

# COGNITIVE READING INSTRUCTION FOR FL LEARNERS OF TECHNICAL ENGLISH

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## ABSTRACT

*This paper reports an investigation into the consequences of EFL readers' lack of basic reading strategies and self-confidence in their reading skills. The initial analyses of these EFL learners' reading capacity indicated they read deliberately slowly, proceeding word by word, and relying heavily on dictionary work and on L1 translation. We consider that a better understanding of the way students learn would help teachers to devise a more effective instruction. To accomplish this aim, a research study has been conducted in order to ascertain whether direct cognitive instruction of reading strategies might contribute to a higher level of comprehension, motivation and autonomy in Spanish students of technical English. A comprehensive plan of reading instruction for FL learners was designed following the fundamental premises of cognitive theories of learning together with the assumptions stated by interactive reading models. The paper presents the main results obtained in this study, and discusses their implications and applications for the teaching of reading strategies to foreign language learners.*

## INTRODUCTION

Within the current political and geographical framework, the knowledge of foreign languages becomes a fundamental requirement to reach certain professional, academic and personal success. More specifically, since the vast majority of technical and scientific literature is published nowadays in English, being able to read in this language has become essential in Secondary and University studies. Yet, it is still frequent to find students who are unable to read in a comprehensive and autonomous way in this foreign language. In this respect, research on ESL reading demonstrates that reading in a second language involves a complex cognitive process with a high degree of difficulty. Research on the readers' problems suggests that it is difficult for second language readers to comprehend a L2 text when they lack linguistic, pragmatic and/or cultural knowledge (Clarke 1978). In spite of this complexity, there is a tendency to ignore this receptive skill in the EFL curriculum. Students hardly receive any guidance into the strategies which may facilitate the interpretation of a text. In fact, it is generally assumed that EFL readers' degree of comprehension will be similar to their L1. Goodman (1973), in this respect, suggests that the reading process may be the same across languages. Some researchers on first language have alerted teachers not to interfere with students' reading skills (cf. Bettelheim & Zalen 1981). They claim that reading is a process which will develop itself if learners are enough motivated, and texts interest each individual learner.

However, the initial findings of the present study suggest that EFL readers lack basic reading strategies and self-confidence in their reading skills. Most of the problems detected in our student's reading comprehension were connected to identifying the linguistic form of technical texts. Three basic areas were distinguished: At a lexical level, students frequently assigned only one meaning to one word, misinterpreting words in different contexts. The second problem applied to the comprehension of complex noun phrases, commonly used in technical passages. And the third referred to the understanding the logical relationship of

discourse markers and connectors. Therefore, it was likely that their reading strategies were reduce to a 'guessing game' (cf. Goodman 1967: 108), if only interpretation strategies were taught, and these kind of identification problems were overlooked.

Students' lack of confidence in their reading skills often made them read deliberately slowly, proceeding word by word, looking up words frequently in the dictionary and relying excessively on translation. The common result indicated a high degree of frustration and lack of comprehension. It is in this EFL context, we claim, where students would need to receive more effective instructional practice in order to enhance their reading achievement. Nevertheless, in spite of the increasing interest on reading instruction (cf. National Reading Panel report 2003), very few studies have derived instructional procedure from recent theory in L1 and L2. Moreover, there is certain lack of information from teachers and researchers to evaluate comprehensive programs (cf. Jenkins & Pany 1980; Brown & Hirst 1983; Hoffman & Rutherford 1984).

We consider that a thorough grasp of students' learning limitations would help teachers and researchers to devise a more effective training. It would be essential to induce such readers to leave this word-by-word strategy and to take the normal risks that reading normally requires. Students should be encouraged to reconstruct the probable meaning to the text using their knowledge of the form and subject, gaining self-confidence from the successful understanding of appropriate materials through gradual practice and feedback. To attain this aim, a research study has been conducted in order to ascertain whether direct cognitive instruction of reading strategies might contribute to improve the level of comprehension, motivation and autonomy in Spanish students of Technical English. A comprehensive plan of instruction for FL learners was designed following the fundamental premises of cognitive theories of learning (Cf. Cohen & Apek 1980; Bialystok, 1981; Faerch & Kasper 1987; Chamot & Küpper 1990; Wenden 1991; etc.), together with the assumptions stated by interactive models of reading (Rumelhart 1985; Barr, Sadow & Blachowicz 1990 and Ruddell & Speaker 1985; Dechant 1991). This reading instruction plan intended to integrate metacongivie, cognitive and social and affective skills (cf. O'Malley & Chamot 1995; Chamot et al. 1999), which may facilitate a better understanding of any text in English. The paper briefly explains the reading program administered, presents the main results obtained in this study, and discusses the effectiveness and implications of reading strategy training to foreign language learners.

