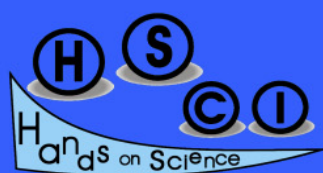


# Hands-on Science

## Brightening our Future

Edited by  
Manuel Filipe P. C. Martins Costa  
José Benito Vázquez Dorrió



The Hands-on Science Network



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ISBN 978-989-8798-01-5

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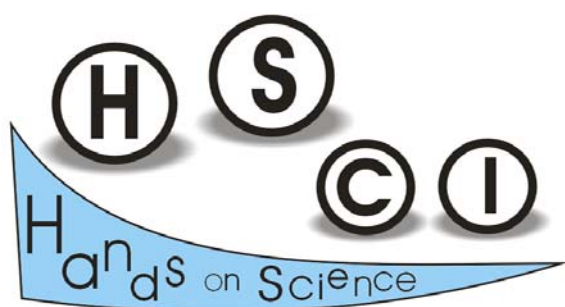


Universidade do Minho  
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Universidade de Vigo

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ISBN 978-989-8798-01-5

Printed by: Copissaurio Repro – Centro Imp. Unip. Lda. Campus de Gualtar, Reprografia Complexo II, 4710-057 Braga, Portugal  
Number of copies: 250  
First printing: July 2015  
Distributed worldwide by *The Hands-on Science Network* - [contact@hsci.info](mailto:contact@hsci.info)  
Full text available online (open access) at <http://www.hsci.info>

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Please use the following format to cite material from this book:

Author(s). Title of Chapter. Hands-on Science. Brightening our Future. Costa MF, Dorrío BV (Eds.); Hands-on Science Network, 2015, Page numbers.

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## Syntax and Biology: a Teaching Experience with the Laboratory Notebook

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**Abstract.** In the 1st Cycle of Primary Education at the University of Madeira, preservice teachers have different courses including Portuguese and Natural Sciences. Education in Portugal from primary school to university level follows a unitary pedagogy circumscribed to every discipline rather than a global approach. We believe this pedagogic approach could benefit from an entirely different organization in which, instead of having a fragmented program, would have, when possible, pedagogical proposals and knowledge together. We demonstrate the usefulness of this interdisciplinary approach, bringing together two areas of knowledge (Syntax and Biology) that generally consider themselves apart, but that have much to give each other for the benefit of students and pupils at primary schools.

**Keywords.** Syntax, Biology, Laboratory Notebook, Pedagogy, Preservice teachers.

### 1. Introduction

In the occidental contemporary education systems like the Portuguese, it is common to separate, from elementary to higher education, Science teaching from Arts and Humanities education. However, in the past, as, for instance, was stated by the philosopher Anselmo Borges [1], these two branches of knowledge were together. This may explain why, presently, most science students never interconnect these two areas of knowledge and believe that what they learn when studying language like Portuguese is not useful and important for learning Sciences. The opposite is also true for students interested in Humanities. For instance, in the elementary school lessons in mother language, students develop writing and reading skills that have to be used in Science lessons but they rarely joined knowledge of both. In a different sense, but perhaps with the same purpose, the authors of "New Directions in Language and Science Education Research" [2] show the relevance of writing in school science lessons. These

authors focused their research on Higher Education students and, showed, indirectly how important is to write well -syntax knowledge- and to write in Science research:

"Writing is an essential feature of all science-related endeavors, such as health care, agriculture, computing, and engineering, as well as the work of professional scientists. Practitioners of science regularly write in a variety of forms including personal notes, memos, diagrams, graphs, grant proposals, and reports. Effective use of different writing forms to address specific purposes with various audiences is part of the fundamental sense of science literacy in which students are expected to «become competent at communicating experimental methods, following instructions, describing observations, summarizing the results of other groups, and telling other students about investigations and explanations» (National Research Council, 1996, p. 148). Writing in science classrooms serves two primary learning purposes: enculturation of learners into the discourse practices (genre perspective) and personal engagement of learners (diversification perspective)"

At the "Concluding remarks" [2], these authors explain:

"A growing number of science educators are now aware of the importance of the research being conducted by colleagues in the language and literacy research community. The Island Conference (funded by the National Science Foundation, Iowa State University, and the University of Victoria and attended by cognitive scientists, literacy researchers, science educators, and graduate students from Australia, Canada, Italy, the United Kingdom, and the United States) focused on linking these researchers, enculturating the next generation of researchers, and generating a number of issues and controversies for future literacy and science education research, teacher education, and classroom practice."

