Research Issues

Think Aloud Protocols and Metacognitive Reading Strategies in English for Science and Technology/Foreign Language Class[1]

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"Extraño, es incómodo prestar atención a un proceso natural que se realiza automaticamente, en cuestión de segundos..". (It's strange. It's uncomfortable to pay attention to a natural process that is done automatically, in a matter of seconds...." (3rd trimester EST/FL university student).

One of the challenges we as teachers face in our university EST/FL reading classes is the task of making our students become proficient and self-sufficient readers. Reading has been considered an interactive process involving the reader, the text and the interaction of both. (Rummelhart, 1977; Carrell, Devine & Eskey, 1988; Grabe, 1991).

Grabe (1991) points out that good readers have a large vocabulary, know the structure of the language and have both cultural, as well as previous knowledge of the content of the text. A good reader is also able to evaluate, synthesize and relate the new information with already existing knowledge, which involves the use of prediction and inference. Finally, Grabe emphasises that "..the ability to use metacognitive skills effectively is widely recognised as a critical component of skilled reading." (p. 382).

Research done by Chamot & O'Malley (1994) show that good readers tend to use both cognitive and metacognitive strategies when facing a text.

Field, Anderson & Carrell (1997) have divided cognitive strategies into two categories: Micro strategies, used by the reader individually while reading a text, include skipping an unknown word, guessing meaning from context, translating the word or phrase into L1, formulating questions, using context to build meaning and aid comprehension, among others. Macro strategies, on the other hand, are a group of strategies used before, during and after reading in order to activate previous knowledge and promote interaction with the text. Main idea comprehension, summarizing and note taking, schema and text mapping techniques are a few of these strategies. Schema has been defined in text linguistics and discourse analysis as "..the underlying structure which accounts for the organisation of a text or discourse·(Richards, Platt & Platt: 1997), while text mapping or diagramming "..is intended to display the structure of the text·the way the ideas and information are presented. {They} aim to help the student by setting out the relationship between parts of the text and showing what each part contributes to the whole.." (Nuttall, C, 1989).

Metacognitive strategies, on the other hand, are used not only in reading, but in any learning process and imply knowledge about cognition and the self regulation of cognition (Baker & Brown, 1984 in Grabe, 1991). They involve knowing about what we know. With regard to strategies, metacognition would entail knowing what strategies we use, when and how we use them. Examples of reading metacognitive strategies include recognising the more important information, adjusting reading rate, formulating questions about the information, recognising problems with information presented in the text, testing self comprehension and checking the effectiveness of strategies used, among others (Grabe, 1991). Consequently, with this type of cognition, the students should show awareness and understanding of the strategies and therefore select those to be used according to the kind of text and the reader's purpose. As stated by Anderson (1999) "..metacognitive awareness of the reading process is perhaps one of the most important skills Second Language readers can use while reading" (p.72).

In our daily interaction with our third trimester EST/FL reading course students at a Venezuelan university, we have come to realize that most of them are not aware of the strategies they use when reading in their L1 (Spanish). We thought that perhaps this was one of the reasons they could not use strategies efficiently when trying to read in the target language. We therefore decided to promote the use of cognitive and metacognitve strategies through Think Aloud Protocols, in our reading methodology. Another factor which influenced our decision was the positive relationship that has been found to exist between metacognitive knowledge and reading comprehension in

EFL. In a study carried out with 167 1st trimester EST/FL Venezuelan university students, Rodriguez (1995) found that there was a significant relationship between metacognitive knowledge and reading comprehension. Horibe (1995), in a study carried out with 43 Japanese university students found a "... clear relationship between reading comprehension examination scores and strategy use: .. the higher the scores, the more frequent the use of top-down strategies.." (p. 191).

The purpose of this article is to describe how we incorporated Think Aloud Protocols into our daily lesson plans, in our 3rd trimester English for Science and Technology classes, as a means of promoting students' awareness of the strategies they should use when they read. The final objective was to make them aware of the use of adequate reading strategies in order to become efficient and self-sufficient readers. We also discuss the results of a study carried out while using this technique.

Think-Aloud Protocols

Our first concern was to find out the strategies students used while reading and so they were asked to make a list. We were surprised to learn that most of them were unable to name more than three: finding the main idea, guessing meaning from context and using the dictionary, strategies which were explicitly taught to these students during the first two reading courses.

