
DISCOVERY-LEARNING IN GRAMMAR EDUCATION: A STUDY ON ANAPHORIC PRONOUNS

APRENENTATGE PER DESCOBRIMENT EN L'EDUCACIÓ GRAMATICAL: UN ESTUDI SOBRE ELS PRONOMS ANAFÒRICS

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Abstract: In the last decades, in the Portuguese educational context, as in other countries, grammar has been a central topic of debate in L1 education. Since 2001, a perspective of grammar education as *explicit knowledge of language* has prevailed in the Portuguese L1 curriculum. From this perspective, inspired by proposals of the Anglo-Saxon movement of language awareness, the main goal of grammar education is to develop the implicit knowledge that children already have and use into an increasingly reflected and explicit knowledge. In this conception, which supposes that «most of data needed to teach grammar is in children's heads» (Hudson 1992), discovery-learning approaches seem to be particularly adequate. Founded by Bruner and brought into grammar education by Hudson, this learning approach gives the student a central role and reflection upon language is stimulated through scientific reasoning. In this article, we will refer to a study on the comprehension of anaphoric pronouns in which a discovery-learning approach, the «grammar lab», was used with 20 students in grade 4. Proposed by Duarte (1992, 2008) after Hudson (1992) and sharing characteristics with other approaches (e.g., the «linguistic inquiry» by O'Neil and colleagues), the grammar lab allows students to use their intuitive knowledge and guides them to observe linguistic data, to test and validate hypotheses about language. In our study, which investigated relations between explicit knowledge and reading, students were guided to reflect upon different properties of anaphoric pronouns to develop strategies to identify antecedents of pronouns in a reading task. Some of the materials used will be presented and the main results obtained, which show positive effects of this approach in grammar education, will be discussed.

Key words: anaphoric pronouns, discovery-learning, grammar laboratory, explicit knowledge of language.

Resum: En les darreres dècades, en el context educatiu portuguès, com en altres països, la gramàtica ha estat un tema central de debat en l'educació L1. L'any 2001, amb la publicació del Currículum Nacional d'Educació Bàsica, la gramàtica, que es va anomenar «coneixement explícit de la llengua», es va considerar un dels components bàsics del currículum de L1 portuguès. Des d'aquesta perspectiva, inspirada en les propostes del moviment anglosaxó de consciència lingüística, l'objectiu principal de l'educació gramatical és desenvolupar els coneixements implícits que els infants ja tenen i utilitzen en un coneixement cada cop més reflexiu i explícit. En aquesta concepció, en què se suposa que «la majoria de les dades necessàries per ensenyar gramàtica són al cap dels nens» (Hudson 1992), els enfocaments d'aprenentatge per descobriment semblen ser especialment adequats. Fundat per Bruner i introduït en l'educació gramatical per Hudson, aquest enfocament d'aprenentatge dona a l'estudiant un paper central i la reflexió sobre el llenguatge s'estimula mitjançant el raonament científic. En aquest article ens referirem a un estudi sobre la comprensió dels pronoms anafòrics en el qual es va utilitzar un enfocament d'aprenentatge per descobriment, el «laboratori de gramàtica», amb 20 alumnes de 4t proposat per Duarte (1992, 2008) a partir de Hudson (1992) i compartint característiques amb altres enfocaments (per exemple, la «investigació lingüística» d'O'Neil i els seus col·legues), el laboratori de gramàtica permet als estudiants utilitzar els seus coneixements intuïtius i els guia per observar dades lingüístiques, per comprovar i validar hipòtesis sobre el llenguatge. En el nostre estudi, que investiga les relacions entre el coneixement explícit i la lectura, els estudiants van ser guiats per reflexionar sobre les diferents propietats dels pronoms anafòrics per tal de desenvolupar estratègies per identificar els antecedents dels pronoms en una tasca de lectura. Es presentaran alguns dels materials utilitzats i es comentaran els principals resultats obtinguts, que mostren els efectes positius d'aquest enfocament en l'educació gramatical.

Paraules clau: pronoms anafòrics, aprenentatge per descobriment, laboratori de gramàtica, coneixement explícit de la llengua.



