text about evolution for Workshop 1 and another text about taxonomy for Workshop 2) followed by activities to promote the use of prior knowledge and the dictionary. The first activity consisted of reading the text carefully to recognize and classify the unknown words into scientific words and other words. The second activity included multiple-choice questions that implied establishing relationships between prior knowledge presented on these issues in Spanish and the text presented on the workshop. The third activity focused on the use of the dictionary to ask for the meaning of selected words from the text using the dictionary or the context. The fourth activity tapped into students' prior knowledge to ask for definitions of scientific words promoting the use of prior knowledge or context. The final activity included true or false questions that implied that students established relationships between different elements of the text (see Appendices A and B).

Questionnaire

A questionnaire was designed and administered at the end of the two workshops. They inquired about the students' points of view and feelings regarding the activities, difficulties found in decoding the unknown vocabulary using different resources like the

context, previous knowledge and dictionary, and the advantages and disadvantages of using dictionaries (see Appendix C).

Field Notes

Field notes were kept to register students' behaviors and participation during the application of the workshops.

Data Analysis

Data were analyzed based on triangulation processes, which involved resorting to the literature review and the results of the applied workshops, as evidenced in the questionnaires and field notes. This was done in order to ensure the reliability and validity of the research.

Findings

Three categories emerged after examining the information gathered. They are, namely: Using the Dictionary, Looking for Information to Define Given Issues, and Reading Comprehension. The categories and their subcategories are shown in Figure 1 and they are described and discussed below.

Using the Dictionary

Students were asked to classify unknown vocabulary from scientific texts into scientific and non-scientific (Activity 1) terms and to write *yes* or *no* if they had used the dictionary for each word (see Appendixes A and B).

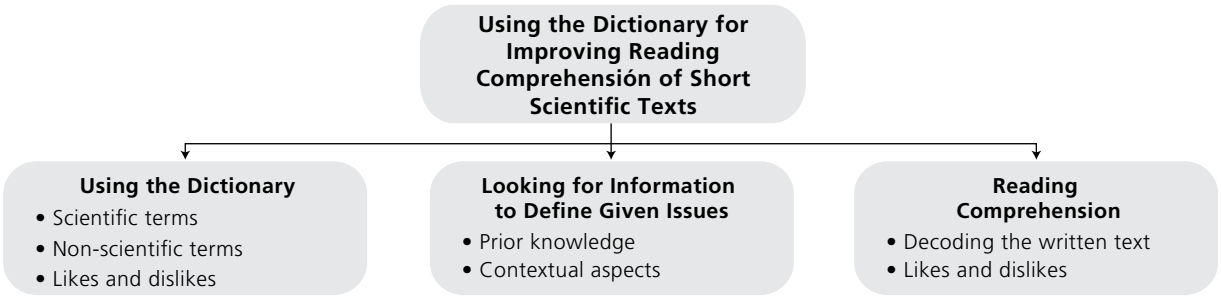
They were not sure about differences between these words so they expressed many doubts in Workshop 1. After Workshop 1, a feedback session was done, which allowed among other things, the consideration of the classifications made by the students and to clarify terms differences, including correspondence with one or more meanings as well as general or restricted Science use. Probably because of that, they felt more confident in Workshop 2 and, as a result, the successful classification of terms increased from 50% in Workshop 1 to 69% in Workshop 2. Students were also asked to find the meanings of different words—scientific and non-scientific terms—by paying attention to the context or by using the dictionary (Activity 3).

Given the characteristics of the scientific and non-scientific terms, they were considered as two subcategories for the analysis. An additional subcategory was established to review the opinions and feelings of the students about the search for meanings process.

Scientific Terms

According to the results obtained by the students, most of the scientific terms achieved correct recognition percentages (between 78% and 94%). Terms like *theory*, *hypothesis*, *fossils*, were easily recognizable because they were similar in the students' native language (Fernández de Bobadilla, 1999). Also easy to recognize, but not similar in the native language were: *kingdom* (using the context), *fertile offspring* (using

Figure 1. Categories Derived From the Data Analysis



the dictionary and prior knowledge), *traits*, *whales* (using the dictionary).