Science students, as well as preservice school teachers, need to be proficient in their mother tongue or another language they want to use, especially when they have to communicate the results of their research. Regarding, the mother language, school teachers need to understand the language *per se* to teach children to write and read.

However, on pursuing this goal, teachers often separated language from science lessons.

The origin of this dual conception of knowledge is probably related to the curricula promoted by the national educational systems that separate lessons of Science from Art and Humanities. In Portugal, after completing the first nine school years of elementary education, students have to choose between Humanities and Sciences. However, at the primary school, during the four first years, children have the same teacher for Portuguese, Natural Sciences, History and Mathematics. Thus, the teacher can construct and promote a unitary vision of knowledge. In contrast, when students have separate lessons for different disciplines and use different textbooks, the knowledge become fragmented. Why this does happen? Perhaps it is because the university curricula for teacher education have separated all these subjects. Once a student becoming a teacher, it is likely he reproduces the same method, switching from one subject to other using different textbooks. This common trend occurs also at the University of Madeira (UMa), in the undergraduate and master of teacher education. Here students have different courses including Portuguese (Basic Syntax: Portuguese III) and Natural Sciences (Environmental Studies IV - Biology). In the course of Portuguese they learn the language using often literary texts but the scientific discourse is not analyzed. Similar guidelines are evident, for instance, in the National Reading Plan ("Plano Nacional de Leitura") that recommended essentially literary books for children to read.

As a result of this, it is common that the language subjects such as Syntax and Natural Sciences as Biology never connect together. Is it possible to teach language using scientific texts? Primary school children can learn and improved knowledge from these two different areas at the same time, but, for this, preservice teachers need to consider this learning conception. For instance, when a child describes a butterfly in his science lessons, he is improving also writing and he also needs to use syntax. What a child learns about sentence structure in his mother tongue will be necessary for his writing practice in natural sciences. Therefore, it will be important to find a way to put together knowledge of Sciences and Humanities that promote meaningful learning. If

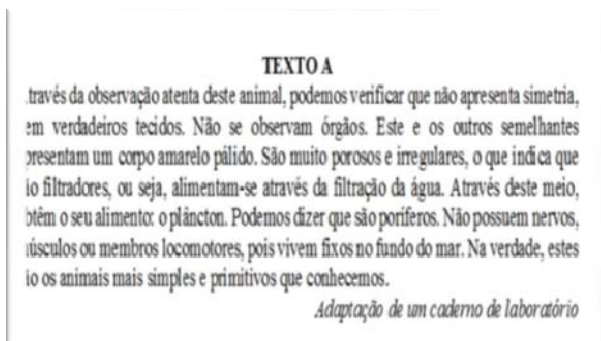
the teaching strategy is useful the same text can be used for teaching language and many other scientific matters such as Physics, Chemistry or Geology.

Undergraduate students, future teachers, at the University of Madeira, in the course of Portuguese III, enhanced their knowledge of Syntax, through literary texts. In the Environmental Studies IV (Biology) course, they conceive a laboratory notebook in which students describe observations and report the experimental activities performed in the laboratory lessons. Can students, future teachers, take advantage of notebooks to learn and teach Portuguese, namely syntax? From our point of view, this not only is possible but desirable. We propose to demonstrate that such an interdisciplinary approach, bringing together two areas of knowledge, often considered unrelated, can benefit both, preservice teachers and elementary students. Our purpose was to understand the opinion of future primary school teachers concerning the use of science texts to teach Syntax to children. Specifically we wish to know what students prefer most, scientific or literature texts, and which think to be the best for this purpose.

