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The effects of text analysis on drafting and justifying research questions[1]

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Abstract

Introduction. A correspondence has been seen between the level at which one can read scientific texts and his/her performance in writing this type of texts. Besides being able to read at the most complex levels, formulating research problems requires explicit training in writing. The objective of the present study was to evaluate whether identifying and drafting the different types of paragraphs of an experimental article improved graduate students' performance when asked to write a pertinent research question.

Method. Eleven graduate students in psychology participated. The experimental group was given training which consisted of identifying and rephrasing some elements of an experimental article. The control group did not receive any type of training. The evaluation consisted of drafting and justifying a research question.

Results. Before the training, students exhibited great difficulty in the drafting and justification of research questions; they were exercising reading and writing behaviors at a less complex level. After training, their performance improved substantially; they were able to behave from an extra-situational orientation. Participants in the experimental group performed better than those in the control group, both in drafting and in justifying their research questions.

Conclusions. The results obtained in the present study seem to indicate that exposing researchers-in-training to the reading of complex materials, and training them in an explicit way to write scientific texts, improves their performance when drafting and justifying novel research questions. Such data suggest the need to provide training in reading and writing at more complex levels to novice researchers.

Key words: reading behavior, writing behavior, drafting and justification, research questions, graduate students.

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Resumen

Introducción. Se ha encontrado correspondencia entre el nivel en que se ejercita la lectura de textos científicos y el desempeño al escribir dicho tipo de textos. Además de leer en los niveles más complejos, formular un problema de investigación requiere instrucción explícita en escritura. El objetivo del presente estudio fue evaluar si identificar y elaborar diferentes tipos de párrafos de un artículo experimental, propiciaba que estudiantes de posgrado pudieran escribir una pregunta de investigación fundamentada.

Método. Participaron 11 alumnos de un posgrado en psicología. El grupo experimental se expuso a un entrenamiento consistente en identificar y completar, reformulando o parafraseando), algunos elementos de artículos experimentales. El grupo control no recibió ningún tipo de entrenamiento. La evaluación consistió en la elaboración y fundamentación de una pregunta de investigación.

Resultados. Los datos mostraron que antes del entrenamiento los estudiantes tuvieron severas dificultades en la elaboración y fundamentación de preguntas de investigación ya que ejercitaron los comportamientos lector y escritor en el nivel menos complejo, pero luego de exponerse al entrenamiento su desempeño mejoró sustancialmente, al lograr comportarse en niveles extrasituacionales. Los participantes del grupo experimental tuvieron un mejor desempeño que los del grupo control, tanto en la elaboración como en la fundamentación de sus preguntas de investigación.

Conclusión. Los resultados obtenidos en el presente estudio parecen indicar que exponer a investigadores en formación a la lectura de materiales complejos, y entrenarlos de manera explícita a escribir textos científicos promueve que éstos mejoren su desempeño al elaborar y justificar preguntas de investigación novedosas. Tales datos apuntan a la necesidad de proveer entrenamiento lector y escritor en niveles complejos a los científicos en formación.

Palabras clave: comportamiento lector, comportamiento escritor, elaboración y fundamentación, preguntas de investigación, estudiantes de posgrado.

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Introduction

One of the main objectives of teaching science is for new researchers to be able to perform their functions effectively and creatively (De La Fuente, Justicia, Casanova & Trianes, 2005; Sánchez, 2004). This includes using writing skills, since writing specialized texts is part of the practice of any specific discipline (Cassany, 2006). According to Keys, Hand, Prain and Collins (1999), the writing of scientific texts, in addition to disseminating knowledge and empirical evidence, promotes the generation of new knowledge.

On the other hand, reading scientific texts is an activity essential to doing research, due the collective nature of scientific practice, which requires constant bibliographic reviews that let us know what others have done in our area of interest. In fact, generally speaking, researchers propose their own research questions based on a review of these materials, deriving novel questions from what has already been done in the field (Viniegra, 2002).

There has been extensive research on the diverse variables involved in reading, with-different theoretical approaches represented. However, despite its importance in scientific practice, there are few studies which analyze what variables influence the *writing* behavior of scientists and their apprentices, and even fewer that study the relationship between their reading skills and the writing skills deployed in a specific task. We conclude, therefore, that doing research in this direction is relevant (Carpio & Irigoyen, 2005; Pacheco, Ramírez, Palestina & Salazar, 2007).

The present study enters in the framework of interbehavioral psychology; from this base we define *comprehensive reading* as a psychological function where there is a relationship between the subject who comprehends, what is being comprehended, and the conditions minimally required for establishing a relationship between these two elements (Fuentes, 2005). It is said that someone has comprehended when his or her behavior corresponds to different situations characterized as comprehension. Carpio, Pacheco, Flores and Canales (2000) suggest that reading adjustment refers to how well one's behavior fits the demands of a specific situation, embodied in a text. Such demands or adjustment criteria can involve behavioral requirements of different complexities (Carpio, 1994; Ribes, 2004).

Reading and writing can be practiced at different levels of functional detachment, becoming progressively more complex and inclusive (Ribes & López, 1985). These levels are:

1*) Differential situational level*: At this level the individual responds to the space-time controls of stimulus objects without altering them. An example of this level of interaction takes place when a child says "Coca Cola" when seeing a soft-drink carton with these letters printed on it, or when the child copies this text.