For the translation of scientific terms they found less difficulty in relation to grammatical categories and entries because these do not accept synonyms (Díaz de León, 1988), but they could not find some words in dictionaries, for example, *phylogeny* and *kingdom*. On the other hand, they found difficulties with the translation of compound words (*classification system*, *bottle-nosed dolphin*).

Non-Scientific Terms

Regarding this issue, I observed students' results using the dictionary with non-scientific terms and students' opinions about the difficulties faced during the workshops. Students identified non-scientific terms already known by them and, as a result, they were easily recognized and adjusted to the context. For example, *survive* and *changes* were recognized properly by 91% of the students.

On the other hand, in relation to the unknown terms, students had difficulties with dictionary use when they were trying to find the most appropriate meaning among the options presented in it. Furthermore, they did not check that the meaning selected in the dictionary was in accord with the context of the reading. For example, the word *suited* was understood as the noun *suit* = "*colección*" (collection) by most of the students and the correct meaning was the verb in passive voice: *adaptado*. Only 22% of them found the correct answer because the translation they found was not checked with the context.

They reported many difficulties while searching for non-scientific terms like *suited*, *means*, *called*, *gathered*, *known*, *commonly* (that they extracted from the text). This was evidenced in expressions observed in Workshop 1 such as "I cannot find this!", "There are some meanings!", "I cannot find the word!", "The word is not here!".[3] Fortunately, in Workshop 2 students were more focused and willing to resolve the activity in an autonomous way using other resources as context and prior knowledge.

Likes and Dislikes

I got to know students' opinions through the questionnaire and the observation notes. Most of the students recognized that they had difficulties with unknown words when facing a scientific text in English. For 41% of them, the use of the context is a useful strategy to find meanings and 47% of them think that even though they keep on reading, they do not find meanings so they decide to look in a dictionary. One student wrote: "It is difficult for me but I try to understand."

In addition, students were asked about the use of the dictionary. All of them consider the dictionary useful but 23% notice that they cannot always find the word that best corresponds to the text. In relation to the understanding of scientific texts in English, the opinions of the students were divided: those who understand the vocabulary (32%), those who have difficulties with the scientific vocabulary (even in their mother tongue) (29%), and those who have difficulties with foreign language vocabulary (29%).

Students' opinions confirm the difficulties to use the context and to appropriately use the dictionary to find scientific and non-scientific terms. Another important point was the quality of the dictionaries that they brought to class. Although the number of suitable dictionaries for the activities increased in Workshop 2, which suggests students were more aware of the importance of a good dictionary, some of them were not good enough to resolve the activities.

3 These expressions were translated from Spanish: "¡No puedo encontrar esto!"; "¡Aquí hay muchos significados!"; "¡No puedo encontrar la palabra!"; "¡La palabra no está aquí!".

Looking for Information to Define Given Issues

Knowledge acquired in the mother tongue and contexts are useful sources when facing scientific readings. In this section the use of prior knowledge and context are analyzed (Activity 4).

Prior Knowledge

Students answered multiple choice questions concerning information which we had worked previously in science class, and in their mother tongue (see Appendices A and B). More than 50% of the students reached correct answers. For example, they easily recognized that "Charles Darwin was an English naturalist" and that "Cordata is not a kingdom."

The use of prior knowledge was useful in the reporting of specific data such as dates and events, but not as useful when students were required to establish relationships with the text. In the case of the question, "Traits best suited" *relates to*…, the answer, "helpful variations," involved understanding the meaning of the words according to the context. Only four students answered correctly. In connection to this, we should remember that

> The reading comprehension process focuses on three elements: the text being read, the background knowledge possessed by the reader and contextual aspects. [Hence], to comprehend a reading it is necessary that the reader can extract key words in order to capture the whole sense of the text. (Calderón et al., 2007, p. 28)

To define scientific terms in English, students had two chances: using prior knowledge or using context provided by the readings. Students wrote the use of one of the two strategies showing prior knowledge preference in both workshops (percentages averages were 71% and 48%) despite the fact that in the second workshop around 25% of the population did not write their preference. In addition I could notice that students used their notes along the development of both workshops. Although in their notebooks there were no literal definitions, most students realized that when they define most of the scientific terms they can use prior knowledge.