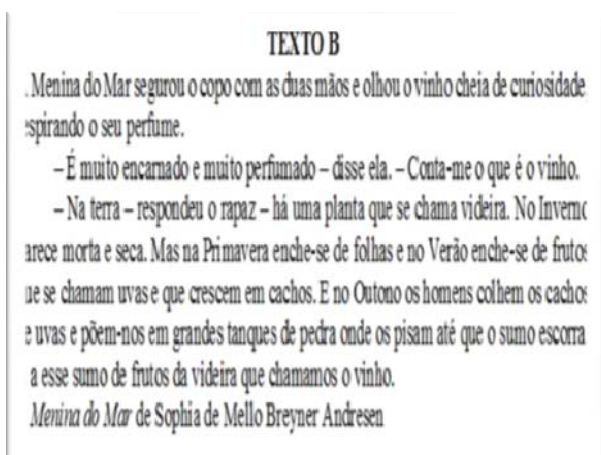
## **2. Laboratory notebook**

The guidelines for science teaching in elementary school suggest that children should have specific science skills. It has been stressed the need for teachers to be able to guide students in conducting science investigations. However, to implement these new science curricula, school teachers should have competences in experimental science. An essential part of science learning is to communicate the results of observations and findings. Thus, writing a laboratory report is regarded as an important part of teacher education. In the course on Environmental Science IV (UMa), notebooks were used as a pathway for students to learn through an inquiry-based method. In this course students have to write up a laboratory report of each of the 12 lab sessions performed during a semester. At the beginning of the semester, future teachers were given the guidelines to prepare individual lab reports and an evaluation grid with the items that will be assessed: question to be answered, objectives, hypothesis, materials, methods, procedures, results, discussion and conclusion. The

procedures developed during lab activities included mainly descriptions, comparisons, and inquiry-based science investigations. Notebooks were prepared during lab activities and remained in the lab after the lessons.



**Figure 1. The text A (laboratory notebook)**



**Figure 2. The text B (children's literature)**

### **3. Methodology: the test and the questionnaire**

In the course of Portuguese III at UMa students learn Syntax. At the end of the Portuguese III course, during the lesson period, students were asked to answer a questionnaire and an elementary syntax test on two different texts: a science (A) and a literary (B) text. The questionnaire aimed to evaluate the students' opinion on the use of the two texts to teach syntax. The test evaluated their knowledge on syntax and verified in which of the two texts (A or B) students had more difficulties in the analysis.

#### **3.1. The test**

The test consisted of four syntax questions on two texts excerpt (A and B). Text A was an extract of a laboratory student's notebook performed in the course of Environmental Sciences IV (Biology) by a student of the

teacher education course. This text described the characteristics of a sea sponge observed during laboratory lessons. The students were informed that the text A was produced by a student of the teacher education course. The text B was an extract of a literary book, *A Menina do Mar* written by Sophia de Mello Breyner Andresen [3], a Portuguese Children's literature writer. This book is used to study language in the Portuguese III classes. In this book, by means of poetry, a little boy explains in his words to a new friend how the wine is made and its flavor is. This book and the text extracts were chosen randomly.

In the test questions, the students have to identify all the sentences, to count them, to classify the structure of the sentences into simple or compound/complex ("complexas"), to identify the sentence clauses and the subject and predicate in all.

#### **3.2. The questionnaire**

The questionnaire consisted of seven questions, four related to the students identification (sex, age, nationality, name and year of the studied course) and three critical thinking questions about the students opinion on which of the two texts was the best to teach syntax to children. The first of these three questions aimed to know which of the two texts was considered easier to analyze by students and why they believed to be less difficult. The second question inquired students what of the two text types would prefer to teach Portuguese Syntax to 8 and 10 years old children. The last question asked students whether they believe that textbooks of Environmental Sciences ("Estudo do Meio") could help elementary school children to study Portuguese language. In the three questions students were asked to justify their answer. The results presented here include the analysis of the responses to all questions except the last question of the test.

### **4. Results and discussion**

#### **4.1. Answers to questionnaire**

As whole 46 students -one male and 45 females- answered the test and questionnaire. The student group inquired was rather homogeneous concerning age and professional experience. About 50% of students were below their twenties, about 43% were between 21 to 29 years old and 7% where in their thirties or

older. Most of them had no professional experience in teaching. Many were full time students from Madeira (85%).

About half of students (57%) considered the literature text (B) the easiest to analyze. They argued that the literature text was easier because the boy and girl in the story used simple vocabulary commonly used by children. In contrast, 39% of the students selected the science text as the easiest (Fig. 3).