## **AN INTERACTIVE READING MODEL**

As mentioned above, students' difficulties affected not only their interpretation of the textual meaning, but also their identification of textual linguistic forms and structure. Hence, what we needed to find was an approach to reading which may combine bottom-up and top-down types of knowledge in a holistic framework. For this purpose, we decided to use an interactive reading model, proposed by Rumelhart (1985), or Barr, Sadow and Blachowicz (1990). This reading model recognizes the interaction of bottom-up and top-down processes simultaneously throughout the reading process. As Rumelhart (1985: 722) explains, reading is both a perceptual and a cognitive process. The reader interacts with the text and constructs meaning by the selective use of information from all sources and cues in the text (cf. Goodman 1981: 477; Dechant 1991: 27). In other words, a skilled reader must be able to make use of sensory, syntactic, semantic and pragmatic information to accomplish the reading task. All these sources of information seem to interact in complex ways during the reading process.

Traditionally, it was assumed that a reader proceeds by moving his eyes from left to

right across the page, first taking in letters, combining these to form words, then combining the words to form phrases, clauses, and sentences of the text. In fact, this is the way many students think they read in their L1 and L2.

Instead of this 'bottom-up' model, Goodman (1967), proposed top-down models of the reading process. His analysis of the reading process was followed by authors such as Rigg (1977) and Smith (1971, 1973 and 1982), who have exerted a strong influence in researchers and teachers interested in this skill. Some of the ideas derived from Goodman and Smith are the notion of reading as a reconstruction of meaning, the use of linguistic redundancy, the role of prior knowledge in prediction, and the need for reading at a reasonable rate in larger, more meaningful chunks of text to improve comprehension. These general ideas have been included in L2 reading methods and materials such as Mackay et al. (1979), Croft (1980), Nuttall (1982), Krashen and Terrell (1983), Grellet (1984), etc.

However, interactive theorists see certain distortion in the description of top-down models (cf. Rumelhart 1977, 1985; Stanovich 1980; Lesgold and Perfetti 1981). Good readers are not only better at interpreting texts but also at identifying language forms. On the contrary, poor readers are as likely as good ones to depend on predictive reading strategies (Stanovich 1980). In fact, research suggests that simple identification skills continue to play an essential role in good reading interacting with the higher-level cognitive skills required for an accurate interpretation of texts. It seems that fluent readers predict as they read, not reading word by word, but identifying forms as they read, a reciprocal process which is partly aided by, but also crucially contributes to, their accurate semantic prediction (cf. Smith 1982). A good reader can process automatically larger and more meaningful chunks of information than simply words or phrases, allowing his conscious mind to devote more time and attention to meaning. In contrast, poor readers are too involved in solving the meaning of unfamiliar language forms to give much time to higher cognitive predictions. Fluent reading, as Carrel (1985) and Carrel et al. (1988) suggest, depends on the students' ability first, to avoid making accurate identification of forms, and then, to start guessing on the basis of their prior knowledge. Therefore, the interactive model predicts that fluent readers will not become less concerned with identification, but rather progressively more efficient at interpretative skills. We hypothesize that adopting this kind of approach may help learners improve their reading skills, bringing positive consequences in our EFL learning context.

In the interactive model, reading is conceived as a kind of knowledge which forms part of readers' cognitive structure in the brain (cf. Rumelhart 1985; Anderson 1994). In this cognitive structure, readers' schemata, or their knowledge of the world, subject matter, language form, text structure, etc., is stored as part of their long term memory. The readers' knowledge of the language graphemic, phonemic, lexical, syntactic, semantic and rhetorical form will provide them with certain expectations about the language of the text. From these expectations, during the act of reading, they are able to identify forms from a minimum number of visual cues. If their reading skills are effectively developed, they will be able to proceed in the process quickly and automatically. Therefore, as Wilson & Anderson (1986) explain, learners' prior knowledge schemata interact with the texts, allowing the learners to construct new knowledge.

