FURTHER RESULTS OBTAINED IN THE APPLICATION OF A NEW DIDACTIC METHOD TO TEACH IN ENGLISH DIFFICULT OR COMPLEX TECHNOLOGICAL SUBJECTS

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Abstract: - This paper describes a method used to improve education in the Telecommunication' Engineering field, by applying PQRST methodology to the educative environment. This methodology has been successfully applied to a subject which has traditionally been considered as difficult within the Telecommunication Engineer teachings. Results confirm student's learning improvement when attending these classes, as well as the popularity of this educational methodology among them .Main objectives pursued are described, as well as developed activities during academic year 2004-2005 and 2005-2006 in, introducing, finally, the conclusions obtained by the application of this methodology. We have compared the results obtained the previous academic year 2004-2005 in which the PQRST method was applied in Spanish with the results obtained this year 2005-2006 in applying the same method in a course taught exclusively in English.

Key-Words: - PQRST, didactic technique, educational, infrastructure, didactic technologies, information technologies education.

1   Introduction

This report is based on a series of activities carried out as part of a Research Project on Innovation in Teaching which was undertaken during the current academic year, 2005-2006 in the Telecommunications Engineering degree program within the Polytechnic Institute at the UEM.

During this academic year the UEM decided to create a pilot program in which one of the subjects forming part of the curriculum of Telecommunications Engineering, Electronic Communications, would be taught exclusively in English. This decision included both those parts of the course which dealt with the theoretical aspects of the subject as well as the more practical classes with greater student participation.

Within the Telecommunications Engineering program this particular subject has traditionally been considered as quite difficult for students, the proof being that the results of the final exams were clearly unsatisfactory. This difficulty inherent to the subject was further compounded by adding the additional burden of teaching it in English to a group of students whose mother tongue was by and large Spanish.

Faced with this double academic challenge it was decided to take advantage of the experience gained the previous year in which this same subject had been taught using an innovative teaching method known as PQRST. The excellent results obtained through the use of this method offered the necessary encouragement to put it in practice again but this time teaching the different stages of the method in the English language.

This new teaching method employs techniques which are substantially different from those used in traditional teaching methods and which at the same time facilitate adapting to the new educational technique which will be implemented progressively with the arrival of the new European Higher Educational Space.

In section three of this report the objectives set by the authors are presented. The activities developed in order to reach these objectives are listed in section four. The document finishes with a series of conclusions resulting from this pilot experience. In addition a series of appendices are included which we feel enrich the document but whose inclusion in previous sections could interrupt the smooth reading of the document itself.

2   Preliminary Considerations

It is a well known fact that in all university degrees programs there are courses which are usually thought to be especially difficult or complex for students.

This is often the case in certain subjects in engineering degrees. A simple analysis will lead us to some of the reasons why a course can be classified as "difficult":

- The material covered in the course is complex in itself.
- The syllabus is particularly dense in relation to the time available to cover the material included.
- The level at which the teacher pitches the class.
- The level of background knowledge required to study the material being taught is quite high.
- The level of preparation students must have in order to master the material is quite high.
- The time available to deal with practical examples and problems to be solved is limited in comparison to the breadth of material in the syllabus.

The combined results of these factors leads to, in some courses, low academic performance and unsatisfactory final results (measured in terms of number of students who pass the courses).

Given the evolution of teaching practices in Spain towards those sanctioned by the European Higher Educational Space (EHES) several of the points mentioned above take on a critical dimension particularly since the educational model incorporating greater student participation in the classroom as proposed by the EHES could face serious difficulties in addressing all of these points in a coherent manner. Furthermore, due to the continual increase in technical and commercial exchanges, it is increasingly necessary to assure the proper training of university students in the area of foreign languages. With this objective in mind, it became clear that one way to complete the preparation of our Telecommunications Engineering students would be to teach one of the year-long courses forming part of the curriculum exclusively in English.

Due to organizational needs within the Polytechnic Institute it was decided that the course which would be most appropriate for this learning-in-English experience would be the Electronic for Communications course. This particular course had been designated, due to the inherent complexity of the material it covers, as a course to be taught in Spanish using the PQRST method.

2.1 The PQRST Method

This method of learning was Developer in the 1980's in the United Status as an effective way of analyzing and studying materials considered to be particularly difficult for students and was used successfully in such institutions as NASA, other research centers and universities within the country.

The methodology used involves the systematic application of a series of stages or steps

- P   Preview
- Q   Question
- R   Read
- S   State
- T   Test

The systematic application of this method was considered as a possible way to improve students' understanding and assimilation of material taught in difficult subjects and, at the same time, a way to greater final student performance without sacrificing material included in the syllabus.