2) Effective situational level: At this level the individual, through his or her activity, modifies the environment, eliminating objects or events in the present situation. An example at this level is when a student reads research reports and identifies and transcribes elements such as definitions, evidence, etc.

3) Precise situational level: This level implies that the subject differentiates changing contextual relationships, based on the dimension of the current functional significance of the events and organisms in the context. An example of behavior at this level is when a student classifies the paragraphs that make up an introduction or discussion from an article read previously, based on a categorization or taxonomy which is given him for this purpose.

4*) Extra-situational level*: At this level the individual alters the relationships between objects and individuals in the current, concrete situation, based on the contingencies of another concrete situation (past, future or distant). An example of this type of behavior occurs when a student reformulates (paraphrases) the introduction or the discussion of a research article, or when writing his or her own project derived from one or more scientific articles read previously.

5) *Cross-situational level*: At this level the individual interacts in terms of conventional behavior and its products, implying contact with abstract conventional systems, applicable to diverse situations and not to one in particular. An example of this level of behavior is when a student proposes a new model or taxonomy in order to explain a phenomenon, based on what he or she has read in a certain area of knowledge (Pacheco, Ramírez, Palestina & Salazar, 2007).

Some studies which analyze reading behavior have been carried out. The basic experimental task has involved giving university students different tasks in order to evaluate their reading comprehension at the five functional levels shown above. Results indicate that greatest accuracy is found at the less complex levels, while the poorest performance is seen in tasks that require participants to read at extra- and cross-situational levels (Canales, Morales,

Arroyo, Pichardo & Pacheco, 2005; Carpio & Irigoyen, 2005; Irigoyen, Jiménez & Acuña, 2004).

One of the main objectives of scientific practice is to generate knowledge. For this purpose it is essential for scientists to be able to read and write at all functional levels, especially in the more complex levels, since in order to generate knowledge it is necessary to behave at the extra-situational level at a minimum. This implies being able to identify the different elements that make up a text, relate them with what has been read earlier, as well as to form arguments and derive novel research questions, justifying them or basing them on the technical material which has been reviewed (Fuentes, 2005).

Although there are other conditions as well, reading skills are indispensable for the development of writing behavior (Pacheco, 2008). In this regard, Cassany (2007) holds that "writing demands a refined, diverse mastery of reading skills" (p. 39). When speaking about the psychological evolution of linguistic interactions (reading and writing among them) toward more complex levels (extra- and cross-situational), Ribes, Cortés and Romero (1992) hold that the individual develops morphologies and exercises them in specific situations and domains when participating in conventional, reactive systems. They affirm that the individual's participation in conventional reactive systems always occurs as a configuration of conventional and non-conventional morphologies in specific circumstances (toward specific objects and events).

According to Ribes (1990), the conditions for such psychological evolution are: 1) an interactive history which involves conventional reactive systems at the levels of intra-situational detachment; 2) "*An aptitude for being influenced by the conventional responses of another individual regarding contingencies of and between physical and social events not present in the situation, and neither directly observable nor apparent … 3) Explicit training of the individual to interact as an influence on other individuals, where non-present properties are considered to be currently available contingencies" (Ribes, 1990, p. 169).*

Reading behavior, linked to the second evolutionary condition described above, implies that for reading at more complex levels, the individual makes functional contact with a referent, through the text which another individual has composed. The individual who reads is making contact with the referent and with the way it is referred to in specific domains (mor-

phologies, styles, syntax); this in turn may help that individual to interact in writing about other referents. In line with the above, reading only at intra-situational levels makes it less likely that an individual can interact in writing under different types of contingencies (for example, formulating research questions). From this it can be inferred that an individual's performance as a reader is related to his or her effectiveness as a writer (Pacheco et al., 2007).

Pacheco et al. (2007) carried out an investigation in order to analyze a possible relationship between reading and writing behavior. University students in psychology were asked to read a scientific article and perform a series of activities: write a summary, give an opinion about the text they had read, identify elements of the text, propose a research question based on it, and suggest a possible research project. The authors found that most participants performed better on reading and writing tasks that involved situational interaction levels, than when the activity required behavior at a more complex level. This seems to indicate that interacting with the text at an extra-situational level is necessary in order to be able to write at that level.

Apparently, reading at an extra-situational level allows the student to establish relationships between different elements contained in the text, making it possible to propose novel research questions (Pacheco et al., 2007). A research question is considered novel to the extent that there is a change of value in at least one of the variables being assessed. This change should be with respect to the research reports or texts from which the novel question is being derived.

As mentioned above, and in accordance with Ribes et al. (1992), the individual necessarily requires exposure to training where he or she is explicitly taught to identify properties which are not present or apparent in a situation. This requirement is in addition to an interactive history at intra-situational levels, and having learned to be influenced by the conventional responses of others, in order to also interact as an influence over others.

However, in the case of writing behavior, explicit instruction is not the norm. Pacheco (2008) reported that in the case of undergraduate psychology students at the *Iztacala* center of the *Autónoma* National University of Mexico, the teaching and learning of writing is usually a collateral effect (and consequently not systematic), more than a concrete objective of program curriculums. Pacheco thus stresses the need to explicitly design and implement didactic tools

for helping students develop specific skills in preparing experimental psychology projects, a matter which has often been reiterated in the literature (Cassany, 2006).

Considering this to be applicable to postgraduate courses, our current investigation seeks to analyze the effects on postgraduate students' writing behavior and in particular, on the drafting and justication of psychology research questions, when they have received training in classifying and reformulating different types of paragraphs.