In light of this, we chose the Think Aloud Protocol, not only to find out the strategies that our students unconsciously used while reading, but also to make them aware of how these, and other strategies are used. Effective strategy use is an important step toward becoming a good reader. The Think Aloud Protocol is a technique used in investigating the reading strategies used by learners while completing a reading task. They are asked to think aloud and the researcher asks questions to find out the type of strategies they are using. We selected this procedure as we believed that the students were simply not aware of the strategies they could use while reading, and it appeared to be an excellent way to explicitly show them what strategies could be used, when, how and where, as well as to help them determine if they were using them correctly (Winograd & Hane, 1988). Think Aloud Protocols are an adequate way to explore the mental processes involved in reading and have usually been used in research for this purpose. We thought it could be an excellent tool for practical classroom use with our interactive methodology as Anderson (1999) states that "..getting students to think aloud and use verbal reports is a beneficial metacognitive activity" (p. 72).

Class Procedure

We designed our first lesson plan adapting some of the proceedures suggested by Anderson & Vandergrift (1996).

Lesson Plan (Class 1)
Objective: make students aware of their mental processes (strategies they unconsciously use) when they read a text in English - metacognition.

Activities:
1.- Play hangman or unscramble the word "METACOGNITION"
2.- Brainstorm on the word. Make students aware of the two components (cognition: knowledge) (meta: further). So metacognition is knowledge about knowledge. Give concrete examples. For example, ask them what they know about the Universe. Write answers on the board. Tell them that this is the knowledge they have about the Universe.

Relate the concept to READING. Brainstorm on the mental processes they use when they read. If this is difficult for them to understand, tell them that these mental processes are the strategies they use. Talk about the strategies they have already learned.

4.- Explain that you will do a demonstration of what goes on in your mind as you read a text. (We used the article "Spores in Space"). Ask them to follow the reading silently.

5.- Do the modeling. Slowly (See modeling paragraph in Appendix A).

6.- When you are finished ask the students what they have observed. Ask them if they had any other ideas about the text while you were reading.

7.- Through questions, get the students to tell you the strategies you were using. You can help with labels. Write the strategies on the board (See list of strategies found by students in Appendix B)

8.- Ask students to finish the following two paragraphs of the text in the following way: reading and writing down their thoughts (give ten minutes). An alternative is to have students work in pairs. One student reads and verbalizes his/her thoughts about the second paragraph while the other one writes. They then switch for the third paragraph.

9.- Divide the class into groups of 3-4 students. Ask them to share the strategies they used and as a group have them write a list of the strategies used by all. Monitor the activity, helping when needed.

10.- Each group shares with the whole class. Make a list of the strategies used. Discuss each one: when they were used, why and how.

11.- Ask students for their written list. You can use it as evaluated classwork, so students realize how important the activity is.

12.- Ask students how they felt during the activity and how useful they feel the technique is.

13.- Close the session by discussing the end of the article and the content.

Results

After analyzing students' written list (activity 11), we found that the most frequently used strategy seemed to be formulating questions, which was listed by 70% of the students. Guessing meaning from context was listed by 45.8%, looking for evidence to answer questions (41.6%) while relating texts to graphics and pictures and re-reading sections of the text were listed by 37.5% respectively. We also found that most of them did, in fact, use more strategies than they had mentioned during our previous research, as 22 different strategies were listed on the whole. Of these, 16 corresponded to top-down strategies* which indicates that students were using their knowledge of the world and their own experiences, interacting with the text to try to understand it better (see Appendix B). However, In the study done by Horibe (1995), the subjects used more bottom-up than top-down strategies.

We ended this first session by discussing how they had felt using this technique and how useful they considered it. Some of the comments were:

· "..We liked it a lot. It helped us to better understand the text. Also let us kind of critic it. It also provoked our imagination and guessing sense.."
· "..It is a good conditioning, but it comes with practice.." and, "This strategies made easier the reading and therefore it allow us a major comprehension about the reading's content...".

Some students said that they had felt uncomfortable because they "·had to slow down a process which is naturally done very quickly. ". However, those who used the strategy of re-reading , said they "·felt more comfortable after reading the text a second time". The majority felt that the technique had helped them to better understand the text and had freed them from using the dictionary.

On the other hand, three (3) students mentioned that it was difficult for them to concentrate on what they were reading because they had to verbalize what was going on in their minds and as a result, they gave isolated thoughts when they were asked to report on the text. This occurs because students are not able to record everything that goes through their heads, leaving many questions unvoiced and unanswered. Finally, these students said that they felt uncomfortable using the technique since they have been trained to consider reading a silent process and so they may not be inclined to continue using it.

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* In contrast to top-down models, bottom-up ones process information "..from letter features to letters to words to meaning. Bottom -up models emphasize what is typically known as "lower-level" reading processes"(Anderson, 1999, p.2).