1. OVERVIEW OF GRAMMAR EDUCATION IN PORTUGAL

The state of grammar education has been the focus of a considerable number of studies in the field of linguistics and language teaching in the last decades in the Portuguese context (e.g., Delgado-Martins *et al.* 1987; Lobo 2001; Sim-Sim & Rodrigues 2006; Ucha 2007; Costa 2008; Duarte & Rodrigues 2008; Coelho 2018; Batalha & Costa 2020). As Costa & Rodrigues (2019: 23) sum up, either from the perspective of teachers or students, these studies agree on finding «disheartening results». From the teaching perspective, Coelho (2018), who developed a case study with four future teachers, found out that teachers recognized the importance of grammar education but their teaching practices were predominantly unsystematic, atomistic and decontextualized;

she also found a mismatch between teachers' perception of their practices and their actual practices, which were mainly teacher-centered and based on an expository approach. As for grammar learning, in a study with 65 first-year graduate students, Batalha & Costa (2020) found out that students' grammatical knowledge was far below from what the learning outcomes currently in force (ME 2018a) define for the end of compulsory school in the grammar component. When given different tasks demanding the use of explicit grammatical knowledge, less than 50% of the students were able, for example, to identify the verb tense of a verb in the past simple or the subject of a sentence; about two thirds of the students were unable to identify subordinate clauses, such as causal or final clauses; only 15% of the students were able to formulate a rule to explain why a comma cannot be used between a subject and a predicate in a written sentence.

As Costa (2020) points out, unlike some countries where grammar disappeared from the official curricula (e.g., Hudson & Walmsley 2005; Denham 2020), there has always been a place for grammar in the Portuguese L1 curriculum and that place has been a central one at least since 2001, when the *National Curriculum for Basic Education* was published. This document adopted a new perspective¹ on grammar, which was inspired by the Anglo-Saxon movement starting in the 1960s and 1970s that aimed at the integration of linguistics in school curricula. This perspective not only recognizes that the study of grammar, which was renamed *explicit knowledge of language*, benefits communicative purposes but it also considers language study such a well-worth studying domain as any other (Duarte 2008; Costa *et al.* 2011; Fontich *et al.* 2020).

However, as Batalha & Costa (2020: 51) conclude, curricular changes that gave grammar a place in the Portuguese language core curriculum, as well as the approval of a linguistic terminology (ME 2008), which updated grammatical terms and concepts to be used in grammar education, appear not to be enough to tackle «persistent difficulties» in grammar teaching and learning. Thus, while bringing some consensus to what Boivin *et al.* (2018: 5) called the «to-grammar-or-not-to-grammar» question - we would say that the debate on grammar has moved from *why* to teach grammar to *what* and *how* to teach - these difficulties demonstrate that much more needs to be done to improve grammar teaching practices and students' learning.

1. It is important to note that this perspective was not consistently maintained in subsequent curricular documents, although it is, in general terms, the perspective of the current curricular guidelines, the *Essential Learning* (ME 2018a). For a detailed analysis of the place of grammar in the Portuguese curriculum between 1991 and 2019, see Costa (2020).

In this article, we offer a contribution to the identification of more effective ways to develop explicit grammatical knowledge. We focus on the discovery-learning approach (section 2), firstly proposed by Bruner (Bruner 1961) and brought into grammar education by Hudson (Hudson 1992), and particularly on the grammar lab (Duarte 1992, 2008; Costa *et al.* 2011), a method which has been implemented in the Portuguese context with positive results, as will be shown in section 3, with an empirical study on anaphoric pronouns (Batalha 2018).

2. DISCOVERY-LEARNING IN GRAMMAR EDUCATION

If we consider the three dichotomies on which Costa (2020) based her study on the place of grammar in the Portuguese L1 curriculum - dependence/autonomy, prescriptivism/descriptivism and language skills/reflective thinking - the explicit knowledge perspective could be briefly defined as autonomous, descriptive and reflective. From this perspective, as we mentioned, grammar is considered an autonomous curricular component (ME 1997, 2001, 2009, 2018a) and a «cultural» view of language overtakes an «instrumental» one (Van Rijt & Coppens 2017: 362). While expecting students to develop a reflective and explicit knowledge of language, based on their own unconscious knowledge, the attitude towards grammar is mainly descriptive and both standard and non-standard language varieties can be accepted as valuable objects of study (Hudson 1992; Duarte 1992, 2008; Denham 2020). Finally, the explicit knowledge perspective is intrinsically linked to the development of metacognitive and metalinguistic processes. This supports analytical thinking and scientific methods, in which abilities such as observation, hypothesis formulation, testing and reformulation, and generalization are learned.

Considering such principles, the discovery-learning approach is particularly well suited for grammar education (Hudson 1992). According to Heinz (2012: 1009), discovery-learning denotes a general instructional approach of constructivist learning for school-based learning environments. Bruner derived discovery-learning from contemporary studies in cognitive psychology and stimulated the development of more specific and effective instructional methods. To the author (Bruner 1961: 1), discovery is not simply the act of finding out something that before was unknown or finding it out in the sense of encountering new facts in the form of «islands of truth in an uncharted sea of ignorance», but rather includes «all forms of obtaining knowledge for oneself by the use of one own's mind» (Bruner 1961: 1). In this sense, «discovery is in essence a matter of rearranging or transforming evidence in such a way that

one is enabled to go beyond the evidence so reassembled to additional new insights» (Bruner 1961: 2). A subject who discovers looks for regularities and relatedness in their environment and devises ways of searching and finding.