We assumed that in the evolution of extra-situational interactions, individuals first learn to be influenced, that is, to make contact with the referents and with how these are referred to, and that progressively, as they acquire more and more experience, they can learn to interact as an influence, eventually with different referents. Under this assumption, training was designed which required participants first to learn to identify some elements that make up the introductory section of a research report, such as definitions of basic concepts, experiemental evidence, hypotheses, and different research questions and experimental objectives. Later, they were to learn to reformulate such elements, with the final objective being for them to derive novel, pertinent, well-founded research questions, based on texts they had read.

The present hypothesis is that training in comprensive reading and in written composition of scientific texts, at the extra-situational level, will promote drafting and justification of research questions at that level, in first-semester, postgraduate students.

Method

Participants

The sample selected for the present study is composed of all the students who began a postgraduate course in behavioral sciences in the fall of 2007. The objective of this postgraduate program is to train new researchers in the area of experimental psychology. The curriculum plan revolves around a tutorial approach. In order to be able to prepare students in an individualized manner, only a small number of students are admitted each semester. For the semester that we selected, a total of 11 students were admitted: 5 men and 6 women, between 23 and 30 years of age. Participants were randomly divided into two groups, an experimental

group, composed of six students (3 men and 3 women), and a control group, composed of five students (2 men and 3 women). None of the participants had been exposed to tasks similar to those used in the present study. In other words, they had not been trained to identify elements of scientific texts, or to rework sections of these texts, or to draft or justify research questions. Since the objective of this study was to provide this specially-designed, experimental preparation to all the students enrolling in a given semester, and since the number of students was quite small, there was no *a priori* control of participants' prior experience in carrying out research activities, even though this was identified. In order to identify their initial level of reading comprehension and written composition, a Base Line (BL) was applied. Participation was voluntary.

Instruments

For the BL, for the training and for the evaluation of reading comprension and written composition, we used texts from scientific articles (in the inter-behavioral area) and materials prepared *ex profeso* (these are describe in the following section). The topic area of these articles had to do with implementating experimental preparations for the purpose of identifying the variables involved in solving complex problems; for example, they analyzed the generation of creative behavior, the effects of being exposed to different types of feedback, and the conditions that allow equivalency relationships to be established. Appendix 1 shows the list of articles that were used.

Design

Two groups were formed randomly: one experimental and one control. The experimental group was administered a BL (pretest), training Exercises 1 and 2 (intervention), and an evaluation with feedback (posttest), while the control group was administered the BL, the reading of articles used in Exercises 1 and 2 for the experimental group, and an evaluation without feedback. Participants in the control group were asked to read the articles used in Exercises 1 and 2 since the evaluation involved deriving a research question based on these articles (as a control measure, both groups needed to derive questions from the same articles); additionally, we wanted to ensure that simply reading such materials did not enable the subjects to draft and justify research questions. The experimental sessions were carried out in soundproof cubicles measuring two square meters, with both natural and electric lighting. In

each cubicle there was a table, a chair and a computer system. Table 1 presents the experimental design

Table 1. Experimental design used

	CONDITIONS			
		Training (Intervention)		
	Pretest	Exercise 1	Exercise 2	Posttest
Experimental Group N = 6	Base Line	1) Read articles 2) Do identification exercises	1) Read articles 2) Do composition exercises	Evaluation
Control Group N = 5	Base Line	1) Read articles	1) Read articles	Evaluation

Procedure

Participants were exposed to different conditions: a BL, 2 block of exercises and an evaluation. On the BL, participants were to identify the different elements that make up a scientific article, and draft and justify a research question derived from articles read. In Exercise 1, they were to *identify and classify (situational level)* the types of paragraphs that make up an article. In Exercise 2, they were to complete, by reformulating or paraphrasing (*extra-situational level)*, some paragraphs from the introduction of each of the articles read, in addition to identifying the type of research question that these articles were seeking to answer, as well as to identify the variables being evaluated. In the Evaluation, they were to *draft and justify (extra-situational level)* a novel, pertinent research question, based on the texts read in Exercise 2.

The experimental and control groups were differentiated in that participants in the control group were not exposed to the training exercises, although they were required to read the articles that the experimental group read in order to do these exercises. This ensured that the only difference between the two groups was their exposure to the training exercises. We proceed to describe in detail the conditions which participants were exposed to.

Base Line. Each participant was to read two scientific articles, and based on the reading, they were to draft an introduction and an outline of a proposed research study. Later they were to identify, in one of the texts they had read: the authors, the title, the independent and dependent variables, the central concepts, the evidence, the results and the conclusions. Next they had to draft and justify a research question derived from the articles they had read. It is worth clarifying that the BL and the evaluation differed in that the evaluation only required them to draft and justify a research question, while in the BL, in addition to this, they had to perform the activities described above. The additional activities were included because, during a pilot study where these activities were not carried out in the BL, a large number of participants stated that they were unable to perform the task and withdrew from the study, arguing that they did not know how to draft, or much less justify, a research question.