After analyzing the results of our first Think Aloud session, we realized that not all the strategies had been used by everyone and some students were not inclined to the procedure. So we thought it necessary to first stress the importance of making students aware of the wider range of strategies at their disposal in order to incorporate them into their own repertoire. This we tried to achieve throughout the rest of the term by using different activities in which students were asked to evaluate their use of Think Aloud and reading strategies. By providing activities which actively involved the students' use of the technique, we could observe their weakness and strengths with regard to reading and we also provided activities which encouraged them to use the technique in order to improve their reading comprehension. In this sense, we used some activities suggested by Anderson & Vandergrift (1996).

· giving the class a reading passage and having one student read a line at a time, verbalizing thoughts and strategies used;
· asking one student to read a short passage and verbalize his thoughts while the rest of the class follows silently and the listeners can then contribute with their own thoughts;
· as a homework assignment students can be asked to make a list of the strategies they used while reading a take home reading text;
· teachers can hold one-on-one conferences with different learners that is, with students who do not feel motivated to share their thoughts aloud in public.

By midterm, when the students had certain practice with the technique, we decided to incorporate more evaluative tasks. Chamot & O'Malley (1994) suggest that students should develop awareness of their use of strategies (which strategies work for them and why) through self evaluation activities, such as:

· debriefing discussions after using strategies,
· self reports telling when they use or do not use strategies and why and,
· discussing why specific strategies are used for particular tasks.

We implemented the above activities in the following way: when students were given a reading comprehension worksheet, they were often asked to evaluate the difficulty of the questions and what strategies they had used to answer them and share their thoughts with a classmate. When an incorrect answer was given, the students were asked to re-read both the question and the text in order to determine why they had made the mistake and to try to find the correct answer. In this way, the students realized that the error was due to the lack of/or the incorrect use of a particular strategy. Over a period of time, they became more adept at seeing and correcting their own errors.

Another activity involved sharing the process they had used to arrive at the answer to a particular question. Students were often asked to orally explain how they had arrived at the answer and through discussion, the group as a whole was able to benefit from evaluating the manner in which they and their classmates used a variety of strategies.

The effectiveness of the Think Aloud Protocol in raising students' awareness of the use of reading strategies was seen at the end of the term when we compared the students' final grades with those obtained in their first evaluation. We gave two types of formal evaluations: Departmental type exams, which are constructed with validated and reliable multiple choice questions taken from the Language department's item bank, and quizzes which are integrative. Both the first departmental exam and quiz were given to our forty students (two sections) before the Think Aloud Procedure was introduced. As we can see in table 1 below, there was an increase in the students' grades for these final evaluations. (Dept 2 and quiz 2). The median for quiz 2 is very close to the mean while that of the second departmental exam is the same. The standard deviation was also lower for the final evaluations indicating that there was less variability in the answers. These final scores seem to indicate, on the one hand, that most students improved their reading comprehension and on the other, that the group as a whole behaved in a more homogeneous manner. While in the second quiz, all students (100%) increased their grades, on the second departmental exam, 76.9% of the students improved their grades and only 7.7% lowered theirs. The results of the second departmental exam were very important due to its special characteristics. Unlike the quiz, the departmental exams are made up of 20 short paragraphs, each on a different theme, with a multiple choice question aimed at evaluating specific areas of reading comprehension. This type of exam also carries a heavier psychological burden than the quiz and most students tend to lower their grades on this exam. So, any improvement in this evaluation is considered important.

Table 1: Results from evaluations

	Dept. 1	Dept.2	Quiz 1	Quiz 2
Mean	4.5	5.5	12.73	15.99
Median	4	5.5	13.3	15.63
Standard deviation	1.33	1.14	2.05	1.73

Departmental exams were scored over 10 and the quizzes over 20.
passing grade: D.E. 05   Quizzes 10
N=40

These results seem to indicate that on the one hand, students' reading comprehension can improve when they are aware of and can evaluate the strategies they actively use while reading. On the other hand, Think Aloud Protocols can be used, not only in research, but also as an effective classroom tool in the process of raising awareness of the use of reading strategies.

Advantages of Think Aloud Protocols

Although the main disadvantage of this technique is that readers may not be able to verbalise all their thoughts as they read, as mentioned by some of our students, there are many advantages. The Think Aloud Protocol allows the teacher to better understand the reading comprehension problems that a student might face. Horibe (1995) says that " ...it can provide a more direct view of reader's mental processes than other research methods.." (p.182). This technique is a more direct way of making students aware of the internal processes they use when reading. It can be beneficial by showing the strategies that good readers use to solve their own reading problems. It is a new experience for the students and makes understanding the text more interesting. It also helps them to realize that each person uses different strategies and that they can also benefit from each of them. Anderson (1999) points out that verbal reports are an effective way of making students realise the different ways the same text can be read and understood by different readers.