At the same time, students' cultural, pragmatic, subject-specific knowledge will provide them with certain expectations about the larger conceptual structure of the text. From these expectations, readers are able, while reading, to make accurate predictions interpreting and comprehending the meaning of the text as a whole. In interactive model theory this is known as a personal reconstruction of the meaning of the text (cf. Goodman 1981; Dechant 1991). This approach to reading implies, first, that there is interaction of the reader's several kinds of knowledge (bottom-up and top-down) and, secondly, the interaction of the reader and the text. In the normal process of reading, both kinds of interaction merge into one as the

reader incorporates the text into her/his schemata or general knowledge (Rumelhart 1980; 1984; Wittrock 1981; Hudson 1982; Widdowson 1983; Carrel and Eisterhold 1983; Anderson and Pearson 1984). Our goal, as teachers and researches, should be to facilitate the access to relevant schemata which may allow students to construct meaning simultaneously from bottom up to top-down information. To achieve this objective, we have integrated learning strategies, cognitive, meta-cognitive and social-affective, into the reading program (Cohen 1998: 96), which is briefly presented below.

## **READING: A NEED FOR STUDENTS OF TECHNICAL ENGLISH**

The ability to read in English has become essential in scientist and technical studies. Extensive reading, as Asimov (1971), Bateson (1979) or Waldrop (1984) assert, provides the means for developing knowledge of the English language. More specifically, reading may broaden students' understanding of the common features of technical English regarding its form and structure. Features such as grammatical metaphors, heavy nominal groups, nominalizations, elaboration, expansion, relational identifying clauses, thematic progression, etc. (cf. Martin, 1992; Ferguson 1995, Ramirez Verdugo 2001). Accordingly, as Stotsky (1983), Krashen (1984), Smith (1984) and Chamot & O'Malley (1993) assert, there could be a positive relationship between reading and writing skills. Both skills are involved to activate a range of world-background knowledge, language conventions, and vocabulary development which can only be internalized by exposure through reading (deBeaugrande 1984; Brown and Yule 1983).

Rumelhart (1980, 1984), Wittrock (1981), Hudson (1982) and Widdowson (1983), among others, suggest that the world-background knowledge is organized in clusters of topics that constitute the internal information that is called upon to interpret and comprehend texts. The comprehension of a text may require rapid processing of text if the information is to be stored, incorporated, combined and retrieved in a manner similar to fluent L1 reading. But as Gibson and Levin (1975) recognize, information processing often entails a slow reading rate to enable the identification and understanding of certain language difficulties, for example. Hence, students need to be informed that they had to learn to read at different rates according to the text and their specific reading purposes in any particular circumstance. Therefore, for a foreign language reader, the proper blend of bottom-up and top-down strategies varies, depending on their knowledge, skills, purpose in reading the text and the complexity of the information in that text, especially technical prose. Any approach to reading must be flexible enough to be adapted to particular students in different contexts.

Taking into account the initial diagnostic results obtained in the present study, it was obvious that our students had acquired a number of bad habits which were preventing them from learning to read as successful readers. This situation demanded the inclusion of explicit reading instruction in the curriculum. These students needed extensive practice to develop new habits proper of more efficient and fluent reading which may also enhance their linguistic knowledge of English. Considering the theoretical premises discussed above, we decided to adopt an interactive reading model as a general framework for the instruction of cognitive skills and activities significant to our students in an EFL context. Our main objective was to facilitate and improve Spanish learners' EFL reading ability and overcome the shortcomings detected.

## **METHODOLOGY**

Based upon the assumptions on reading processes outlined in the introduction, the present research was primarily designed to train students in using different strategies and acquiring specific reading habits which may facilitate and improve their comprehension and autonomy. To attain this general goal, student's reading styles and difficulties needed to be identified. A range of instruments was developed specifically for this purpose. They comprised:

1. An initial diagnostic assessment to gain deeper insights into students' difficulties and perspectives on reading including
  - a questionnaire on students' learning preferences
  - a formal test to find out students' strong and weak areas
2. An analysis of students' problems and needs through their responses to the initial questionnaire and formal test.