Prior knowledge seems to be useful and students realize it in concepts like *reproduce* and *evolution*, in which they reached higher percentages (66 and 53%) of correct answers. However, in Workshop 1 they had many difficulties defining the concept of *natural selection* and only three students took it from the text. The answer was literal: "Natural selection means that organisms with traits best suited to their environment are more likely to survive and reproduce" (see Appendix A).

There were the same difficulties when defining scientific terms in Workshop 2. *Phylogeny*, *kingdom*, and *species* as *natural selection* definitions were taken literally from the text (see Appendix B), but the students' percentages of correct answers decreased compared to Workshop 1 (percentage average 27%). Here we saw the importance of creating awareness among students of the importance of establishing relations between prior knowledge and context to create definitions because prior knowledge is not always enough to resolve the task. Alderson and Urguhart (as cited in Calderón et al., 2007, p. 28) emphasize that "background knowledge is a helpful tool," but the reader has to take in mind the text, to "reorganize his knowledge and put it together better."

Contextual Aspects

In general terms, students improved their performance in Workshop 2 in relation to Workshop 1. According to the percentages of correct answers, students improved in Activities 1, 2, and 5: in Activity 1: *classifying unknown words*, from 50% to 69%; in Activity 2: *activating prior knowledge*, from 52% to 69%; and in Activity 5: *reading comprehension*, from 42% to 63%. Activity 3, *using the dictionary*, was almost the same (81% and 79%); whereas in Activity 4, *defining scientific terms*, their performance decreased from 47% to 27%. In this case, the use of prior knowledge

proved not to be enough for the development of appropriate definitions.

Scientific terms as *phylogeny*, *kingdom*, *species* (present in Workshop 2) and *natural selection* (in Workshop 1) had in common that they were the concepts to be defined and with the least number of correct answers. Although the concepts' definitions could be taken literally from the text of the workshop, I could notice that students needed a greater use of the context to construct definitions.

Reading Comprehension

This section includes the analysis of the results obtained in the resolution of the last activity of the two workshops in which students were expected to show their understanding as well as their likes and dislikes in relation to them.

Decoding the Written Text

For Lopera (2012), "reading is an interactive process in which the writer and the reader dialog through a text" (p. 85). In my case, this was enhanced by engaging students in using some reading strategies. In connection to this, the same author reviews several related studies and points out that the reading process can be more successful if students receive strategy instruction. I could observe that activating prior knowledge and searching in the dictionary seemed to facilitate the use of the text to answer the questions through which students were expected to signal understanding of the given texts. In the last activity of the workshops, students were expected to decode the written text, that is, to extract the underlying meaning from it.

Students' average of correct answers to the items contained in the last activity was 42% in Workshop 1, and in two questions they showed percentages above 50%. The highest percentage was for the item "The Origin of the Species was never published" (59%). The other item, "When Darwin refers to traits, this is the same as the individual characteristics," scored 53% of right responses. Probably, it could be answered correctly because of the use of the dictionary. In a previous activity, 72% of the students used the dictionary to look for the meaning of the word *trait*, which proved to be useful, because 84% of the students found the correct meaning.