In conclusion, based on the results of this classroom experience, we believe that the Think Aloud Protocol seems to be an excellent procedure for teachers and students. Teachers will find that this technique is an excellent way of finding out the reading strategies their students use. With this knowledge, teachers are in a better position to expose their students to the wider range of strategies at their disposal, helping them to evaluate the best one to be used when reading. This is especially important when reading in a foreign language. By using the Think Aloud Protocol students may become more confident readers as they evaluate each kind of strategy and may be better prepared to confront any text. As the scores show, our students did improve their reading comprehension after being exposed to this technique. It is, however, not our intention to generalise our findings since this was classroom based research intended to find a possible solution to a reading comprehension problem faced by our students. Nevertheless, we believe that more research is necessary in this area, perhaps with the use of control groups.

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Appendix A
Modeling Paragraph*
Spores In Space
Creating an interstellar environment

* Teacher's thoughts are represented in parenthesis, in bold letters).

(What does this title tell me? Spores remind me of ferns and how they reproduce, so it might be related to life in space.) (The drawing has nothing to do with the title. They may talk about an experiment and the drawing is the device used for it.)

At the turn of the century, **(which century? Probably the 19ᵗʰ century. let's see)** The Swedish chemist and physicist Svante August Arrhenius outlined **(the verb is in the past tense, so I was correct it was referring to the 19ᵗʰ century otherwise it would have been in the future tense)**, the principles of Panspermia **(Panspermia, what is it? It must be a theory because of its location in the first paragraph. It might be the topic of the article, so it has to be defined somewhere)** the theory that life was transported from solar system to solar system through interstellar **space (Oh, it sounds interesting! So I was correct, the article has to do with life. Let's see what evidence they give).** Since then, **(when? oh yes, the end of the 19th century, I wonder what year it was),** various scientists, arguing **(they were probably against the theory)** that the earth was too young for life to have evolved here, (this is one evidence for the theory. I was wrong thinking that the scientists were against the theory) have carried the torch. **Iin other words, they have been the first to study the theory. let me read the whole paragraph again.)········(Ok. Now let me con- tinue).**

Now, **(Ok. They've started talking about the past and in this paragraph about the present)** astrophysicists Peter Weber and J. Mayo Greenberg, writing in Nature **(probably a scientific journal and these people are two of the scientists they were talking about in the first paragraph, they have carried the torch),** have placed Arrenius's ideas **(he is the one that outlined the principles of panspermia)** in

a modern astrophysical context" (**I wonder what they mean by this**). Arrenius, they say, believed that solar radiation pressure could drive microorganisms into interstellar space with enough speed to reach another star (**Ok. Now we have the principle of Panspermia according to Arrenius. They will probably present now their new "astrophysical context"**) but he (**that is Arrenius**) didn't consider that many aspects of space - especially ultraviolet cosmic rays, low temperatures and a vacuum - are hostile to life. (**They found a flaw in the principle. It could be interpreted as if they were against it. But according to what was stated before, they might have found a way to overcome this flaw and that is why they say they have put Arrenius' ideas in a new astrophysical context**).

Appendix B
Strategies used by Teacher
(list made with student's help)

MICRO STRATEGIES
- use text features (title-subtitle-graphic)
- use of previous knowledge
- formulate questions
- note key words
- recognize thesis or topic sentence (theme)
- make inference/verify inference
- predict what will come next/verify prediction
- paraphrase
- react to text
- re-read sections of the text
- understand the relationship between parts of the text
- identify grammatical function of words

Appendix C
Strategies used by Students in the First Class

Strategies	%	Type of Strategy
Formulating questions	70	TD
Guessing meaning from context	45.8	BU
Looking for evidence to answer questions	41.6	TD
Relating text to graphics or pictures	37.5	TD
Re-reading sections of the text	37.5	TD
Predicting	29.1	TD

Strategies	**%**	**Type of Strategy**
Formulating and verifying hypothesis	25	TD
Paraphrasing	25	BU
Making conculsions	25	TD
Reacting to texts	20	TD
Using previous knowledge	16.6	TD
Visualizing	12.5	TD
Relating parts to whole	12.5	TD
Looking for the main idea	8.3	TD
Using the dictionary	8.3	BU
Using grammar for comprehension	4.1	BU
Doing a fast first reading	4.1	TD
Skipping unimportant words	4.1	TD
Using key words	4.1	BU
Sharing ideas with classmates	4.1	TD
Making inferences	4.1	TD
Using text features (italics, quotation marks etc)	4.1	TD

N - 40 students
TD - Top down strategy
BU - Bottom up strategy