The following difficulties were identified: slow reading rate, need to reread, poor comprehension and concentration, insufficient vocabulary, difficulty with complex structures, need to translate, inability to pronounce each word correctly, boredom and frustration.

All of these factors were valued in order to design an appropriate reading course for these EFL learners which may reduce their difficulties.

## **Objectives and Hypotheses**

Once students' reading problems had been identified, our main objective was to enable learners with the sufficient strategies to improve their reading ability. Our intention was to facilitate cognitive instruction so that learners could apply some of the risk-taking strategies used by more confident, fluent readers to improve their motivation, autonomy and comprehension (cf. Cohen and Hosenfeld, 1981). The hypotheses to be validated in the study were:

- Null Hypothesis: There are no differences between the control and the experimental group regarding their reading ability after the cognitive instruction program.
- Hypothesis 1: A specific cognitive reading instruction course contributes to learners' improvement of their reading ability, autonomy and motivation.

## **Subjects**

A sample of 40 students enrolled in a two-year course on computing science at a college in Madrid was used. They were divided into two homogeneous groups of 20 students with similar academic and social backgrounds. They presented an intermediate level of English decided on the initial test scores. One of them was randomly selected as an experimental group and the other one as a control group. The experimental group received direct and integrated cognitive reading instruction (O'Malley & Chamot 1995: 153-154). That is, students in the experimental group were informed of the value and purpose of the reading strategies. The instructor raised learner awareness of the rationale for strategy use, identified the specific strategy being used, and systematically provided opportunities for practice and self-evaluation (cf. Wenden 1987: 159). The control group followed uninformed strategy instruction (O'Malley & Chamot 1995: 153). The cues for students to use specific strategies were embedded in the textbook rubrics (O'Malley & Chamot 1995: 153-154). They worked through materials and activities designed in their textbook to elicit the use of specific strategies, but these students were not explicitly informed of the name, purpose or value of the specific reading strategy.

## **Taxonomy of reading strategies and course orientation**

Considering students' initial difficulties and needs, the cognitive reading instruction had to include specific strategies ranging from basic perceptual and recognition skills to skimming, scanning, reading rate, vocabulary in context, rhetorical pattern recognition and critical reading. For this purpose, and taking into account the assumptions of the interactive reading model presented earlier, we developed a reading model which included a taxonomy of strategies adapted from those learning skills proposed by O'Malley et al. (1985); Grabe et al. (1986); Jones et al. (1987), and O'Malley and Chamot (1990, 1995).

According to some researchers (cf. Chamot et al. 1988; O'Malley and Chamot 1990; O'Malley et al. 1985; Rubin 1987), learning skills can be classified into three main categories: meta-cognitive, cognitive and social and affective skills. Meta-cognitive skills are self-regulatory strategies in which learners are aware of their own thinking, and are able to organize, monitor and assess their own learning processes. Cognitive skills are specific to each particular task. By these skills learners actively control the information or strategies to be learned. Finally, social affective skills involve a direct interaction with other colleagues and the teacher for the purpose of learning, or control one's own understanding and affective attitudes.

In our reading model, the skills outlined below were taught arranged into four major interacting components:

- a. The first component included skills of identification and meta-cognitive skills: recognition and identification practice, previewing, scanning, reading rate practice, being aware of the reading processes, monitoring one's comprehension, etc.
- b. The second component comprised cognitive skills related to vocabulary and syntax.
- c. The third component incorporated cognitive skills of coherence and application and certain meta-cognitive skills: reading extended passages for general information, keeping concentration, etc.
- d. The fourth component involved cognitive skills of coherence, cohesion, recognition of rhetorical patterns and author's intention, application skills, etc: making inferences, noting textual relations, summarizing information, recognizing discourse information, expressing personal opinion or critical reading, etc. Finally, social and affective skills were included within the last three components.