The main role of the teacher in this approach is to make students as «autonomous and self-propelled thinkers» as they can in a way that students can go along on their own after formal schooling has ended. This role is not compatible with a teaching «expository mode», but rather with what Bruner (1961: 3) calls a teaching «hypothetical mode», in which teacher and learner are in a more cooperative position, and the learner, who is not a passive listener, takes part in the decisions and may have an «what if» attitude towards these.

The benefits of learning through discovery were identified by Bruner in his first formulation of the approach (Bruner 1961: 3-8): the increase in intellectual potency, namely in problem-solving and in hypothesis formulation and testing; the shift from extrinsic to intrinsic rewards, in rejection of a theory of drives and reinforcement; the learning of the heuristics of discovering; and the aid to memory process, particularly in making material more readily accessible in one's memory.

In grammar education, the primary aim of discovery-learning is «to make pupils aware of what they know already, namely the grammar of their own language» (Hudson 1992: 9). As Hudson (1992: 10), we assume, then, that «most of the data needed for a grammar lesson are already in children's heads» and «the teacher's role is mainly to guide them in exploring the patterns in the data and gradually expanding their linguistic horizons». In other words, students discover general patterns for themselves in material which is organized and presented by the teacher. The ideas, concepts and terminology that emerge from the exploration of language can be used as tools to help students to expand their knowledge and to learn to use it in different contexts.

As noted by Costa (2020: 25), in the Portuguese context, the discovery-learning approach has been referred to in the LI curriculum as «laboratorial work» (ME 1997, 2009) and it has been mainly implemented in the format of «grammar labs» as proposed by Duarte (1992, 2008) and Costa *et al.* (2011). The grammar labs share characteristics with other approaches, such as the «linguistic inquiry» (Honda 1994; Honda, O'Neil & Pippin 2010):

Through linguistic inquiry, students come to discover how very difficult it is to make explicit their unconscious knowledge of language, and also, how very satisfying it can be to do this. Explaining the nature of linguistic knowledge requires students to develop and hone methods of scientific inquiry: posing questions, collecting and analyzing data, formulating testable hypotheses, testing hypotheses by searching for confirming and disconfirming evidence, and revising or rejecting hypotheses. (Honda, O'Neil & Pippin 2010: 10)

As a teaching and learning sequence which is based on scientific reasoning, the grammar lab is organized into four main phases (Duarte 2008; Costa *et al.* 2011), which are represented in figure 1: planning, observing and describing, practicing, and evaluating.

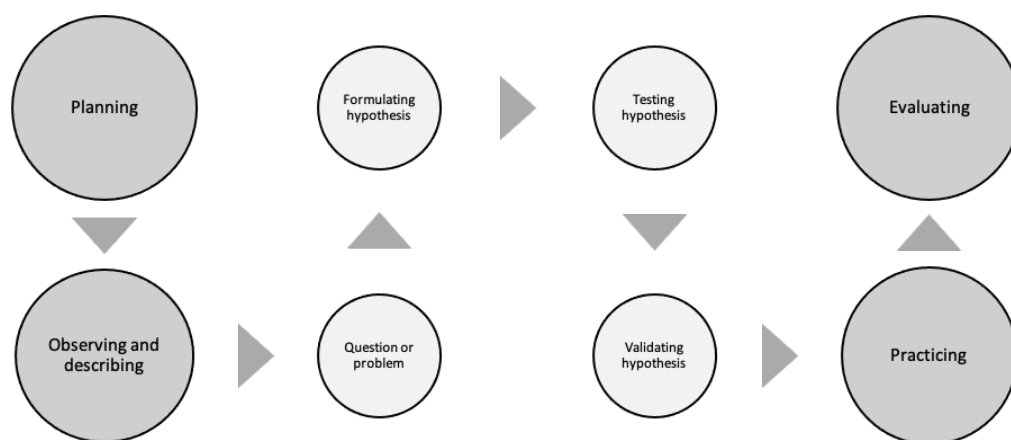


Figure 1: The grammar lab as teaching and learning sequence based on scientific reasoning.

Planning, which would be mainly carried out by the teacher, is a key phase for successful grammar discovery-learning activities. Most of the planning is about selecting the adequate linguistic data that students will observe and describe. The data sources are multiple (oral and written texts, students' own productions) and will depend on the grammatical topic to be studied, but it is important that data are organized in such a way that students can find patterns and formulate and test their hypotheses. Complete and organized paradigms are particularly relevant for this (Duarte 2008; Costa *et al.* 2011; Honda, O'Neil & Pippin 2010; Denham 2020) because data is presented in the right amount and clearly enough to ensure that students focus on what is relevant; paradigms also make it possible to present data in a way that students will find the need to reformulate hypotheses.

