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Critical Thinking, Autonomous Learning and Metacognitive Strategies in ESP Science Teaching

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Abstract: ***Teaching and curriculum involves not only adhering to the teaching content, but the teaching methodology, learning strategies and the changed relationship between students and teachers. The purpose of this paper is to suggest that what is needed for ESP in science particularly is a different orientation to English study. There is a shift of the focus of attention from the grammar to the communicative properties and functions of language. Difficulties students encounter arise not so much from a defective knowledge of the system of language but from the unfamiliarity with English use and the adequate rhetoric used to convey scientific facts. It is suggested that in teaching ESP learning strategies should play not only important but a vital role. Accordingly, autonomous learning and metacognitive strategies are suggested as basics for teaching and learning ESP and especially ESP in science.***

Keywords: metacognition, science, process, ESP

1. Introduction

English for specific purposes (ESP) is a movement based on the proposition that all language teaching programs should be tailored to the specific learning and language use needs of identifying groups of students After the Second World War English became the accepted international language of technology, science, and commerce, it created a new generation of learners who knew specifically why they were learning the language. In fact there was a pre-determined goal in their learning English. Whereas English had previously decided its own destiny, it now became subject to needs, and demands of people other than language teachers. Dovey (2006) states courses which prepare students for the workplace in specific ways can be expected to have purposes quite different from those of discipline- based courses and can also be expected to introduce new questions. ESP also became an important part of English –as-second language teaching in the 1970s and 1980s, probably as a direct result of the introduction of communicative teaching curricula. Its main drive was practical, driven by the increasing numbers of people around the world who needed English for clearly defined reasons such as reading academic textbooks or transacting business (Hutchinson and Waters, 1987). It is suggested that ESP could easily be outlined based on the sorts of texts that learners need to become familiar with, or the needs-related nature of the teaching (Swales, 1985). The early analyses of ESP texts took the form of frequency counts of structures or verb forms, but such analyses only provided descriptions and had little or no explanatory force. These limitations, together with the increasing importance of the communicative aspects of the language and an increasing interest in linguistic use rather than form, led to researchers using rhetorical or discourse analysis methods to discover the main characteristics of texts in different academic fields (e.g. Widdowson, 1979). During the late 1970s ESP course designers started to carry out a needs analysis of their students' future linguistic requirements. These needs analyses were often expressed in terms of notions and functions (Wilkins, 1976) and the most celebrated model of such a needs analysis are described by Munby (1978) in his communicative syllabus design in which he presented a system for devising appropriate syllabus specification from adequate profiles of communicative needs. These profiles included the purposes of communication, the communication settings, and the language skills, functions and structures required.

1.1 Statement of the Problem

An ESP teacher lives with the question whether an English teacher or the specialists from the field should teach an ESP. Some students think that ESP is a new label for GPE and nothing else. For them this is invented by English teachers to make students interested in English programs. They believe that their instructors in their field will be more successful to teach ESP courses even not being familiar with English teaching and learning theories. For some others having knowledge in the field is not sufficient for an ESP Instructor, they should have a good command in general English and they should be familiar with the basic principles and teaching and learning theories.

1.2 Review and Discussion

To make things clear it is better to have a brief look at some definitions and explanations by some specialists in the field to support the idea that ESP is not the same as EGP. One of the generally accepted definitions refers to Hutchinson and Waters. What is the difference between the ESP and General English (EGP) approach? Hutchinson and Waters 1987:53) answer this quite simply, "… in theory nothing, in practice a great deal". This definition by Hutchinson and Waters raises one important question. If in theory there is no difference between ESP and EGP, what is the theoretical justification

for ESP? It seems that without a theoretical justification to ESP there will be no acceptable rational for such a course. But Widdowson (1983) attempts to theorize ESP and this can be followed in his works under two interrelated headings: Learning purpose and Language use. For Widdowson GPE is no less specific and purposeful than ESP. What distinguishes them is the way in which purpose is defined, and the manner of its implementation. Based on this definition there are two interpretations from learning purpose. One might be regarded as objective- oriented learning and the other as an aim-oriented one. In ESP Specification of objective is equivalent to aim that is a training operation and deals with the development of restricted competence. Whereas, in the GPE Specification of objective is not equivalent to aim but it leads to aim that is an educational operation and deals with the development of general capacity. The following quotation (Widdowson, 1983) clarifies the point:

ESP is essentially a training operation which seeks to provide learners with a restricted competence to enable them to cope with certain clearly defined tasks. These tasks continue the specific purposes which ESP course is designed to meet. The course, therefore, makes direct reference to eventual aims. GPE, on the other hand, is essentially an educational operation which will seek to provide learners with a general capacity to enable them to cope with undefined eventualities in the future. (p.6) To suggest his model of language use, Widdowson (1983) criticizes the two models of idealization, registers analysis and needs analysis and suggests his own model of idealization.