## **Procedure**

The course consisted of three hours of instruction and practice during a period of thirty weeks. The methodology used in both groups favored the integration of the four major language skills in a communicative language learning approach. Taking into account students' learning preferences and interest on reading English texts on computing, *Oxford for Computing* (1993) was selected as a textbook. This text was supplemented with different passages from other textbooks, newspapers and magazines. Yet, those materials were adapted to our teaching context, students' level and course design. The ultimate goal, as explained earlier, was to enable students in the experimental group to acquire specific reading habits as result of explicit strategies instruction. However, we were aware that the success of the course depended on a number of significant factors. A crucial factor concerned the ability to make students confident in their capacity to face technical passages, reducing their over-reliance on translation as the unique method to understanding. A second important factor was to overcome students' initial frustration when reading in English, assigning them challenging and appropriate tasks (cf. Krashen 1981a, 1981b or 1993).

The analysis of students' questionnaires and tests indicated the need to make students

in the experimental group aware of the strategies used by fluent readers and the possible benefits of specific instruction on reading. As Widdowson (1978:109) asserts, 'the acquisition of abilities requires the learner to assume a more active and responsible role involving an awareness of his own learning processes and of the relevance of particular exercises to their development'. Students' willingness to modify old reading habits, their confidence on the teacher, the reading tasks and their own capability were vital to overcome their initial reluctance to any change. Thus, to inform students of the course orientation, a handout including the aims of the reading program was designed. The teacher explained the basis of the reading course to students, providing reasons for the inclusion of its components and, at the same time, trying to raise students' awareness on the multiple strategies involved in the reading process.

The instruction was explicit and direct so that students were able to understand its purposes and anticipate its possible effects. Students were encouraged to believe that their reading difficulties were due to lack of strategies rather than a lack of aptitudes. A relatively large number of strategy options were presented so that students could select those that worked best for them. The teacher named every strategy and explained it in English, though difficult aspects were also explained in Spanish, students' L1. Next step was to provide practice on those strategies to show students how to apply them. As O'Malley and Chamot (1990) suggest, students should gradually assume more control of their own learning. To promote certain autonomy in their reading skill, tasks were designed to extend strategies beyond the teacher guided practice to students' self-guidance and practice to any other passages (cf. Wenden, 1991).

### **Scope and sequence framework for strategy instruction**

The scope and sequence framework for learning strategy instruction proposed by O'Malley and Chamot (1988, 1995) in a content-based ESL was adapted to our particular EFL context as follows:

**1. Preparation phase.** Students were taught to develop certain awareness of the strategies that were to be introduced through questionnaires, whole class brainstorming, thinking aloud elicitation, small group discussion about tasks and their difficulties (metacognitive and social-affective skills).

**2. Presentation phase.** The teacher explained the reasons for the strategy use, she described and named each strategy and exemplified them (metacognitive and cognitive skills).

**3. Practice phase.** Student skills were developed using reading strategies through cooperative tasks, thinking-aloud while problem solving, group discussions, etc. (cognitive and social-affective skills).

**4. Assessment phase.** Students were encouraged to monitor and self-assess their own strategy use and their own progress through keeping records of their progress, discussing strategy use in class and small groups and keeping dialogue with the teacher about the instruction (meta-cognitive, cognitive, social-affective skills).

**5. Expansion phase.** The strategies practiced had to be transferred to new tasks by discussions on meta-cognitive and motivational aspects of strategy use, additional practice on similar tasks, assignments to use reading strategies on outside class tasks such as extensive reading: fiction, journals, magazines of their personal interests, etc. (meta-cognitive, cognitive skills).

### **Tasks for reading strategies instruction**

Due to space limitations, we can only enumerate here the tasks for reading strategies instruction used in the program to develop meta-cognitive and cognitive skills:

### **1. Reading Rate Tasks**

- a. pre-reading
- b. reading rate recognition
- c. phrased reading
- d. paced reading, pacing tasks
- e. cloze identification tasks

### **2. Skimming or Extracting Main Ideas**

- a. match pictures with text
- b. choose the best title for the text
- c. choose a suitable heading for each paragraph
- d. write a title for the text
- e. choose the statement that best sums up the main idea
- f. choose the best summary
- g. match questions with answers

### **3. Scanning or Reading for Specific Information**

- a. eye movement tasks
- b. rapid reading rate
- c. discriminate information

### **4. Predicting or Preparation Time for Reading**

- a. pre-reading
- b. using prior knowledge
- c. activating schemata: text content
- d. brainstorming
- e. topic discussion
- f. looking at the title and predict expected vocabulary in the text