At the second phase, which is mainly based on students' intuitive knowledge, students are guided to observe and describe data in a scientific mode, which will support the development of explicit knowledge. According to Duarte (2008), in a grammar lab, this phase usually starts with a problem or question and includes hypothesis formulation, testing (through manipulation of linguistic units) and reformulation until hypotheses are validated and eventually generalized as a grammatical rule.

Students need then to be given opportunities to practice in a regular basis and consistent practicing will eventually allow students to use grammatical knowledge in oral and written situations (Duarte 2008; Costa *et al.* 2011).

The evaluation phase is the final one and it should be guided by formative principles, as pointed out by Costa & Rodrigues (2019). Although declarative knowledge may be evaluated, procedural knowledge should be the object of the evaluation in a grammar lab.

The grammar lab has been the object of a considerable number of studies in the last decade in the Portuguese context, as Rodrigues (2019) finds out in her documental research, which identified around 20 studies investigating the effectiveness of this method in grammar lessons, at different school levels (from primary to secondary levels) between 2009 and 2018. Some of these studies focus on the autonomous study of grammar, mainly in the syntactic domain, whereas others additionally investigate if explicit grammatical knowledge may be positively related to reading and writing. Most of them confirm the positive impact of the use of grammar labs in students' learning.

In line with these studies, the present study investigates the ability of fourth graders² to identify antecedents of anaphoric pronouns in a reading task before and after a teaching intervention in which a discovery-learning approach was used. The general hypothesis of our study is that students' explicit knowledge on anaphoric pronouns, developed through a discovery-learning approach, namely a grammar lab, is positively related to a better performance in a reading task that requires the identification of antecedents of pronouns. Besides predicting the effectiveness of the discovery-learning approach, we are also predicting that explicit grammatical knowledge will be reinvested in reading comprehension tasks.

3. STUDY ON THE COMPREHENSION OF ANAPHORIC PRONOUNS

3.1 ANAPHORIC PRONOUNS

In general terms, we consider that the referential value of a pronoun is fixed either deictically, i.e., in relation to the personal, spatial, and temporal parameters of a particular context of utterance, or anaphorically, in relation to the referential value of another expression, an antecedent, that occurs in the discursive context. In this

2. The study also assessed six and eight graders, but the teaching intervention was conducted only with fourth graders. For a review of the study, see Batalha (2019a).

second process, we say that there is there an anaphoric relation between the antecedent and an anaphoric expression.

Pronouns are called anaphoric when they are the anaphoric expression in an anaphoric relation between two or more terms, such as the pronoun *she* in the sentence in (1). In this example, the meaning of *she* is fixed in relation to the noun *Mary*, which occurs previously in the sentence as an antecedent. Because pronouns carry no autonomous referential value, they are always referentially dependent expressions and may also be known as referential dependencies (Duarte 2003; Lobo 2013).

- (1) I invite Mary_i to the dinner, but she_i did not come.

The identification of an antecedent (of a pronoun or any other expression) is dependent on different linguistic factors, such as the nature of the anaphoric expression and of the antecedent itself, the distance between the anaphoric expression and the antecedent and the syntactic properties of the material inserted between the anaphoric expression and the antecedent. When the anaphoric expression is a pronoun, certain linguistic properties of the pronoun appear to be relevant. For example, the phonological form³ of the pronoun (strong or clitic) and its syntactic function in the sentence (subject or object) seem to play an important role to the resolution of an anaphoric relation, and some asymmetries regarding these properties were found in different languages, including in European Portuguese. For example, young children seem to have more difficulties in understanding relative pronouns in object position than in subject position and there is evidence that this asymmetry persists when children enter school (Costa, Lobo & Silva 2011; Batalha 2019b).

In reading comprehension, the identification of an antecedent may require a reader to use inferential processes, particularly when there is referential ambiguity, that is, when several entities may be potential antecedents, as in example (2).

- (2) The boy_i called his father_j. He_{i,j} was happy.

Several studies suggest that comprehension of pronouns is an indicator that differentiates good and poor reading comprehenders (see Oakhill, Cain & Elbro 2015 for a review). For instance, children with poor comprehension levels are less able than same-age good comprehenders to identify the antecedent for a personal pronoun in

3. Pronouns in European Portuguese may be specified in terms of their non-clitic or clitic nature (there are strong or stressed forms, and clitic or unstressed forms) and case (nominative, accusative, dative, and oblique cases) (Brito, Duarte & Matos 2003; Raposo 2013).

a simple sentence and they are also less likely to supply the appropriate anaphoric expression in a cloze task (Oakhill & Yuill 1986).

Three types of pronouns that occur in European Portuguese were selected for our study: (i) third person personal pronouns *ele* (he), *o* (him), *lhe* (to him) and their morphological variants; (ii) invariable demonstrative pronouns *isso* and *o*; and (iii) invariable relative pronoun *que* (that).