1. The register's analysis approach is a kind of idealization that involves the dissociation of linguistic forms from their communicative function in discourse. In fact the specification based on register analysis does acknowledge the pedagogically necessary distinction between aims and objectives. It rests on the assumption that a definition of objectives in terms of linguistic terms will provide for the subsequent satisfaction of communicative aims. That is to say that the imparting of linguistic competence will enable the learner to develop communicative capacity under his own steam. In this respect, it allows for learning to take place beyond the limits of the teaching input. So it is based on educational theory.

2. The needs analysis approach is a kind of idealization that seeks to retain the communicative value of linguistic elements and analyses language into its notional and functional. What this needs analysis approach seeks to do is to bring aims into closer approximation to objectives. Here, findings that emerge from needs analysis characterize aims. This is, in fact, the orthodox view of ESP course design. This idea can also be followed in methodology literature where ESP is considered as the natural product of a Notional functional approach to language teaching. Richards and Rogers (2001) state that a notional functional syllabus would include not only elements of grammar and lexis but also specify the topics, notions, and concepts the learner needs to communicate about. The English for specific Purpose (ESP) movement likewise begins not from a structural theory of language but from a functional account of learner needs.

Widdowson challenges this orthodox view of ESP and he suggests a discourse approach to ESP. For him what we must look for is a model of language, using which does not simply atomize the user's behavior into components of competence, but which accounts for the essential features of the discourse process. At the same time, such a model should provide us with the means of characterizing ESP at different points on the scale of specificity and consistent with the distinctions I have proposed in the preceding chapter. The model therefore has to lend support to the concepts of training and education, of competence and capacity, of aims and objectives, and so give us a theoretical basis for ESP (Widdowson 1983:34). For Widdowson the register analysis and needs analysis approach to ESP focus on systematic knowledge whereas in his suggested discourse process approach both systemic knowledge and schematic knowledge are involved.

Hutchinson and Water (1987) claim that ESP must be seen as an approach not as a product, ESP is not a particular kind of language or methodology, nor does it consist of a particular type of teaching material, it is an approach to language learning, which is based on learner need. It seems that in the three approaches stated earlier (register analysis, needs analysis and discourse processing approaches) the idea of what to learn plays an important role and how to learn is not the main concern. The following quotation from Hutchinson and Waters (1987) is to support this idea. …. But our concern in ESP is not with language use –although this will help to define the course objectives our concern is with language learning. We cannot simply assume that describing and exemplifying what people do with language will enable someone to learn it. If that were so, we need to do no more than read a grammar book and a dictionary in order to learn a language. A truly valid approach to ESP must be based on an understanding of the processes of language learning." (p.24)

There is a need to an attempt to seek possibilities of fostering learner autonomy in the ESP course design in the universal arena EFL teaching context. This importance can be followed by applying metacognitive strategies for ESP learning. In fact, an autonomous learner should be able to manage or regulate the process of learning which involves making decisions as to what to learn, how to learn, when to monitor, and in what way to evaluate success or failure of learning (Wenden 1987; Holec1987; Cotteral 2000).

2. Goal Oriented and Process Oriented Syllabus

Generally speaking, the process of deciding what to teach is based on consideration of what the learner should most usefully be able to communicate in the foreign language. In ESP, According to Mackay and Mountford (1978) when needs are clear, learning aims can be defined in terms of these specific purposes to which the language will be put, whether it be reading scientific papers or communicating

with technicians on an oil rig. The result is that almost immediately, teaching can be seen to be effective in that the learner begins to demonstrate communicative ability in the required area. What Mackay and Mountford suggest is only the realm of Goal-oriented syllabus and there is no place to processes-oriented one in such an interpretation of the learner needs.

We know goal-oriented approach focuses on the selection of language by reference to the ends of learning, but the process-oriented approach focuses on the presentation of language by reference to the means of learning and allows the ends to be achieved by the learner by exercising the ability he or she has acquired. The first approach assumes that the completion of a course of instruction marks the completion of learning and that all that is left for the student to do is to apply this ready-made knowledge. The second approach assumes that learning will continue beyond the completion of instruction since the aim of such instruction precisely is to develop a capacity to learn: it does not itself realize any special purpose, but provides the learner with the potential for its realization.

In practice, syllabuses in which the selection and grading of items was carried out on a grammatical basis fell into disfavor because they failed the adequacy to reflect changing views on the nature of language. In addition, there was sometimes a mismatch between what was taught and what was learned. Some SLA researchers have claimed that this mismatch is likely to occur when the grading of syllabus input is carried out according to grammatical rather than psycholinguistic principles, while others suggest that the very act of linguistically selecting and grading input will lead to distortion. Moreover it seemed that functional-notional principles would result in syllabuses which were radically different from those based on grammatical principles. However, in practice, the new syllabuses were rather similar to those they were intended to replace. In both syllabuses, the focus tended to be on the end products or the results of the teaching / learning process.