Exercises 1 and 2: The training given to the experimental group consisted of Exercises 1 and 2. In order to ensure that the training was sufficient for participants to learn what was needed, each Exercise consisted of 3 similar sessions (differing only in that each session used a different article). In Exercise 1, the participant was to: a) classify the paragraphs that make up the introduction to an experimental article in psychology (identifying whether they involved definitions, evidences, the resulting approaches, formulation of questions and objectives, or a combination of the above); and b) read the definition of an independent variable and a dependent one. In Exercise 2, the participant was to: a) read an article, b) identify that the paragraphs that make up the introduction to an experimental article in psychology are linked through a research question; c) identify the type of research question that was proposed in each of the articles read (using criteria that are described in the next section); and d) complete (by reformulating or paraphrasing) some paragraphs from the article, and finally, e) identify the independent and dependent variables under consideration. At the end of each session in both Exercises, participants were given feedback with regard to their performance.

For part c, consisting of identifying the type of research question that was proposed in each of the articles they had to read, participants were given the guidelines shown in Table 2, which lists the types of questions that can possibly be proposed. According to this classification, the levels at which a question can be proposed are inclusive, and go from lesser to greater complexity, implying that the researcher exhibits behavior which is increasingly more detached from the concrete properties of the situation presented in the experimental report(s) that he or she has reviewed, in order to derive an original question from these.

Table 2. Classification of research questions (Pacheco, 2007).

1. Only variables already assessed are manipulated, and only the value of one variable is changed.
2. a) Relationships (between variables) are evaluated which have not been considered in the literature, b) variables are manipulated which have not yet been assessed and which are pertinent to the problem at hand, and c) principles from a scientific theory are applied in order to explain a concrete social problem (related to technological research) or scientific problem (related to basic research).
3. Experimental preparations are proposed which can validate the facts of a theory.

The control group, at this stage, read the same articles being reviewed by the experimental group, as well as the definition of an independent and dependent variable. Exercises 1 and 2 are described in Table 3.

Table 3. Description of Exercises 1 and 2, which made up the training

		Experimental Group	*Control Group*
Exercise 1	Session 1	a) Read an article which was previously classified, b) classify the paragraphs that make up the introduction to an article, and c) read the definition of an independent and dependent variable.	a) Read an article (the same one read by participants in the experimental group), and b) read the definition of an independent and dependent variable.
	Session 2	Similar to the previous session, but with a different article.	Similar to the previous session, but with a different article.
	Session 3	Similar to the previous session, but with a different article.	Similar to the previous session, but with a different article.
Exercise 2	Session 1	a) Read an article, b) identify in this article the link between introduction and question; c) identify types of questions, d) complete (by reformulating or paraphrasing) some paragraphs from the article, e) identify independent and dependent variables in the article.	Read the same article as participants in the experimental group.
	Session 2	Similar to the previous session, but with a different article.	Similar to the previous session, but with a different article.
	Session 3	Similar to the previous session, but with a different article.	Similar to the previous session, but with a different article.

Evaluation. This phase consisted of two sessions as described in Table 4. In the first session, participants were to draft and justify a novel, pertinent research question, derived from any or all of the texts read in Exercise 2. After completing this task, only participants from the experimental group received feedback on their performance, after which they passed to session 2, which consisted of correcting the errors that had been pointed out to them. We decided to provide feedback and make this part corrective only for participants in the experimental group, since we were testing the effect of exposing subjects to training in comprehensive reading and in written composition (experimental group), versus the mere act of reading articles and rereading what one has written, without receiving any kind of training or feedback, nor being required to correct one's mistakes (the situation which the control group was exposed to).

Table 4. Outline of the procedure used in the Evaluation

		Experimental Group	*Control Group*
Evaluation	Session 1	Read the complete articles from Exercise 2, derive a research question, draft the introduction to a proposed project, classify paragraphs and question, and define DV and IV.	Read the complete articles from Exercise 2, derive a research question, and draft the introduction to a proposed project.
	Session 2	Rework the research question and its justification based on feedback received.	Rework the research question and its justification without receiving feedback.

The following data were analyzed: from the BL, identification of the different elements that comprise an article, as well as the research question that was drafted and its justification; from Exercise 1, the identification and classification of types of paragraphs that make up the introduction to articles; from Exercise 2, the identification of types of research questions proposed, the paraphrases which were drafted, and identification of the dependent and independent variables in each of the articles reviewed; and from the Evaluation, the drafting and justification of the research question, before and after feedback. The following data were obtained: a) from the BL, the number of elements correctly identified from the article which was presented to them for this purpose; from the BL and the Evaluation, the number of correct responses from each subject in justifying the research question, whether or not they

drafted a research question and at what level it was proposed; and b) from Exercises 1 and 2, the number of correct answers obtained by each subject in each of the three sessions involved.

Data obtained on the BL and in the Evaluation were analyzed as follows: the justification of the research question was evaluated in terms of whether it met the criteria for paragraphs corresponding to the following elements: title, definitions, evidence, approaches derived from the evidence, and formulation of the question and objective. The response was given 1 point if it was sufficient, 0.5 points if it was insufficient, and 0 if it was inadequate or absent. Additionally, the participant was give one point for correctly identifying the dependent variable and another point for identifying the independent variable in the question and justification that he or she had prepared. The sum of total points was obtained, and from this the percentage of correct responses. Based on Pacheco's classification (personal communication, 2007), the level at which each participant's research question had been drafted was identified (see Table 2).

Regarding data collected from each of the sessions in Exercises 1 and 2, where participants had to identify and classify paragraphs in the case of Exercise 1, and identify the type of question, reformulate some parts of the article and identify its independent and dependent variables in the case of Exercise 2, one point was given for each correct answer, a half point if the answer was correct but insufficient, and zero points if it was inadequate or absent. The sum of total points and the percentage of correct answers were obtained. Analysis of all the data was submitted to a reliability test using two independent qualifiers, giving an average reliability of 98.80% (% Confidence = 1 – [(n1–n2) / (n1+n2)] * 100).