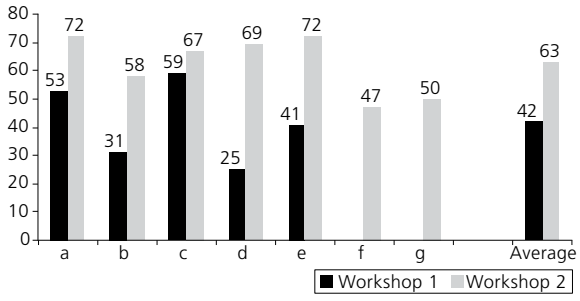
Workshop 2 showed the three highest percentages (72%, 72%, and 69%) for three questions that implied an appropriate use of the context and establishing relations among different elements of the text as well as taking advantage of the methodological process of the workshop using dictionary and prior knowledge. This can be contrasted with Workshop 1, in which the highest percentage reached 59%.

The lowest percentage found in Workshop 1 was 25% for question 5d. It is likely that this problem is related to the previous difficulties defining the *natural selection* concept, because it was literal. In contrast, 47% was found in Workshop 2, when students answered the question "Man and bottle-nosed dolphin belong to the same class." This low percentage was perhaps due to difficulties in finding the meaning of a compound word.

The above results confirm that reading scientific texts requires the stakes of skills that are not restricted to decoding the written text. It is also necessary to know how to use it to organize the information provided in the resolution of academic problems (Díaz de León, 1988).

The average of correct answers increased from 42% in Workshop 1 to 63% in Workshop 2 (see Figure 2). The difference is attributed to a greater use of context in addition to the prior knowledge in the resolution of questions. Perhaps this was due to the fact that students took into account the feedback received in Workshop 1 and that empowered them to improve their results. As can be seen, the highest number of correct responses was gotten from questions which required a literal information search within the text, as well as easier ways to explain why the sentence

Figure 2. Comparison Between Percentage of Correct Answers Achieved in Questions From Activity 5: Reading Comprehension in Workshops 1 and 2



was true or false. Students were asked to write arguments, but the frequency of writing was very little. Two questions presented the highest number of arguments. One of them was the question "The Origin of the Species was never published," where five students wrote not only *false* but answers such as "It was published in 1859;" in the other, "Phylogeny refers to the economical history of an organism," six students wrote not only *false* but explanations such as "It refers to the evolutionary history." This question obtained 67% of correct answers (see Figure 2).

Despite the increase in positive results in Workshop 2, it was observed that most students were still reluctant to develop arguments in their responses, although in the feedback provided in Workshop 1, taking this into account was suggested. Additionally, there were difficulties in establishing relationships between elements of the text and the true or false sentences, for contrasting ideas or finding similarities that allowed them to justify their answers or at least make it explicit in writing. Some students wrote arguments like "I am not sure," "I think so," "It is said in reading," "This is in reading." Although they are not valid arguments, this could reflect that the requested process is difficult for them and that they are not aware of its importance because they consider that recognizing the sentence as true or false is enough.

When students were asked about their whole understanding, 50% of them considered that they understood science in Spanish. According to the review of the other percentages, English understanding reached 12% and science in English understanding reached 26%. It could be argued that science in English has a lower degree of difficulty for students than regular English, which would be contradictory. However, this result could be explained by the satisfaction of some of the students with the positive results reached in the development of the workshops, which made them feel empowered to take on challenges.

Likes and Dislikes

A high percentage of students (86%) expressed they liked having lessons that included science activities in English. Their responses were as follows: all science classes (12%), once a week (53%), and once a month (21%). Among the reasons that justify why they would prefer this once a week, they mentioned the possibility of improving their English by applying it in different contexts as well as the enrichment of not only their usual vocabulary but scientific vocabulary too. They also remarked on the value of the contribution of this kind of initiatives to science learning which at the same time helps them improve their English proficiency. Finally, it should be noted that when students were asked about strategies for improving their understanding to develop science workshops in English, they recognized and equally valued prior knowledge of the subjects (44%) and the use of the dictionary (44%).

Limitations

Results of this innovation are limited and require the implementation of a greater number of designed and applied workshops to test the significant effectiveness of the methodological process implemented. Although students showed better performance in the second workshop and felt comfortable with the methodology,

which could be an indicator of its success, students' results must be better.