According to Widdowson (1983) the absence of distinction between aims and objectives leads to an ambiguity in the expression “learner needs”. On the one hand, it can refer to what the learner has to do with the language once he has learned it: in this sense it has to do with the aims. On the other hand, it can refer to what the learner has to do in order to learn: in this sense, it relates to pedagogic objectives. If one follows a goal-oriented approach one needs to take one’s bearing from models of linguistic description, since these will define the units of course content.

A process-oriented approach, on the other hand, can only be pursued with reference to some idea about how to learn. In this regard, according to Atay (2007) the interest in the strategies has paralleled a movement away from a dominantly teaching –oriented perspective to one that emphasizes the learner's active role in the learning process. Thus, if ESP is an approach not as a product, it must be an approach to language learning. And here, Learning strategies and activities should play a more important role than selecting and grading appropriate materials to meet the students' needs.

2.1 Learner Autonomy

Holec (1987) defines Learner autonomy as the ability to take charge of one’s learning. It is good for teachers introducing such key concepts as ”learner-centeredness” and Learner autonomy” and their theoretical underpinning, and stress the importance of learning how to learn so that students would be psychologically prepared and are likely to cooperate. As a learner-centeredness is one of the tendencies that support autonomous language learning, students should be given a clear explanation as to what it means, how it is conducted, and what benefits could be gained through this approach. Aebersold and Field (1997) define the term” student-centered and describe its advantages as the following:

Courses in which the students have some degree of control over what goes on in the course and how it occurs are considered to be student-centered. Giving students some control over their learning process has many benefits: It makes them feel confident; it puts some of the decision making in their hands; it puts the responsibility for learning in their hands; and over the long term it builds independence and self-reliance so that they can read on their own without being dependent on teacher direction and supervision. It activates the students’ own learning spirals. (p. 37).

Even giving students’ freedom to choose materials is not only compatible with the theory, but also satisfies learners’ needs. A better understanding of the theory would stimulate learners’ interest and motivation to practice autonomous learning.

Thus consciousness raising was chosen as the first measure to implement the innovation. To transfer the responsibility of selecting materials to learners is supported by (Hollec, 1987, Vitori, 1995), because it stimulates their interest, enhance the do-it-yourself ability. Engaging learners in activities of selecting, preparing and presenting materials could be considered creative because these activities involve problem–solving and decision –making.

2.2 Cognitive Strategies

The term cognitive strategy refers to specific measures or steps that learners take in order to fulfill learning tasks (O’Malley and Chamot 1990). Literature in reading research has shown that cognitive strategy use can facilitate understanding and successful learners seem to be differentiated from less successful ones in terms of strategy use. Similarly learners who possess summarizing skills (Kintch and Van Dijk 1978) have improved comprehension of the texts and increased recalls.

2.2.1 Monitoring

Monitoring refers to both learners’ identifying learning difficulties and pointing out shortcomings of the program so that decision could be made as to what to do about it (Rubin 1987). As the shift of responsibilities from the teacher to the learners takes place, it is important for the learner to do self-evaluation and provide feedback to the program in order to

regulate learning process. Nunan (1997) suggests that monitoring plays an important role in informing the learner of the problems encountered during the course of learning. Thus the course should intend to raise learners' consciousness to monitor their learning process.

2.3 Metacognitive Strategies

Metacognition is cognition about cognition or thinking about thinking. Thinking can be about what the person knows and what the person is currently doing. Metacognition is deliberate, planned, intentional, goal directed and future-oriented mental processing that can be used to accomplish cognitive tasks (Flavell, 1971). Metacognition involves active monitoring and consequent regulation and orchestration of cognitive processes to achieve cognitive goals. As metacognition involves an awareness of oneself as an actor , a deliberate Store and retrieval of information, it may be reasonable to reserve the term metacognitive for conscious and deliberate thoughts that have other thoughts as their objects (Hacker, 1998). According to Block (2004) metacognition can be defined as a reader's awareness of (1) what he or she is thinking about while reading, (2) what thinking processes he or she initiates to overcome literacy challenges, and (3) how a reader selects specific thinking processes to make meaning before, during, and after reading.

Auerbach and Paxton (1997), define metacognition as "knowledge of strategies for processing texts, the ability to monitor comprehension, and the ability to adjust strategies as needed" (pp. 240-41). Research studies (Duell, 1986) seem to confirm that as children get older they demonstrate more awareness of their thinking processes. Metacognition is relevant to work on cognitive styles and learning strategies in so far as the individual has some awareness of their thinking or learning processes.