Results

In order for the research questions that were drafted to be considered valid, they had to be experimental and to express an interaction between an independent and a dependent variable. A participant might draft a question that did not qualify as valid, but, since several aspects were evaluated in the justifications (see the procedure section), scoring for some correct responses was still possible.

Of the total points for identifying the different elements that make up a scientific article, the average scored by participants in the experimental group was 68% correct responses, while the control group reached 86%.

With respect to drafting the research question, as one can observe in Figure 1, only two participants were able to do so at the BL, and both of these questions represent Level 1. As for justifying the proposed research question, Figure 2 shows that scores for both groups ranged from 20% to 40% correct responses, except for one participant in the experimental group who scored 60% (P5) and one from the control group who scored 10% (P11).

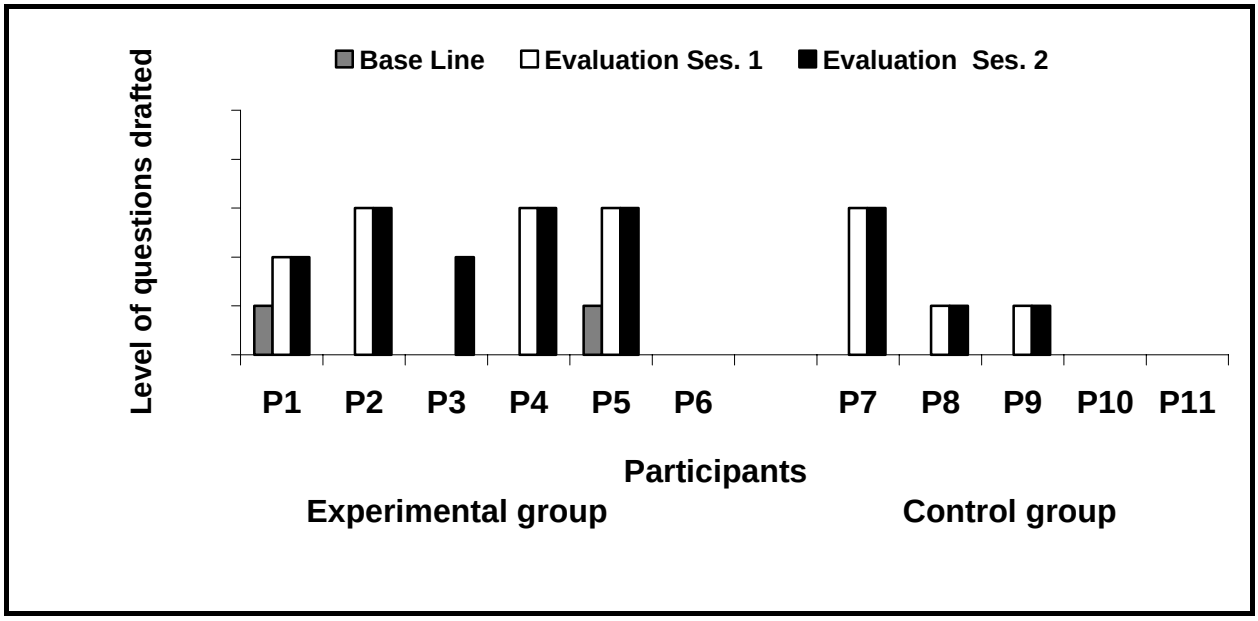

Figure 1. **Levels represented by the research questions drafted by each participant, at the Baseline and in Sessions 1 and 2 of the Evaluation.**

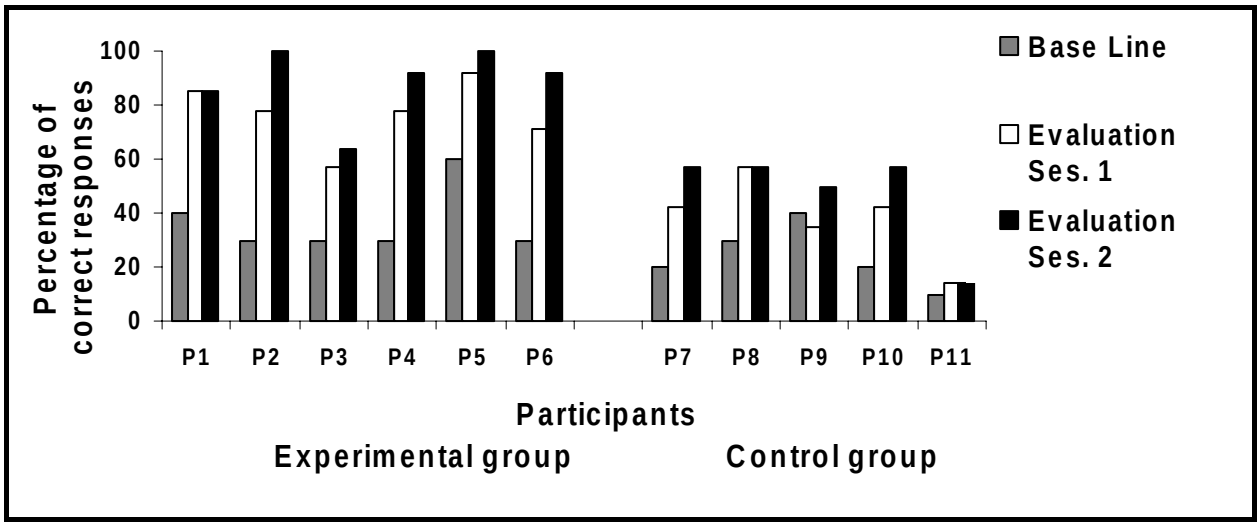

Figure 2. **Percentage of correct responses on the justification of the research question at the Base Line and in Sessions 1 and 2 of the Evaluation.**

Figure 3 graphically represents the percentage of correct responses from each participant at each of the sessions in Exercise 1. All participants obtained a greater percentage of correct responses in Session 1, with the exception of subjects 3 and 4, who reached their highest percentage of correct responses in session 3. Everyone obtained their lowest scores in session 2.