### **5. Dealing with Unfamiliar Words**

- a. guessing meaning from context
- b. paying attention to linguistic clues
- c. looking at pictures, diagrams, charts
- d. using clues of definition to figure out meaning
  - parentheses or footnotes
  - synonyms and antonyms
- e. using Latin and Greek roots, prefixes and suffixes

### **6. Vocabulary Development**

- a. using new words in different contexts

### **7. Rhetorical Patterns Recognition**

- a. deducing text type and genre
- b. understanding text organization:
  - putting scramble sentences and paragraphs in the correct order
  - deciding where certain sentences should go in the text
  - deciding which sentences are in the wrong position and where



## **ASSESSMENT**

As Grabe (1985) suggests, interactive models imply that skills are tested at many levels, since all of them are assumed to play a significant role in the reading process. These skills range from the rapid identification of vocabulary and syntactic structures to the interpretation of larger discourse patterns. Therefore, ideal assessment of reading strategies should involve the combination of all these skills.

Most programs also recognize the need to construct their own tests to match the specific context constraints which any program may operate under, an EFL context in our case (cf. Heaton, 1975; Madsen 1983; and Gladstone 1994). Therefore, instead of selecting any standardized test, we constructed our own assessing tools along the reading program.

In order to construct suitable reading tests, it was necessary to select texts that would accommodate with our research objectives and enable the assessment of the reading program results. Thus, when the aim was to assess reading rate, skimming and scanning, we selected long texts on general topics. However, when the goal was to state the main idea, shorter passages were preferred. Finally, when students had to read carefully, to infer the author's arguments, or state their own critical opinion, more specific computing passages of intermediated length were selected.

The reading assessment was carried out by means of initial placement and diagnostic tests, direct and continuous teacher observation, student-teacher dialogues and feedback, outside reading homework, in-class achievement test, final achievement test and questionnaires. The reading assessment program provided fundamental information to determine the degree of success or failure of the reading strategies instruction.

Yet, it is necessary to emphasize the fact that reading comprehension is the result of a number of internal processes and skills in each individual's mind. It may be also affected by a number of diverse factors such as socio-cultural, attitudinal or affective, personal influences, etc. Therefore, it seems unlikely that we could assess a particular student degree of comprehension of any reading passage with absolute reliability.

Despite the previous considerations concerning the comprehension issue, it seems necessary for teachers to assess whether a student understood a text responding to certain related information, at least in a broad sense. Students should demonstrate that they can read and analyze a passage in an autonomous way. They must exhibit on one hand, understanding of all the text syntactic, discursive, semantic and pragmatic levels. On the other hand, students must manifest self confidence in their ability to tackle with the text and to monitor their comprehension. Otherwise, they should be able to apply some remedial work. In addition, students could try to use the information from the text, to develop further tasks, to criticize the author's intention and to incorporate or use her/his message to their personal knowledge. Tasks a fluent reader would normally perform.

## **RESULTS**

By the end of the instruction period we had gathered valuable and sufficient information by means of the formative assessment to determine the degree of effectiveness of the reading program. However, in order to support our continuous assessment with objective data, and to measure how effective the instruction had been in attaining its objectives, a summative assessment was also carried out at the completion of the course. We needed to be able first, to determine experimental group students' degree of progress along the course, and second, compare it with control group students' development.

Students' answers were compared with those of the initial test to verify whether their

reading comprehension had advanced through the instruction period. Special attention was paid to those questions which required recognizing implicit information, and that had caused problems at the beginning. Then, the answers of the experimental group students were contrasted with those of the control group students to ascertain whether or not our initial hypothesis, the effectiveness and benefit of direct strategies instruction, was correct or not. The analysis of the post-test assessment and the final questionnaire provide the following results:

Students' score mean in the final test was higher in the experimental group (85%) than the control group score mean (50%). Additionally, students in the experimental group answered questions demanding the comprehension of some implicit information significantly better (90%) than students in the control group (45%).

Not only their reading comprehension improved, but it took experimental group students less time to read the passages and answer related questions than to students from the control group. While at week 0, both groups presented a mean of 88 words per minute, at week 30, students in the experimental group outperformed the control group students. At the end of the training the experimental group reached a mean of 160 words per minute, while the control group only achieved a mean of 100 words per minute.