The selected forms include strong and clitic personal pronouns (as in example [3a] and [3b]), and strong and clitic demonstrative pronouns (as in example [4a] and [4b]). The relative pronoun *que* was tested in subject and object positions, as shown in examples (5a) and (5b). These pronominal forms differ in terms of the antecedent they refer to: antecedents of personal and relative pronouns are noun phrases, whereas demonstrative (invariable forms in particular) may have as an antecedent an idea expressed by a clause or a sentence (example [4]).

- (3) a. Vi o João na festa, mas *ele* não me cumprimentou.
I saw John at the party, but *he* did not greet me.
b. O meu filho adoeceu, por isso levei-*o* ao médico.
My son got sick, so I took *him* to the doctor.
- (4) a. O criminoso foi libertado. *Isso* foi uma injustiça.
The criminal was released. *That* was an injustice.
b. Ele disse que não regressaria e disse-*o* com convicção.
He said he would not come back, and he said *it* with belief.
- (5) a. Os vizinhos *que* vivem no prédio da frente são barulhentos.
The neighbors *that* live in the front building are noisy.
b. A cidade *que* visitámos era linda.
The city *that* we visited was amazing.

Portuguese curricular guidelines (ME 2018a) prescribe the study of pronouns as a grammatical content from primary education: at the second grade, students should be able to identify personal pronouns (ME 2018b: 11); at the fourth grade, students should be able to identify stressed and unstressed forms of personal pronouns, possessive pronouns and demonstrative pronouns and should also be able to use unstressed forms of personal pronouns in particular syntactic contexts (e.g. with preverbal adverbs) (ME 2018c: 12). In reading and writing, at the second grade, students should be able to write coherent and cohesive short texts using different devices, including pronouns (ME 2018b: 9); at the fourth grade, they should be able to read to find out different elements which connect ideas in a text, for example, to identify the antecedents of pronouns (ME 2018c: 8).

3.2 METHODOLOGY

The study is based on a quasi-experimental design, with pre and posttests and a teaching intervention in the classroom. The effects of the teaching intervention are assessed by comparing pre and posttests results and results of the experimental group and the control group.

Participants are 38 fourth graders, aged 9-10, monolingual speakers of European Portuguese L1 with typical cognitive and linguistic development. Two groups of students were formed: an experimental group with 20 students and a control group with 18 students. These groups were selected by convenience and corresponded to two different classes of the same school. Both groups participated at the pre and posttests phases. Only the experimental group participated in the teaching intervention using a discovery-learning approach.

At the pre and posttests phases, we assessed students' comprehension of referential dependencies in a reading task requiring the identification of antecedents of the selected pronouns. Two similar reading tasks were constructed, one for each test. To complete the task, students had to read four texts in paper (two narrative and two expository texts) with an approximate extension and the same average level of readability. Texts were chosen from authentic sources, but they were necessarily adapted to include the different types of pronouns considered. A total of forty short-answer items assessing the ability to identify the antecedents of the mentioned pronouns were constructed.

The pretest was administered during the first term and the posttest in the third term, at the end of the school year, approximately six months after the pretest. The posttest was administered about six weeks after the end of the intervention.

The teaching intervention was implemented in the second and third terms. It was conducted over six weeks, in five sessions of forty-five minutes, and it took place in the students' classroom with the presence of the researcher and the teacher of the class. In the first session, because students were not familiar with the discovery-learning method, tasks were completed using a whole-class strategy. In the subsequent sessions, most of the tasks were completed individually and materials for self-correction were provided, alternating with teacher correction. Some of the tasks, particularly those designed for practicing, such as games, were performed in groups.

Four sets of materials were produced according to the grammar lab sequence represented in figure 1 (Duarte 1992, 2008; Costa *et al.* 2011). The sequence started with a problem based on students' data collected in the pretest. This problem was formulated as a question: *How do we know to what pronouns refer to?* Students were then guided to observe pronouns occurring in different linguistic units (as isolated

words, in sentences and in texts), to formulate hypotheses about the meaning of pronouns in these units and to draw conclusions about syntactic and semantic properties of anaphoric pronouns.

Three properties were focused: (i) an isolated pronoun has no meaning, so pronouns need to occur in sentences or texts to get meaning from an antecedent; (ii) antecedents of pronouns are generally noun phrases, but some pronouns may have as their antecedent an idea expressed by a clause or even a sentence; (iii) if a pronoun has gender and number marks, it generally agrees with its antecedent.

Finally, students were given opportunities to practice the identification of antecedents in different texts and the sequence ended with formative evaluation, which allowed students to answer to the initial problem / question.