Some students do not have adequate dictionaries for the development of the workshops; this difficulty had to be faced through collaborative work with peers. So, optimized access to resources through checking dictionary availability for each student before workshops application could have improved results.

Conclusions

Before this innovation, when I had applied science workshops in English, students had shown difficulties decoding information due to a lack of foreign language proficiency and scientific vocabulary. There had been emphasis on the strategy of the use of the context to infer missing information but students could not distinguish the majority of the meanings; therefore, most of the students did not get involved in the activity and only a few students attempted to perform it. As far as dictionaries are concerned, they had been requested to develop the workshops; however, not all the dictionaries were suitable due to factors such as a lack of appropriate parents' criteria to buy a dictionary because the lowest cost is generally decisive in the buying decision. As a consequence, dictionaries are not always adequate because they handle a small number of words and limited entries for meanings and grammatical categories. Students showed difficulties in the use of the dictionary, especially managing the division of entries: per meaning and per grammatical category. For example, students tended to consider just the first meaning or they could not find verbs in the past tense, the passive voice or comparatives.

Along the development of the project, decoding unknown words presented more difficulties with non-scientific terms than with scientific terms. This seems to be due to native language similarities, prior knowledge of terms and difficulties using dictionaries. Students appreciate the use of the context, the dictionary, and prior knowledge for the resolution of the science workshops, but strategies have to be implemented to help or motivate them to improve the use of the context in reading comprehension in general.

Students preferred the use of prior knowledge in tasks such as defining scientific terms. Prior knowledge proves to be useful in the reporting of specific data such as dates and events and to create some definitions but when this was not enough to resolve the task; they had difficulties establishing relationships with it and the context.

The methodological process of activating prior knowledge and searches in the dictionary seems to facilitate the use of the text to answer the questions aimed at checking the students' understanding. Students' better performance in Workshop 2 could be considered an indicator of the success of the methodology employed by taking in mind feedback given in Workshop 1.

When students are required to write arguments to support their true or false responses, they are limited to literal information from the text. There is a resistance from most of the students to develop arguments regarding their responses. There are difficulties in establishing relationships between elements of the text and the true or false sentences and in contrasting ideas or finding similarities that allow them to justify their answers or at least make them explicit in writing.

Although we could implement only two workshops, it was observed that some students had an optimistic feeling towards the positive results they reached with the development of the workshops by activating prior knowledge and using the dictionary. The majority of them assessed the science activities in English in a positive way due to the fact that they gave them the opportunity to experience the discovery that English can be applied in different contexts, enriching not only daily vocabulary but scientific vocabulary and science learning.

Further Research

For the purpose of this study I chose short scientific texts from a science book. But articles from scientific journals are also documentary sources that are very important in the science area and so students should know how to handle them. This is of upmost relevance if we take into account that the academic world is based largely on written communication (Díaz de León, 1988).

Considering that reading requires not only decoding the text also establishing relations among elements of the text and the activities to be considered, I saw that students need training in their native language to improve their reasoning process and, hence, their reading comprehension. In line with this, it is very important to insist that students get used to inferring the meaning of the vocabulary from the context as much as possible.

For future innovations about using the dictionary to improve reading comprehension of short scientific texts, I recommended exploring not only dictionaries, but also introductory science texts and technical dictionaries that are recommended in literature and that could be very useful in familiarizing students with different sources of information.

References

Alfonzo, F. (2008, November 4). Innovación educativa [Educational innovation. Web log post]. Retrieved from http://www.natureduca.com/blog/?p=237

Biggs, A., Daniel, L., Ortleb, E., Rillero, P., & Zike, D. (2002). *Glencoe Science: Life Science.* Columbus, OH: Glencoe/McGraw-Hill.

Burns, A. (1999). *Collaborative action research for English language teachers*. Cambridge, UK: Cambridge University Press.

Burns, A. (2010). *Doing action research in English language teaching: A guide for practitioners.* New York, NY: Routledge.