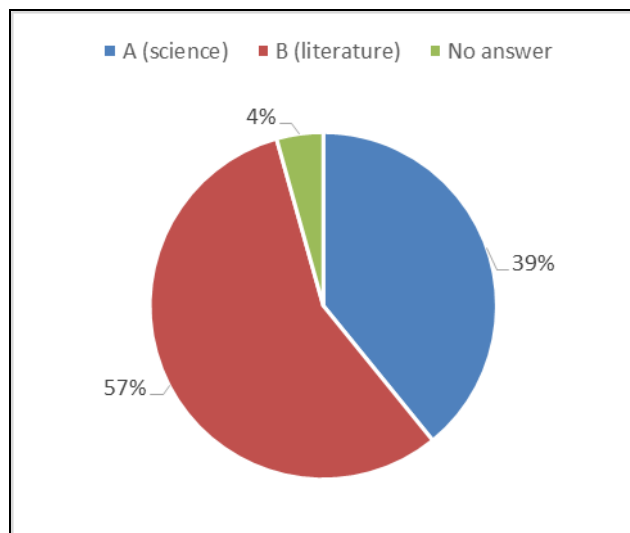


Figure 3. Number of students that answer to the question: which of the two texts (A or B) is easier for syntax analysis?

When students were asked which of the two texts would prefer to teach Portuguese to 8-9 year old children, 67% of the students said that would prefer the text B (literature) (Fig. 4). Of all students, only 22% select text A which reveals a growing interest in using other texts rather than literature ones. The remaining 7% believed that both texts can be used to teach Syntax. However, despite being 29% a small percentage, such positive trend towards science texts, is a surprising result taken into account that Portuguese language is taught almost exclusively based on literature texts from Elementary to Higher Education.

The last question concerning whether students would prefer to use natural science textbooks, particularly excerpts of biology, to teach syntax to children in the future, 77% of the students believed that science texts represent a good resource to teach syntax to children (Fig. 5). Only 4% of the students believed that scientific texts are useful to teach syntax but not all scientific texts. These results are important to understand the student's

perceptions of who are preparing to be teachers at children level education.

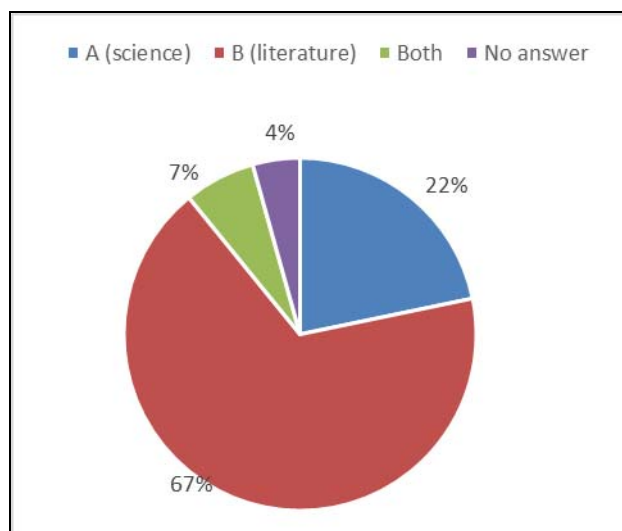


Figure 4. Percentage of answers to the question: which type of text (A or B) would you prefer to teach syntax to children?