In applying the PQRST method, the teacher takes responsibility for the stages labeled Preview and Read (in this case in lecture classes) and leaves the element of student-teacher interaction for the stages labeled Question, State, and Test.

The stages which are expected to offer greater benefits are the last two where the student should be able to see for himself the degree of mastery of the material he has reached.

The effectiveness of the procedure is based on the fact that it is believed that a student begins to show his mastery of a particular topic when he is capable of devising problems of an increasingly complex nature which he himself will have to solve.

2.2 Body of research

The central part of this research project consisted of applying, for the second consecutive year, the PQRST method to the teaching of the previously mentioned course where the traditional difficulties inherent to the subject matter were further complicated by the fact that it was now to be taught exclusively in English.

The research carried out consisted of the application of the five stages of the PQRST method in English including the theory-based lecture classes (R stage)

The objective final results were obtained through written tests and performance assessment of the students in their oral presentations in English which corresponded to the S and T stages.

3 Goals and Objectives

The research carried out during the academic year 2005-06 had as it primary objective:

Compare the results obtained the previous academic year in which the PQRST method was applied in Spanish with the results obtained this year in applying the same method in a course taught exclusively in English.

Through the simple application of this new teaching method it was hoped that the following academic goals would be reached:

1. Encourage the student to improve their previous background knowledge of fundamental concepts through the Q (Question) stage. During this stage any gaps in background knowledge are easily detected.

2. Motivate the Students to actively reflect upon the material being studied prior to its presentation in class and to search for explanations or solutions on their own.

3. Prepare the students to participate in the R (Lecture class) stage with an inquiring attitude towards the material being explained in class.

4. Motivate the students to deepen their understanding through a period of reflexive study (S – stage) which will serve to prepare them for the final stage.

5. Encourage the students to test their degree of mastery of the material by posing increasingly complex problems which they themselves will solve.

6. Encourage the development of autonomous learning in students principally during the State and Test stages.

7. Improve student performance as reflected in the final results obtained by the students.

8. And finally, to confirm that by applying this new teaching method, the teaching of a particular course in English does not necessarily lead to a lessening of the student's ability to absorb the material being taught.

Further benefits resulting from this research project will be discussed later.

4   Project Description

This research project was carried out during the academic year 2005-06 in the Telecommunications Engineering degree offered by the Universidad Europea de Madrid.

As has been previously indicated the particular subject chosen was Electronic Communications, a course whose degree of difficulty corresponds to the following factors:
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1. A particular dense syllabus
2. A reduced amount of time to cover the material included in the syllabus
3. The need for a broad base of prior knowledge in order to be able to master the material
4. A high degree of abstraction and a relatively large percentage of math based contents
5. Limited time available for problem-based study and practical exercises

In total 19 students were involved in the study, a number which we can consider to be statistically significant.

In order to be able to reach coherent conclusions and to carry out a valid comparison, the subject was taught with no changes in the variables in place during the previous years (the same teacher, the same syllabus, the same testing system, etc.); the exception being the fact that it was taught in English but using the PQRST teaching method.

Through the application of this system satisfactory results were obtained, as will be seen, in terms of student motivation and a marked improvement in the degree of understanding and the performance of the students at the end of the course in spite of the added difficulty of the new language.

The quantitative results of this research were measured by comparing the percentage of students who passed the course the previous year to that of this year and by doing the same with the average final grade obtained in each year. Given the fact that there was no change in the course syllabus, this comparison measures the degree of improvement in the results obtained through the use of the PQRST method in English.

The qualitative result was measured through the use of opinion surveys completed by students at the end of the course.

Student progress was monitored on a continuing basis with the class being divided in small groups of two or three students. In basic terms the method was applied in the following way:

1. The PQRST method was used in each of the sections that make up the syllabus of the chosen subject (normally 10-12 sections)
2. In covering the material contained in each of the sections all five stages P,Q,R,S and T were used.
3. After each section of the syllabus had been covered in class the students were given up to two weeks to prepare an oral presentation on the material.
4. This presentation was done in small groups and in English with the content focusing on the development of the Q,S, and T stages with special emphasis on this latter stage.
5. To encourage the students to be especially thorough when working on the T stage it was agreed that some of the exercises included in these presentations would be included on the final exam.
6. In order to offer the students a model upon which they could base their presentations a full PQRST session led by the teacher was held prior to the beginning of the students' presentations.

5 Conclusions

This project on innovative teaching methods, put into practice in the Telecommunications Area of the UEM and explained in this report, was designed to develop a teaching method which would allow students to better comprehend and internalize the material taught in a course traditionally considered difficult with the added difficulty of being taught in English.