Calderón, J. (2000). Enseñar a investigar a los profesores: reflexiones y sugerencias didácticas [Teaching teachers to do research: Didactic reflexions and suggestions. PDF version]. Retrieved from http://publicacionesemv.com.ar/_paginas/archivos_texto/100.pdf

Calderón, S., Carvajal, L. M., & Guerrero, A. Y. (2007). How to improve sixth graders' reading comprehension through the skimming technique. *PROFILE Issues in Teachers' Professional Development, 8*(1), 25-39. Retrieved from http://www.revistas.unal.edu.co/index.php/profile/article/viewFile/10818/11300

Díaz de León, A. E. (1988). *Guía de comprensión de lectura. Textos científicos y técnicos* [A guide to reading comprehension. Scientific and technical texts]. México D.F., MX: CONPES. Retrieved from http://www.uamenlinea.uam.mx/materiales/lengua/DIAZ_DE_LEON_ANA_EUGENIA_Guia_de_comprension_de_lectura_Text.pdf

Fernández de Bobadilla, N. (1999). Hacia un uso correcto del diccionario en la lectura de textos científicos en inglés [Towards a correct use of the dictionary in the reading of scientic texts in English]. *Encuentro: Revista de Investigación e Innovación en la Clase de Idiomas, 11*, 96-105. Retrieved from http://www.encuentrojournal.org/textos/11.11.pdf

Grellet, F. (1981). *Developing reading skills*. Cambridge, UK: Cambridge University Press.

Lopera, S. (2012). Effects of strategy instruction in an EFL reading comprehension course: A case study. *PROFILE Issues in Teachers' Professional Development, 14*(1), 79-89. Retrieved from http://www.revistas.unal.edu.co/index.php/profile/article/view/29057

Markee, N. (1997). *Managing curricular innovation.* Cambridge, UK: Cambridge University Press.

Ministerio de Educación Nacional. (2005, October/November). Bases para una nación bilingüe y competitiva [Foundations for a competitive and bilingual nation]. *Altablero: 37*. Retrieved from http://www.mineducacion.gov.co/1621/article-97498.html

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Appendix A: Workshop 1. Finding the Meaning of Unknown Words

ALCALDIA MAYOR DE BOGOTA D.C. Secretaría Educación

COLEGIO SALUDCOOP NORTE
INSTITUCION EDUCATIVA DISTRITAL
Resolución de Funcionamiento 2734 del 4 de julio de 2007
Para los niveles de Preescolar, Básica y Media Académica
DANE 111001107743 NIT 900172786-2

PFPD Red PROFILE 2010
Project: Science
Ninth grade—afternoon shift

Name:_____

Course: 901

Objective

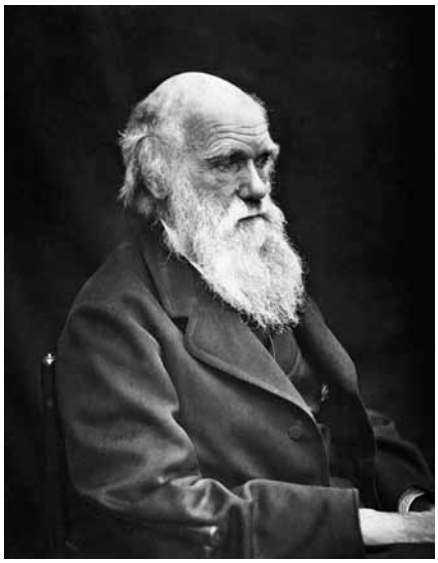
To promote prior knowledge and dictionary use to improve reading comprehension.

Science theme: Evolution, Natural Selection

Activities:

Pre-reading activity: Read the text carefully and underline the unknown words.

The theory of evolution suggests why there are differences among living things!



Darwin developed the theory of evolution that is accepted by most scientists today. He described his ideas in a book called **On the Origin of Species**, which was published in 1859. After many years, Darwin's hypothesis became known as the theory of evolution by natural selection. **Natural selection** means that organisms with traits best suited to their environment are more likely to survive and reproduce. Their traits are passed on to more offspring. The principles that describe how natural selection works are listed in Table 1.