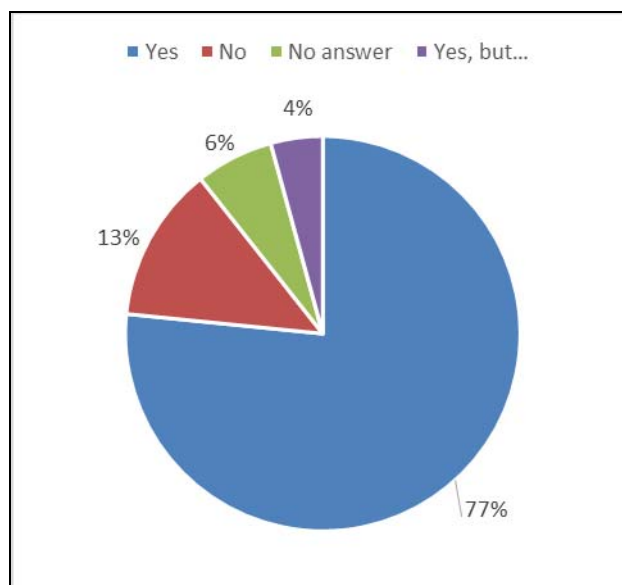
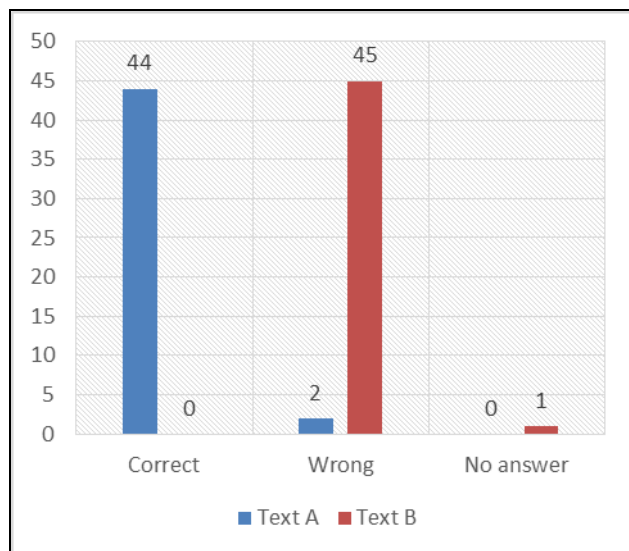


Figure 5. Percentage of answers to the question: Do you believe that environmental science textbooks could help elementary school children to study of syntax of Portuguese language?

#### 4.2. Answers to the tests

From the answers to the first question: How many sentences there are in texts A and B? it was found that all students analyzed correctly the text A but not the text B. The results revealed that students have more difficulties to analyze the syntax of text B than text A. They identified 8 sentences in each text. However, because of direct speech, text B has two additional *embedded sentences* ("frases encaixadas") [6] not recognized as such by

students. Thus, while the text B has 10 sentences, the text A has only 8 (Tab.1). In this case, most students fail to analyse direct speech correctly. Almost all students (45 of 46) failed to identify the number of sentences of text B while 95,6% of the them identified correctly those of text A (Fig. 6).



**Figure 6. Number of wrong and correct sentences identified by students in text A and B**

Although most students believed that the literature text was easier to teach syntax to children (Fig.3). Text B was more difficult for them, regarding the identification and the counting of the sentences. Almost all students (45) gave a wrong answer to this question. No student was able to identify the *embedded sentences* or count them correctly. The way in which direct speech is written, makes often difficult for the students to perform syntactic analysis. For instance, in the excerpt “– É muito encarnado e muito perfumado – disse ela.”, if we think about who is speaking, we see that there are two persons involved: one is the narrator, who tells what the little girls says, and the other is the little girl herself. This explain in part why in this case we should considered two sentences instead of one.

Teachers need to know how to analyze direct speech because children have to learn its syntax. The guidelines for the Portuguese language at Primary School level give relevance to listening, speaking, reading, writing and grammar. Elementary Syntax is part of grammar content. For instance, children need to understand what is a “sentence” and for this grammar books are essential tools for teachers. In the Portuguese III course, students

are recommended to read many syntax studies and use, at least, two different grammars [4] and [5]. Children have to know a simple definition of sentence: it is a sequence of words that is complete in itself. But they have to be able to identify them. Thus, they need to know that simple sentence contain one subject and predicate and convey a statement, a question, an exclamation, or a command. Many times, a sentence has two or more clauses or phrases. The sentence is the unit of the text. When it is written, it begins with a capital letter and finish with a full stop, but it can be replaced by a question mark or an exclamation mark. At the same time, the children have to learn what the subject and the predicate are, and also what is a clause or a phrase. For this reason it is important to know the different sentences types. In Portuguese, there are two general structures. The sentence can be classified into:

- *simple* (“simples”), when contains a single, independent clause, with one predicate;
- *compound* (“complexa por coordenação”), when has two independent clauses that are joined by a coordinating conjunction;
- *complex* (“complexa por subordinação”), when it contains an independent clause plus one or more dependent clauses and
- *compound-complex* (“complexa por coordenação e subordinação”), when has three or more clauses, for instance, when two are independent and one is dependent. All these issues were assessed in the test.