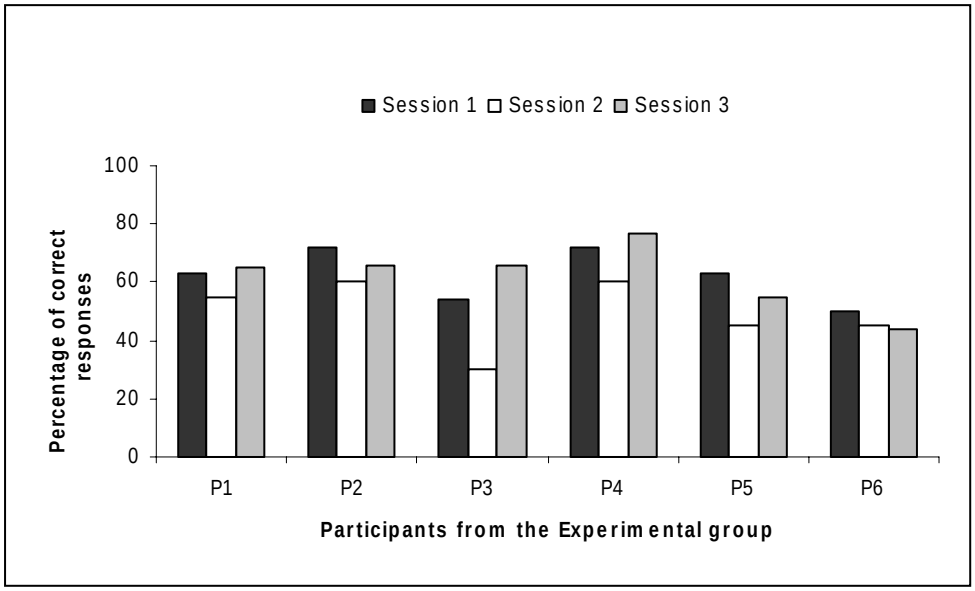

Figure 3. **Percentage of correct responses for each participant in the Experimental Group at the sessions in Exercise 1.**

The percentage of correct responses obtained in each of the sessions of Exercise 2 is shown in Figure 4. With the exception of participant 2, everyone attained more correct responses in session 1. And everyone showed their lowest percentage in session 2, managing to improve their performance in session 3.

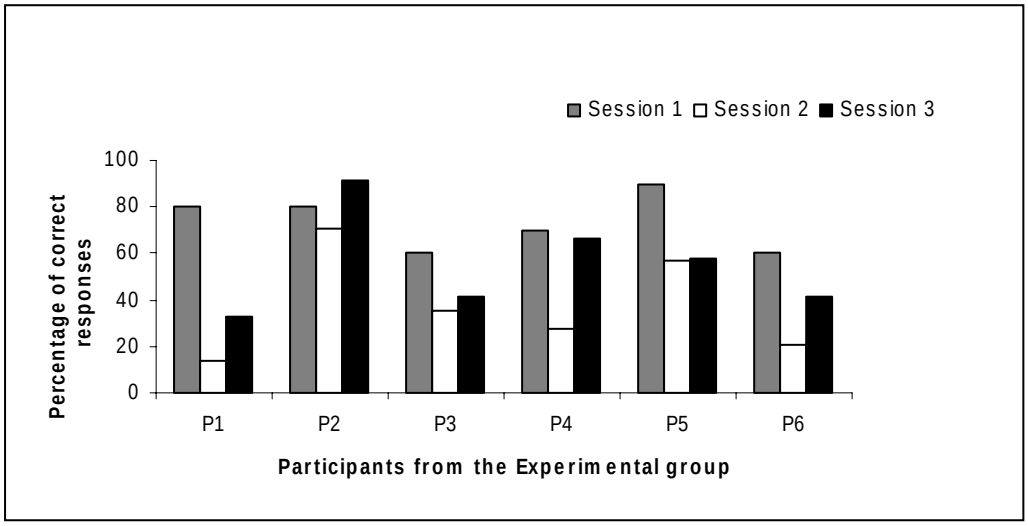

Figure 4. **Percentage of correct responses for each participant in the Experimental Group at the sessions in Exercise 2.**

Figure 1 shows the level at which each participant formed his or her research question at the BL and at each Evaluation Session. With the exception of participants 6 (from the experimental group), 10 and 11 (from the contol group), who were unable to draft a research question, the others all were able to do so in the Evaluation. Those who had reached level 1 in the BL, reached level 2a or 2b in the Evaluation. As the figure shows, after the training, subjects in the experimental group drafted questions at higher levels (2a and 2b) than the control group, who either did not draft a question or did so at level 1 (with the exception of P7, who performed at level 2b); however, these differences were not significant (Fisher's exact test, $p = .455$).