Furthermore, experimental group students gained greater autonomy in the development of the assigned tasks than the control group students. As previously stated, at the beginning of the course both groups had manifested in their initial questionnaire their preference to rely on the teacher's assessment to correct their mistakes and their progress. Yet, during and after the treatment period, the experimental group students were more concerned with their own assessment. Through systematic practice students had progressively acquired the ability to monitor and control their reading comprehension and progress.

However, the students in the control group kept relying on the teacher whenever they did not grasp anything in a passage. Indeed, they did not use textual cues or made inferences to understand the message, or use reference materials as often as the experimental group did.

Regarding students' attitude and motivation towards the activity of reading in general, and reading texts related to computing, in particular, the questionnaires and oral discussions provided the following evidence:

Students from the experimental group valued more positively than the students in the control group the kind of tasks performed along the course. Besides, students in the experimental group relied less on translation, or at least, did not consider it as useful as the control group did. Experimental group students declared that they preferred to translate into Spanish only difficult terms, becoming conscious of the limitations of translation.

On the whole, students in the experimental group felt that they had improved their reading ability and could deal with a text better after the learning instruction than when they started the course. The results showed that the experimental group was more motivated and found the instruction of reading strategies useful. In contrast, the control group felt that they were not progressing too much. According to them the difference with previous texts was that they were more difficult now than at the onset of the course. Thus, they still found computing texts in English hard to manage. In addition, the control group preferred to translate into Spanish rather than relying on textual hints and resources. Finally, students in the experimental group displayed a greater awareness of meta-cognitive skills. They also found it easier to use certain specific cognitive skills in a rather automatic way.

## **DISCUSSION AND CONCLUSION**

Considering the results obtained on the reading strategy treatment period, our initial hypothesis, that direct cognitive instruction of reading strategies might contribute to a higher

level of comprehension, and consequently, to a higher motivation and autonomy, has been validated.

The direct implications of this research would be that students frequently find technical texts useful for their studies but at the same time, they consider those texts difficult in their content and structure. However, taking into account the results of our experimental group instruction and comparing them with those of the control group, we could conclude that the instruction of meta-cognitive, cognitive and social affective strategies cognitive strategies embedded within an interactive reading model seems to help students overcome some of their reading problems. Students' motivation, autonomy and self-confidence in their reading capacity appear to be also reinforced. Therefore, these research results suggest that the applied reading framework has contributed to reduce students' specific reading weakness, which leads us to value positively the benefits of integrating this kind of direct methodology within the curriculum of EFL courses.

Teachers and text writers have tended to place reading skill on a continuum ranging from reading for language practice to reading for meaning. At the initial stages, students need to read for language practice, that is, reading as an activity to increase knowledge of vocabulary and structure. Then, at the intermediate to advanced levels, students need to read for meaning, that is, reading as an activity to gather information. By the intermediate level, teacher, programs, and even materials assume the student is able to read for meaning. However, there is a gap between reading which is really just language practice and real reading for meaning. To fill this gap, as we have seen, students need to be made aware of a variety of reading skills and strategies and to practice new and good reading habits (cf. Johnson 1981). Accordingly, as Wenden (1987: 159) claims, without direct and integrated strategy instruction not all students will have an awareness of the specific strategy being cued.

This paper demonstrates that effective instructional practice may enhance students' achievement in reading comprehension, strategy awareness, autonomy and motivation. The present research on reading comes to reinforce the conclusions drawn in previous investigations on language learning strategies which indicate that training learners to use specific strategies may have positive effects on tasks performance and the language learning process (cf. Bialystok 1983; Gagne 1985; O'Malley and Chamot 1995; Dadour et al. 1996; Johnson 1999; Sano 1999, among others). The findings of this study seem to be favorable, then, as to carry out subsequent investigation in this field. Further research would be needed to introduce new reading strategies. A longer training and practice period would be also necessary to draw new light into learners' autonomy, self-evaluation, cooperative learning, and the transfer of the reading strategies learnt to any reading passage and perhaps to other content areas. A comparison with future studies focusing on this issue and dealing with balanced and effective instructional procedures, we hope, will enlarge our initial objectives.

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