If we compare the structure and number of sentences of both texts, we verify its syntax is rather complex (Tab. 1). How many sentences can we find in both texts? Text B has more compound/complex sentences (“frases complexas”) than text A, that is, more compound, complex and compound-complex sentences than simple sentences.

In the text A, the sentence with more clauses and also more difficult to analyze was the forth that has four clauses: “São muito porosos e irregulares, o que indica que são filtradores, ou seja, alimentam-se através da filtração da água”. In contrast, the text B has two sentences with four clauses each. The first, was the eighth sentence (tab. 1 and fig. 7): “Mas na Primavera enche-se de folhas e no Verão enche-se de frutos que se chamam uvas e que

crescem em cachos.”. The second sentence was the ninth (tab. 1 and fig. 9): “E no Outono os homens colhem os cachos de uvas e põem-nos em grandes tanques de pedras onde os pisam até que o sumo escorra”.

Texts	simples sentences	compound and complex sentences
TEXT A	2, 3, 5	1, 4, 6, 7, 8
TEXT B	2, 7	1, 3, 4, 5, 6, 8, 9, 10

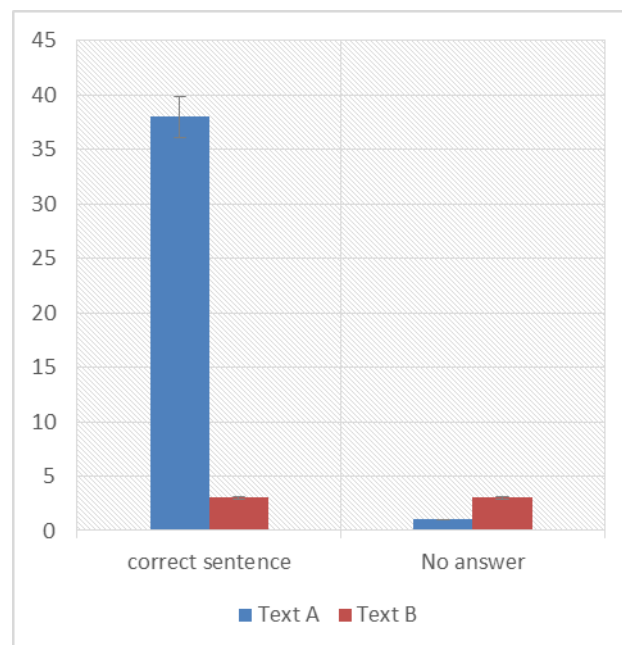
**Table 1. Number of simple, compound and complex sentences in both texts**

Although grammar can be teach to children without any text, most teachers use literary texts for this purpose. Sometimes, this is not the most suitable and easy way to explain children these contents. Nevertheless, the teacher is so familiar with literature texts that do often not want to use others. Teachers choose texts from language textbooks and would rather prefer them than would look for another even if it is easier for children. The results of this questionnaire and test showed that a literary text can be more difficult to analyze syntactically than a scientific one (Fig. 8). Almost all students were able to identify the correct sentence with more clauses in the text A but not in the text B. For example for text B, 39% of the student choose sentence 8 and 41% choose sentence 9.

These results clearly suggest that students could benefit if, instead of a having a fragmented disciplinary organization of curricula, had a different system that, whenever possible, pedagogical proposals and knowledge could be merge together. For example they could began analyzing scientific texts produce by children in science lessons, that are simpler than literature ones. After this first experience they could switched to literary or other kind of texts that are more complex, even if they are excerpts of children’s literature books.

The results of this inquire support our hypothesis: Syntax and Biology can be taught and learnt using the same text. So what would happen if Natural Sciences and Humanities are joined together in the education curricula? What kind of benefits would be expected if humanities and natural sciences become

allied? The knowledge acquisition would be probably better. For instance teaching grammar and syntax will be easier. Writing scientific texts and communicating science would also improve. Children and preservice teachers could benefit if Science and Humanities become allied in education system.



**Figure 7. Number of students that identified the correct sentences with more clauses**

## 5. Acknowledgements

We wish to thank the students that participate in this study.

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