The more important conclusions reached regarding the application of the PQRST method in the particular stage is:

1. The material covered in the course was taught covering the same amount of material and with the same degree of difficulty as the previous year and the students were as motivated to study it as those of the previous year.

2. Even though the material was taught in English it was not necessary to show down the rhythm of the classes and the entire syllabus was covered over the course of the year.

3. It became apparent from the comments made by students in the class that they maintained the same degree of comprehension as was achieved in the previous year's class.

4. Proof that the understanding and assimilation of material was maintained can be found, as we will see, in the quantitative results.

5. The surveys conducted show that the panoramic view of each point in the syllabus given in the P (Preview) stage was considered to be the most interesting element of the method by 12% of the students. This is the stage which allowed them to see the details of the material they would be covering before they actually did so.

6. In contrast the Q (Questions) stage was considered to be the most valuable by 20% of the students. During this stage students had the opportunity to present and explore their own hypotheses thus setting the stage for further explanations that would follow.

7. Nevertheless, the T stage is the stage considered to be the most useful by the largest number of students, 41%. During this stage the students had the opportunity to demonstrate their depth of understanding of the material. It is also the most creative stage in the method and once mastery of material has been achieved it is the stage which produces the greatest satisfaction.

8. The fact that the final debate held in English as part of the PQRST method, in which the Director of English Language Programs collaborated, was so meticulously prepared and so professionally run by the students serves as proof of the interest aroused by the uses of the PQRST method in English.

9. The objective comparison of the results is shown in the following table:

	TRADITIONAL METHOD (Not PQRST)	PQRST METHOD TAUGHT IN SPANISH	PQRST METHOD TAUGHT IN ENGLISH
Academic Year	2003-2004	2004-2005	2005-2006
Passing grades for students who took final exam	60%	80%	78%
Average grade	3.8	4.6	5.0

QUESTION	YES	NO
Has the PQRST method encouraged you to improve your level of English?	94%	6%
Should the activities forming part of the PQRST method in English be taken into account when calculating the final grade?	94%	6%
Do you consider the PQRST method in English to be useful for your professional future?	100%	0%
Should the use of this method be continued in the future?	100%	0%
Do the activities carried out as part of this method represent added value in terms of your professional preparation?	100%	0%
Have your teacher been successful in transmitting their message?	100%	0%

- During the academic year 2003-2004 the course was taught using the traditional method of lecture classes and final exams. 60% of the students who took the final exam paced and the average grade was 3.8 on a scale of 1-10.

- During the academic year 2004-2005 the PQRST method was used for the first time but in Spanish. As can be seen there was a marked improvement in both the number of students passing the final exams and the average grade earned, proof of the effectiveness of the PQRST method.

- And finally during the current academic year 2005-2006 the course was taught entirely in English applying the PQRST method in English, naturally. As can be seen from the table the percentage of those students who took the final exam and passed is very similar to the previous year; nevertheless, the average grade rose by four tenths of a point.

The exit survey completed by the students included questions asking them to evaluate the method or its usefulness in the carrying out their professional duties.

A sample of the responses offered by the students follows. The full results of the survey are included in appendix B, the quantitative results of the surveys.

The results clearly demonstrate how the teaching of a course through the PQRST method, both in English and in Spanish, not only leads to fully satisfactory results but also that this method is accepted by the majority of the students involved.

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APPENDIX.
COMMENTS REGARDING THE QUANTITATIVE RESULTS OF THE SURVEYS:

1. The time the students dedicated to preparing their papers and presentations was mainly between 10 and 35 hours (35%).
2. 94% of the students found that these activities motivated them continue and even increase their English studies.
3. 88% of the students found working with a topic covered in class to be more useful than dealing with a general topic not specifically discussed in class, 12%.
4. The Test stage of the PQRST method was rated more positively by 41% of the students with the Question stage in second place with 20%.

5. A total of 94% of the students felt that these activities should be included in the grading criteria for the course.
6. In terms of the final grade, 70% of the students indicated that the weighting scale they favored was the proportion 2/8. 24% favored the proportion 3/7 for the weighting scale.
7. 100% of the students surveyed believe that these activities are useful for their future professional development.
8. 59% of the students believe that these types of activities should begin in the first year of university studies while 29% felt they should begin in second year.
9. A solid 100% believe that these activities represent an added plus in their preparation.
10. 94% of the students' families were very favorable toward these activities with only 6% expressing indifference and 0% rejecting them.
11. 100% of the students indicated that these activities should continue in the future.
12. All students surveyed, 100%, indicated that the teachers involved were successful in making them aware of the importance of English as the universally accepted means of communication in the business world today.
13. 94% of the students classified the experience as either very highly, highly, or moderately useful, with only 6% classifying it as of little use. .