Cognitive strategies differ from metacognitive strategies in that they are likely to be encapsulated within a subject area (e.g., EFL), whereas metacognitive strategies span multiple subject areas (Shraw, 1998).Cognitive strategies are, for example, making a decision, translating, summarizing, linking with prior knowledge or experience, applying grammar rules and guessing meaning from texts (e.g., O'Malley and Chamot, 1990). Metacognition refers to awareness and control of cognitive activities. Empirical studies show that successful learners differ from less successful ones in both the quantity and quality of cognitive and metacognitive strategy use (e.g., Oxford, 1989). The literature of metacognitive strategies in reading comprehension reveals that poor readers in general lack effective metacognitive strategies and have little awareness on how to approach to reading. They also have deficiencies in the use of metacognitive strategies to monitor for their understanding of texts In contrast successful L2 readers know how to use appropriate strategies to enhance text comprehension (e.g., Pitts, 1983).

Similar to experiences about metacognitive strategies with intermediate-level students in ESP science courses worldwide, we also invited feedback from the students on their impressions and thoughts of the strategies covered during the terms. What follows are an indication of students' retrospective comments on the efficiency of these strategies in ESP science class.

1. Now, I think my brain is more active in reading as if, I read with my brain rather than my eyes.

2. After previewing I can decide how I will deal with any particular text, and which other strategies I am going to follow to have better comprehension.

3. The strategies you applied made me conscious and active I used to read a text word for word until then, being afraid to misunderstand the contents. Now I'm trying to skip as many words as possible even when I am going to read about something not familiar, and I am going to deal with the text I have already had quite a few knowledge.

4. We immediately think about the topics help us to understand the contents of articles.

5. We can improve our reading speed by predicting the following contents.

6. We can associate our knowledge we have concerning the topics and it can help to make our learning much easier.

7. Finding key words in any text was an interesting technique. I think relying on Key words is more helpful than relying on the structure in reading a text.

8. I think it is easier to ask questions when I read something I have prior knowledge with because I have something to base in to ask questions.

9. Now, I have a critical reading and I can use my background knowledge.

10. Using algorithms helps me grasp scientific facts.

11. If you give me words that I can use I am sure I am in the right track.

12. The list of most frequently used academic words helped me a lot.

3. Conclusion

We conclude that ESP generally and in science particularly, is an approach to language teaching which aims to meet the needs of particular learners. This means in principle that much of the work done by ESP teachers is concerned with designing appropriate courses for various groups of learners. It seems reasonable enough to assume that a specification of language needs should define the language content of a course designed to meet such needs. Here "learner needs" is open to question. In fact two different interpretations may be extracted from learners' needs. It may refer to terminal behavior, the ends of learning or it may refer to what the learner needs to do to actually acquire the language.

What is actually needs analysis in ESP science class? Obviously it is not just grammar and style but staple science words lists, frameworks with functional language actually used in labs, in reports, in scientific communication because

we deal with material world and not the poetry, and certainly not with the Shakespearean sonnets. In recent year, some applied linguists have shifted focus from the outcomes of instruction, i.e. the knowledge and skills to be gained by the learner, to the processes through which knowledge and skills might be gained. Although specification of language needs is necessary for ESP course and it will be useful for selecting and grading materials, in teaching ESP, Learning strategies should play an important role. Accordingly, Autonomous learning and metacognitive strategies are suggested as the two basic essentials for teaching and learning ESP. Finally, if we limit teaching ESP to what to learn and forget how to learn, it will be safe to claim that familiarity with teaching and learning theories is not an essential for ESP teacher, otherwise it should be regarded as a sin qua non for ESP teacher.

4. Implications for Further Development

There are several implications emerging from the research in terms of future policy and practice in continuing professional development of ESP science teachers. The most effective in-service content seems not to be that which focuses on knowledge at the teachers' own level, but rather that which deals with subject knowledge in terms of how this is taught to students. There is little evidence that the effective teachers of literacy have an extensive command of a range of linguistic terminology. However, it seems likely that having a greater command might help them further improve their teaching of scientific literacy. Such terminology could be introduced (or reintroduced) to teachers not as a set of definitions for them to learn but as the embodiments of linguistic functions with a strong emphasis upon the ways these functions might be taught.

As with experienced teachers, developing cognitive, metacognitive and affective strategies involves more than simple practical experience. Novice teachers also need to develop an awareness of why and in what circumstances they might employ particular teaching approaches so as to enhance the application of the above mentioned strategies. They need not only procedural knowledge about scientific literacy teaching but also conditional knowledge. The development of this knowledge demands the opportunity to compare and contrast their experiences with those of others and thus further their proficiency in specific domain knowledge.

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