An overview of the implemented grammar lab sequence is shown in figure 2.

| Sessions | Aims | Activities of the grammar lab | Materials |
|----------|---|--|--------------------|
| 1 | Define the aims of the grammar lab with the students | Formulation of a question / problem - <i>How do we know to what pronouns refer to?</i> | Set of materials 1 |
| | Find out that the referential value of a pronoun is fixed in a context (sentence or text) through an antecedent | Data observation: isolated pronouns Formulation of hypothesis 1 Data observation: pronouns occurring in a short text Reformulation of hypothesis 1 Testing hypothesis 1: pronouns occurring in a short text Validation and register of hypothesis 1 as a rule Practice of rule 1 | |
| 2 | Discover that antecedents of pronouns are generally nominal expressions, but some pronouns may have clausal or sentential antecedents | Data observation: pronouns with nominal antecedents Formulation of hypothesis 2 Data observation: pronouns with clausal and sentential antecedents Reformulation of hypothesis 2 Testing hypothesis 2: pronouns with clausal and sentential antecedents Validation and register of hypothesis 2 as a rule Practice of rule 2 | Set of materials 2 |
| 3 | Figure out that variable pronouns generally agree with their antecedents in number and gender | Data observation: variable pronouns Formulation of hypothesis 3 Data observation: invariable pronouns Reformulation of hypothesis 3 Testing hypothesis 3: variable and invariable pronouns Validation and register of hypothesis 3 as a rule Practice of rule 3 | Set of materials 3 |

| | | | |
|---|--|--|--------------------|
| 4 | Practice the use of strategies to identify antecedents of pronouns | Practice of rules 1 to 3 | Set of materials 4 |
| 5 | Evaluate what was learned | Answer to the initial problem / question | |

Figure 2: Overview of the grammar lab sequence.

Metalinguistic terms were used in the materials only when necessary and those terms - such as pronoun - were already familiar to the students.

Figures 3 and 4 show examples of the materials used, with students' answers. In Figure 3, students observe isolated pronouns - *eles* (they), *isso* (that - demonstrative), *que* (that - relative), *os* (them - accusative), *lhes* (them - dative) - and are asked if they can identify the meaning of those pronouns and why / why not. In this example, the student answer is «We can't tell what the pronouns refer to because they are out of their context» and conclude «[...] when pronouns are 'on their own' they don't make sense».

1. Começa por observar alguns pronomes.

eles

que

os

isso

lhes

1.1. Consegues dizer a que se refere cada um dos pronomes?

Não, não conseguimos dizer a que se referem

1.2. Porquê?

Não conseguimos dizer a que se referem, porque estão fora do contexto.

2. Regista a tua primeira conclusão.

A minha primeira conclusão é que quando os pronomes estão sozinhos não fazem sentido.

Figure 3: Examples of materials of the grammar lab sequence (session 1).

In figure 4, students observe pronouns occurring in a short text - *eles* (they), *os* (them - accusative), *lhes* (them - dative) - and try to identify what they refer to. At this moment of the sequence, students only manipulate personal pronouns and some prompts are given to demonstrative and relative pronouns. From the three types of pronouns selected to the study, we predicted personal pronouns to be easily understood, since they exhibit inflectional marks and they generally have nouns as their antecedents.

After identifying the antecedents, students are asked why it is now possible to identify what the pronouns refer to. The student answer was «I can tell what the pronouns refer to because they are ‘accompanied’ in a text».

3. Lê agora este excerto de um texto publicado na revista *Visão Júnior* sobre a exposição *O Fascinante Mundo das Aranhas e dos Escorpiões* do Museu Nacional de História Natural e da Ciência, em Lisboa.

Cuidado, há um museu em Lisboa cheio de artrópodes! Não sabes o que é isso? São aranhas, tarântulas e escorpiões, todos eles invertebrados e com um esqueleto exterior. Os aracnídeos têm oito patas, quatro pares de olhos, um par de quelíceras (tenazes ao lado da boca para apanhar as presas) e são predadores que se alimentam de insetos. Paralisam-nos e injetam-lhes sucos digestivos até o inseto ficar num líquido (...).

3.1. Escreve a expressão a que cada pronome destacado se refere. Para te ajudar, alguns espaços já estão preenchidos.

| | |
|------------------|----------------------------------|
| isso refere-se a | artrópodes |
| eles refere-se a | aranhas, tarântulas e escorpiões |
| que refere-se a | predadores |
| os refere-se a | insetos |
| lhes refere-se a | insetos |

3.2. Porque é que agora já conseguiste dizer a que se referem os pronomes?

Já consigo dizer a que se referem, porque estão acompanhados num texto.

Figure 4: Examples of materials of the grammar lab sequence (session 1).

Materials included a diversity of tasks and formats, which demanded the activation of different cognitive strategies, even though they all involved the manipulation of linguistic structures at the level of identification of antecedents with anaphoric pronouns.