Over time, as new data have been gathered and reported, some changes have been made to Darwin's original ideas about evolution by natural selection. His theory remains one of the most important ideas in the study of life science.

Table 1. The Principles of Natural Selection

1.	Organisms produce more offspring than can survive.
2	Differences, or variations, occur among individuals of a species.
3.	Variations are passed on to offspring.
4.	Some variations are helpful i.e. individuals with helpful variations survive and reproduce better than those without these variations.
5.	Over time, the offspring of individuals with helpful variations make up more of a population and eventually become a separate species.

English text adapted from Biggs, Daniel, Ortleb, Rillero, & Zike (2002, p. 157).

1. Classify the underlined unknown words into

Scientific words	Other words

2. Activating prior knowledge
   Choose the correct option.

   a. Charles Darwin was a(an):
      1. French botanist
      2. Italian zoologist
      3. English naturalist
      4. German geologist

   b. "Traits best suited" relates to
      1. environment
      2. helpful variations
      3. organisms
      4. offspring

c. Darwin's theory has been modified in a modern evolutionary synthesis that is called:
   1. neo-Darwinism
   2. Darwinism
   3. Lamarckism
   4. neo-Lamarckism

d. In 2009, in relation to Darwin's life, a celebration occurred of 200 years of his
   1. birth
   2. death
   3. publication of On the Origin of Species
   4. beginning of the five year voyage on the Beagle

3. Using the dictionary
   Find the meanings of the words (by paying attention to the context or by using the dictionary).

Word	Meaning	Did you use the dictionary?
Suited		Yes___ No___
Traits		Yes___ No___
Offspring		Yes___ No___
Theory		Yes___ No___
Hypothesis		Yes___ No___
Survive		Yes___ No___
Changes		Yes___ No___

4. Define the following words using your previous knowledge (PK) or using the context provided by the reading (C).

Word	Definition	Did you use PK or C?
Reproduce		
Natural selection		
Offspring		
Evolution		

5. According to the text, is the sentence True or False? Why?

a. _____ When Darwin refers to traits, this is the same as individual characteristics.
b. _____ A hypothesis is the same as a theory.
c. _____ The Origin of the Species was never published.
d. _____ Natural selection means that organisms with traits not suited to their environment are more likely to survive and reproduce.
e. _____ Offspring of individuals with helpful variations number more than offspring without these helpful variations.

Appendix B: Workshop. Understanding Scientific Texts

ALCALDIA MAYOR DE BOGOTA D.C. Secretaría Educación

COLEGIO SALUDCOOP NORTE
INSTITUCION EDUCATIVA DISTRITAL
Resolución de Funcionamiento 2734 del 4 de julio de 2007
Para los niveles de Preescolar, Básica y Media Académica
DANE 111001107743 NIT 900172786-2

PFPD Red PROFILE 2010
Project: Science
Ninth grade—afternoon shift

Name:_____
Course: 901

Objective

To promote prior knowledge and dictionary use to improve reading comprehension.

Science theme: Taxonomy

Activities:

Pre-reading activity: Read the text carefully and underline the unknown words.

Modern Classification System

In the late eighteenth century, Carolus Linnaeus, a Swedish naturalist, developed a new system of grouping organisms. His classification system was based on looking for organisms with similar structures. Today studies about fossils, hereditary information and early stages of development are used to determine an organism's phylogeny.

Phylogeny is the evolutionary history of an organism, or how it has changed over time. Today it is the basis for the classification of many organisms.

A classification system commonly used today groups organisms into five kingdoms. A kingdom is the first and largest category. Kingdoms can be divided into smaller groups. The smallest classification category is a species. Organisms that belong to the same species can mate and produce fertile offspring. To understand how an organism is classified, look at this classification of the bottle-nosed dolphin:

Kingdom	Animalia
Phylum	Chordata
Class	Mammalia
Order	Cetacea
Family	Delphinidae
Genus	*Tursiops*
Species	*Tursiops truncates*

The classification of the bottle-nosed dolphin shows that it falls under the order Cetacea. This order includes whales and porpoises.