As for justification of the research question, Figure 2 shows that both the control group and the experimental group showed a higher percentage of correct responses in the Evaluation than in the BL. However, a greater gain was observed on the part of the experimental group, since their performance on the BL was below 60% correct responses, and at the Evaluation it approached 100%; in contrast, participants in the control group obtained percentages of correct responses below 40% on the BL, and at the Evaluation, around 60%. In order to verify whether differences observed between the experimental and control groups were statistically significant, the ANOVA statistic for repeated measures was calculated. A phase effect was observed for both groups ($F (2, 18) = 58.86$, $p < .05$). This effect was more marked for the experimental group, as is observed in the phase and group interaction ($F (2, 18) = 10.07$, $p = .001$). Furthermore, statistically significant differences were observed between the groups ($F (1, 9) = 17.81$, $p = .002$).

In order to facilitate comparison of data, an average was taken of correct responses given by participants from the experimental and control groups in justifying their research questions drafted at the BL, and at the two Evaluation Sessions. Figure 5 shows that at the BL, both groups obtained similar scores (37% and 24%, respectively), while at the Evaluation, at both Sessions 1 and 2, the experimental group obtained practically twice as many correct responses as the control group.

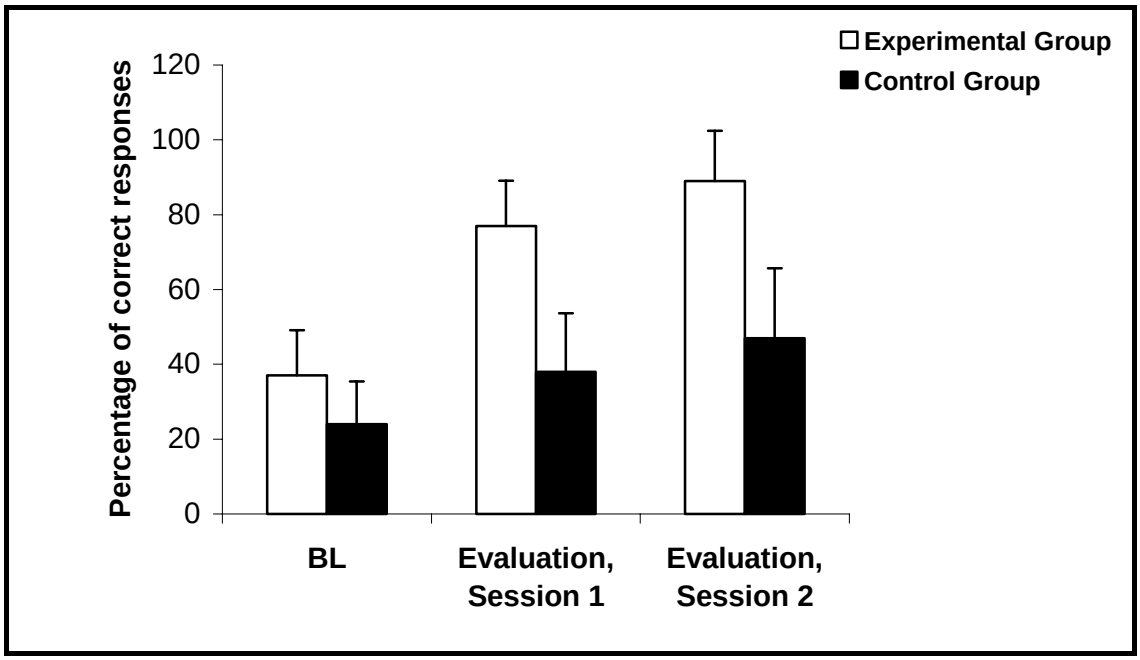

Figure 5. **Average percentage of correct responses given by participants in the experimental and control groups in justifying the research question they drafted at the BL and at the two Evaluation Sessions. The error bars represent standard deviation.**

Discussion

The objective of the present research was to determine whether training in comprehensive reading and in written composition had effects on the drafting and justification of research questions. Specifically, we hoped to demonstrate whether reading at an extra-situational level promoted or facilitated writing at that same level.

To begin, we analyzed at what level participants drafted a research question and how they justified it, before exposing them to training. We found that only two participants in the experimental group and none in the control group were able to formulate a research question. And after analyzing the justifications offered for the proposed research questions, it became clear that every participant responded inadequately.

Regarding identification of paragraphs that make up a scientific article, as required in Exercise 1, we found that most participants had difficulty in doing so, even though this requirement falls at the simplest performance level (situational). In Exercise 2, where participants had to identify the types of questions, identify experimental variables and paraphrase what they had read (extra-situational level), poor performance was generally observed, even

poorer than that of Exercise 1. This agrees with indications from Ribes and López (1985), who state that these levels involve increasing complexities.

Finally, at the Evaluation, where participants were to pose a research question and its justification, we found that four participants from the experimental group were able to pose a research question in Session 1 which represented a higher level of complexity than those prepared by the control group. This concurs with Pacheco et al. (2007), who mention that in order to behave at more complex levels it is first necessary to receive training at the lower levels.

The present study gives evidence for this pre-requisite, since participants in the experimental group were those who received the training and were able to draft a research question at a level that require extra-situational behavior. Additionally, the number of participants who were able to pose a research question was greater in the experimental group than in the control group.