For instance, materials included tasks requiring the association between a pronoun and an antecedent, but also tasks in which the antecedent had to be discovered. In turn, within the activities aimed at the discovery of antecedents, the identification of the antecedent in an example such as *John and Mary run the marathon. He loves running.* was required either directly — *What does 'he' refer to?* — or indirectly — *Who loves running?* In addition, materials not only included paper and pencil tasks (in diverse formats - association, multiple choice, gap-fill, short-answer), but also ludic tasks, such as the games pronoun bingo and pronoun dominoes (Baumann & Stevenson 1986), which were used at the practicing phase.

3.3 RESULTS

As mentioned in section 2, the general hypothesis of our study is that students' explicit knowledge on anaphoric pronouns, developed through a discovery-learning approach, namely a grammar lab, is positively related to a better performance in a reading task that requires the identification of antecedents of pronouns. We, therefore, predict that: (i) students in the experimental group perform better at the posttest than they did at the pretest; (ii) students in the experimental group perform better at the posttest than students in the control group, which did not participate in any controlled teaching intervention.

To analyze the data of the pre and posttests, items of the tests were scored one or zero points. Each test was scored by three experts and a V Cramer test was used, showing a strong association between each expert's scores. Statistical analysis was conducted using non-parametric test Pearson chi-squared in R. Results are considered statistically significant when p value is $\leq 0,05$. Results are presented in this article based on the percentage of correct answers.

As can be observed on the graph of figure 5, the experimental group performs clearly better after the teaching intervention, with a statistically significant difference between pre and posttest ($X^2=160,7$).

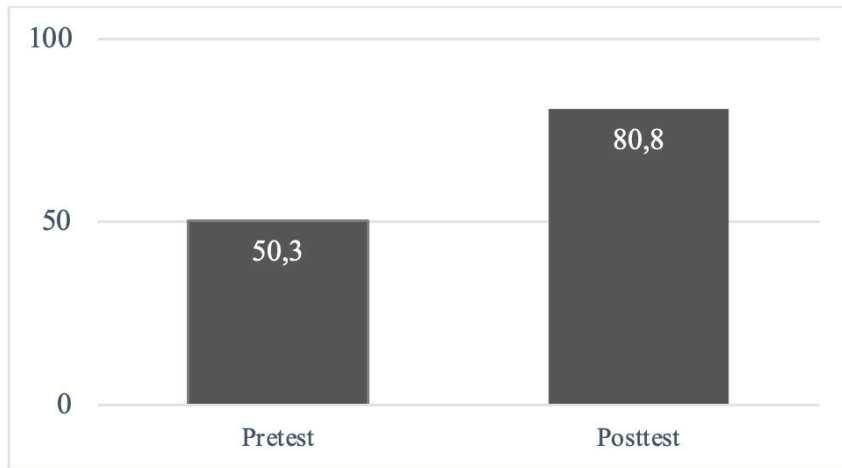


Figure 5: Percentage of correct answers in the pre and posttests by the experimental group.

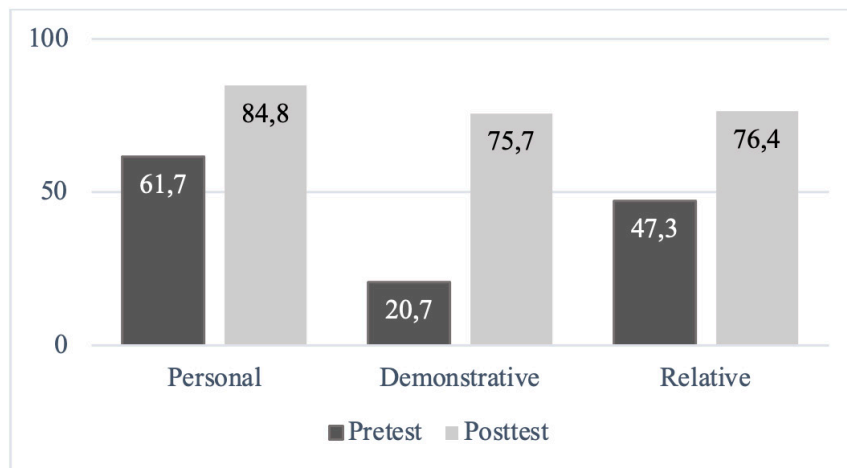


Figure 6: Percentage of correct answers in the pre and posttests by the experimental group by type of pronoun.

Complementary, percentages in figure 6 above show that this difference is significant in the experimental group for the three types of pronouns: personal ($X^2=57,1$), demonstrative ($X^2=84,8$) and relative pronouns ($X^2=39,3$). It is important to note that the different performances associated with the different pronouns at the pretest are

clearly reduced at the posttest in the experimental group. Despite this, results show that the type of pronoun⁴ is a relevant factor in explaining students' ability to identify antecedents of pronouns: from the three types of pronouns selected for the study, personal pronouns were globally interpreted without difficulty; relative pronouns and demonstrative pronouns were more difficult to interpret.