English text adapted from Biggs et al. (2002, p. 23).

1. Classify the underlined unknown words into

Scientific words	Other words

2. Activating prior knowledge
   Choose the best option.

   a. This is not a kingdom
      1. Plantae
      2. Protists
      3. Cordata
      4. Bacteria

   b. Carolus Linnaeus was born in
      1. 1607
      2. 1707
      3. 1807
      4. 1907

   c. Carolus Linnaeus is often called the father of
      1. Genetics
      2. Chemistry
      3. Taxonomy
      4. Zoology

   d. The binomial nomenclature is used for naming
      1. Families
      2. Species
      3. Kingdom
      4. Orders

3. Using the dictionary
Find the meaning of the words (by paying attention to the context or by using the dictionary).

Word	Meaning	Did you use the dictionary?
Classification system		Yes___ No___
Fossils		Yes___ No___
Phylogeny		Yes___ No___
Kingdom		Yes___ No___
Fertile offspring		Yes___ No___
Bottle-nosed dolphin		Yes___ No___
Whales		Yes___ No___

4. Define the following words using your previous knowledge (PK) or using the context provided by the reading (C).

Word	Definition	Did you use PK or C?
Phylogeny		
Kingdom		
Species		

5. According to the text, is the sentence True or False? Why?

a. ___ Carolus Linnaeus developed a new classification system based on organisms' structures.
b. ___ Fossils are helpful to determine an organism's phylogeny.
c. ___ Phylogeny refers to the economical history of an organism.
d. ___ The five kingdoms are bacteria, protista, fungi, plantae, and animalia.
e. ___ A Species is a group of organisms that can mate and produce fertile offspring.
f. ___ Man and the bottle-nosed dolphin belong to the same class.
g. ___ Whales, dolphins, and porpoises belong to the same family.

Appendix C: Questionnaire

PFPD Red PROFILE 2010
Project: Science
Ninth grade—afternoon shift

Objective

To learn students' opinions about the advantages and disadvantages of using dictionaries, the quality of the workshops, the difficulties found in decoding the unknown vocabulary using different resources, and their points of view about the activities.

Dear Student:[4] The purpose of this questionnaire is to get your feedback on activities in science class related to decoding unfamiliar words in English and Spanish and using the dictionary to improve reading comprehension of scientific texts.

Mark with an x the answer that best fits your views. Your sincerity will be of great help to us.

1. How often would you like to develop science in English activities in science classes?

   a. All classes
   b. Once a week
   c. Once a month
   d. Never
   e. Other, which one? _____
   Why?_____
   _____

2. Do you think…

   a. You understand English?
   b. You understand science?
   c. You understand science in English?
   d. Other. Which one? _____

4 The original questionnaires were designed in Spanish and translated into English to comply with the journal requirements.

3. When you face a scientific text in English:

   a. You understand everything.
   b. You have difficulties with some words, but you keep on reading and you find their meaning.
   c. You have difficulties with some words and even though you keep on reading you do not find their meaning, so you decide look them up in a dictionary.
   d. You have difficulty understanding despite implementing the strategies above.
   e. Other. Which one? _____

4. Understanding scientific texts in English.

   a. It is easy. I understand scientific words and other words.
   b. I have difficulties with scientific words and although they are similar to Spanish words, I do not understand their meaning.
   c. It is difficult because I do not understand many words in the text whether or not they are scientific, since they are in English.
   d. Other. Which one? _____

5. To use the dictionary is:

   a. Useful, because I choose the word that best corresponds taking into account the context.
   b. Not always useful, because I cannot always find the word that best corresponds to the context.
   c. Useless, because I do not always find the meaning of the words that I look for.

6. Understanding and developing science workshops in English is easier when:

   a. I have previously worked on the same topic in Spanish.
   b. I have a dictionary.
   c. Other?

Comments_____