Regarding the justification for the research question, Figures 2 and 5 show that the experimental group had significantly better performance than the control group, which seems to indicate that training received by the experimental group was cause for an improvement in performance. Regarding changes from session 1 to session 2, better performance was observed for all participants in the experimental group, except for one who remained at the same level (P1). This could be attributed to the fact that participants in the experimental group received feedback indicating their errors at the end of session 1, which may have brought about their improved performance in session 2. However, we also observed that three participants in the control group also showed gains. This may be due to participants identifying their own errors when they re-read what they had written, enabling them to make corrections.

Generally speaking, participants in both groups improved their performance between BL and Evaluation, both in drafting a research question and in justifying it. However, as seen in Figures 2 and 5, greater gains in both aspects were observed in participants in the experimental group. This could be attributed to the training they received, which may have enabled participants to write at an extra-situational level. This would concur with findings from Pacheco et al. (2007), where the level of reading behavior being exercised corresponds to the

level of writing behavior. In this case it might be said that the exercise of reading behavior at the extra-situational level gave rise to writing behavior exercised at the same level.

Regarding the control group's performance, their improvement from BL to Evaluation might be due to their greater reading experience. At the BL, they had to read two articles, from which they would derive a research question and justify it, while by the time they performed the Evaluation, they had already read six more articles (three from in Exercise 1 and three from Exercise 2), all of these related to the same topic area, from which they were to derive a properly justified research question.

The preceding suggests that in addition to the specific elements manipulated in the present study, there are also others that may affect subjects' performance. One of these relates to the history of referentiality, in other words, how familiar is the subject with the topic area that he or she is to read and write about. Given our results, it may be that each subject's history of referentiality has affected the way and the level at which they performed the tasks assigned in the present investigation. This variable should be controlled in later studies.

On the other hand, it is also necessary to consider participants' differential experience in research activities, since it was found that some had written undergraduate theses and others had served as research assistants during several months (the only ones without any experience were participants 1 and 3). Although it would have been desirable to control the variable of experience during this study, we sought to show the effect of training across a group of students entering in the same academic period, and with the limited number of students admitted to this postgraduate program, it became impractical.

Another element to be considered is the type of text being read. Fuentes (2005) mentions that reading scientific texts involves students deploying behaviors at different levels; in other words, depending on the type of text which the student is interacting with, he or she should deploy behaviors at different levels. Tamayo (personal communication, 2007) analyzed the texts used in the present study to determine the complexity level of each, and found that the texts where participants showed poorer performance were more complex (materials used in session 2 of Exercises 1 and 2). Complexity of the text was determined by identifying the clarity with which each article presents its research question and its corresponding justification. This variable should also be controlled in later studies.

Another aspect which may have influenced our results was each participant's motivation for the task. It has been found that motivated students have better performance on school activities (Pintor & González, 2005). It was observed that two of the participants with low performance, one from the control group (P11) and one from the experimental (P6), showed little inclination toward doing the tasks. We might clarify that the task motivation variable could have been influenced, but since the problem was only observed in two participants, we decided to do nothing, so that all subjects were exposed to exactly the same conditions and that data comparability would be maintained.

Nonetheless, we were able to verify our supposition, in that students initially showed great difficulty in drafting and justifying research questions (Pacheco et al., 2007), exercising reading and writing behaviors at the simplest level (situational), and that after being exposed to training, their performance clearly improved, showing behavior at extra-situational levels. We must note, however, that in none of the three training sessions did any participant reach 100% correct responses, despite the feedback they were given, but even so there was considerable improvement in the level of posing and justifying research questions between the BL and the Evaluation. Given this result, a non-systematic replica study is being prepared, where participants will be exposed to corrective training, and not just feedback at the end of execution, as was done in the present study.

The present study was prepared with the objective of testing the assumption that feedback alone improves execution, as several authors have indicated (Coll, Rochera, Mayordomo & Naranjo, 2007; Ribes & Martínez, 1990). The improved performance seen in participants in the experimental group (see Figure 5), who received indication of their correct responses and their errors, seems to confirm this statement.

Additionally, results from this study concur which those found earlier in Pacheco et al. (2007), where it was confirmed that a subject's level of reading behavior gives rise to his or her level of writing behavior, pointing to the need to provide training in reading at complex levels for scientists-in-training. The fact that participants were able to pose a well-founded research question in the Evaluation seems to indicate that they were able to exercise writing behavior at a extra-situational level after being exposed to the training.

Apparently, exposing researchers-in-training to the reading of technical materials, written in complex language, and training them explicitly to write scientific texts, can help them improve their performance in drafting and justifying research questions derived from articles previously read. Such data seems to indicate the relevance of providing training in reading and writing, using complex materials, with scientists-in-training.

Finally, we must note that one limitation of this study is its small number of participants; however, it was not possible to use a larger group due to the particular postgraduate program that they belong to, with its tutorial nature and limited admission policy. For this reason future studies are planned as new groups are admitted. Nonetheless, results obtained here seem to indicate that it is feasible to improve writing performance in participants, a critical skill for every researcher, by using the procedure we propose here.

In order to continue analyzing the variables that affect the formulation of research questions, future studies are needed where participants are exposed to training with different tasks that promote formulation of research questions at different levels of complexity. Likewise, experimental preparations can be designed to evaluate the effect of different aspects such as the type of text used, its complexity, and the subject's referential history, for example.

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Appendix 1. List of articles presented to participants in the current study.

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