When compared to the control group, which also performed better at the posttest, as shown in the graph of Figure 7, the experimental group demonstrates a much more consistent improvement (experimental $X^2=160,7$ vs control $X^2=8,7$) than the control group.

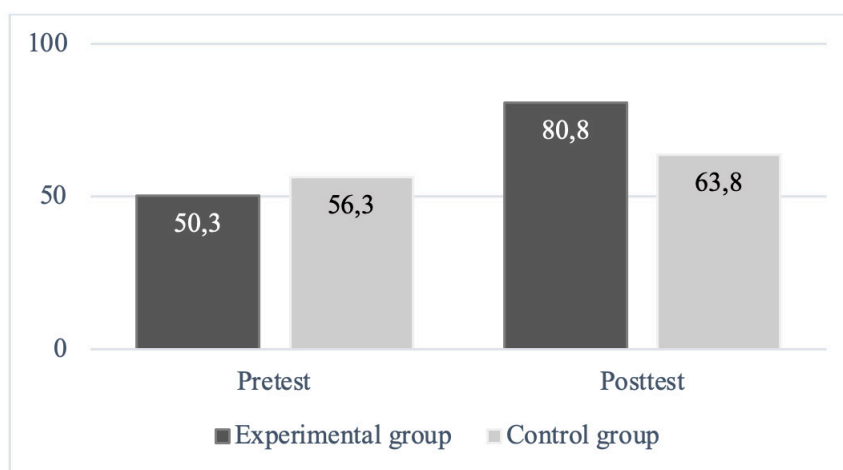


Figure 7: Percentage of correct answers in the pre and posttests by the experimental and the control groups.

4. DISCUSSION

Our study offered a contribution to the identification of more effective ways to develop explicit grammatical knowledge. We investigated the ability of fourth graders to identify antecedents of anaphoric pronouns in a reading task before and after a teaching intervention in which a discovery-learning approach, namely a grammar lab,

4. See Batalha (2018) for a detailed analysis of the linguistic factors that were considered in the study: type of pronoun, properties of the pronouns (phonological form and syntactic function), distance between antecedent and pronoun, and type of text.

was used. Proposed by Duarte (1992, 2008) after Hudson (1992) and sharing characteristics with other approaches (e.g. the «linguistic inquiry» by O’Neil and colleagues), the grammar lab allows students to use their intuitive knowledge and guides them to observe linguistic data, to test and validate hypotheses about language.

The positive effects of the teaching intervention using this type of method were clearly shown in the better performances of the experimental group in the posttest and when compared to the control group. These results allow us to validate the main hypothesis of our study and to confirm out both predictions: (i) students in the experimental group perform better at the posttest than they did at the pretest; (ii) students in the experimental group perform better at the posttest than students in the control group.

We thus may argue that our study is part of a body of research that demonstrates the effectiveness of discovery-learning in grammar education, the adequacy of this method to different school levels and its positive effects to grammar learning and eventually to an articulation between grammar and other skills, such as reading and writing (Rodrigues 2019).

Considering the topic of our study, the comprehension of anaphoric pronouns, which we know plays an important role in reading comprehension, these results also support the hypothesis that higher levels of explicit knowledge are useful for dealing with these structures in reading tasks (Oakhill, Cain & Elbro 2015).

We should note that results of the experimental group in the posttest improved more significantly with the anaphoric pronouns that were particularly difficult in the pretest (object relative pronoun and invariable demonstrative pronouns), thus providing evidence of the role of grammar education to dealing with late developed or more complex grammatical structures. From a perspective of language development and learning, we observed that the type of pronoun and certain linguistic properties of the pronouns (such their phonological form and their syntactic function) condition the anaphoric resolution and are reflected in students’ performance, confirming results found in other studies (Santos 2002; Pereira 2008; Batalha 2019b).

5. CONCLUSION

In this study, we investigated relations between explicit knowledge and reading comprehension, namely we studied the ability of fourth graders to identify antecedents of anaphoric pronouns in a reading task before and after a teaching intervention in which a discovery-learning approach was used. Results obtained confirmed our

general hypothesis that students' explicit knowledge on anaphoric pronouns, developed through a grammar lab, is positively related to a better performance in a reading task that requires the identification of antecedents of pronouns.

Our study provided empirical data on the impact of the discovery-learning approach, firstly proposed by Bruner (Bruner 1961) and brought into grammar education by Hudson (Hudson 1992), and particularly on the grammar lab (Duarte 1992, 2008; Costa *et al.* 2011), a method which is recommended by official Portuguese curricular documents and which has been implemented with positive results.

Despite this evidence, there is an impermeability of teaching practices to this method and a mismatch between recognizing the importance of discover-learning methods and adopting them on a regular basis (Rodrigues 2019; Coelho 2018).

The *how* to teach grammar question remains, as remains the challenge of how to prepare teachers scientifically and pedagogically to implement this type of methods.

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