INVESTIGATION AND MANAGEMENT OF DIVERSE CLASSROOMS OF HIGHER EDUCATION DUE TO DISCREPANCIES IN BACKGROUND KNOWLEDGE

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Abstract: This work identifies and addresses problems that are common in first year classrooms of the Department of Electronic Engineering at the Technological Educational Institution (TEI) of Athens. These classrooms are normally composed of different sets of students. The students are admitted trough different tracks and via different entry examinations. Furthermore, the diversity of the classroom is augmented due to the admission of students transferring from other similar regional departments and who have a significantly lower academic background than those admitted directly to the Department. Their performance in a rating test is directly related to their TEI entry grade. Transferees usually face progression difficulties. The course of action which has been adopted till today to support the weak cohorts of students is described. Last, the classroom's performance in a core module of the first semester is recorded and studied against their performance in the rating test. Additional classroom management action plan is provided.

1 INTRODUCTION

Many classrooms in the Higher Education Institutions reflect diversity in the student population in terms of background knowledge and academic level acquired during their previous training in high school. A classroom with students of different academic backgrounds and capabilities definitely constitutes a diverse classroom and its academic performance should be monitored by the academic community (Denig, 2004).

Students with limited academic background experience difficulties which bring them at a disadvantageous position, compared to students with solid background training, upon entering a new educational setting. Therefore, the Higher Education instructors sometimes find it difficult to deliver the material according to the prescribed timetable. This is particularly visible during the first semester of studies. A classroom with diverse student population is quite common in the first semesters of studies, therefore, a number of teaching strategies and methods have been developed to ensure equal learning opportunities for all students (Knight, Wiseman, 2005). It is essential that the instructor identifies the level of the students' background knowledge, prior to deciding on the optimum teaching method. This can be achieved by conducting a test including a set of questions on topics that the students are supposed to command through their previous training.

This particular exercise brings to light the difficulties that exist in the Department of Electronic Engineering of the Technological Educational Institution (TEI) of Athens, a department that usually reflects strong diversity of the admitted students. This is partly due to the fact that the students enter the Department having graduated from two different sorts of high schools, (and through separate entry requirements for each). This makes for a segmented cohort in terms of academic ability: the first cohort includes the students who have graduated from the General High School and have a satisfactory background in the core courses, i.e. Physics and Mathematics. The other cohort includes students who graduated from the Vocational High School, where a completely different curriculum of limited science courses is delivered.

An additional impediment for the first-year student population is the fact that the admitted students show a significant discrepancy in their

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performance in the National Entry Examinations, as a large number of students transfer from other regional Universities which have lower entry requirements. This means that the academic level of the transferees is substantially below than that of those admitted directly to the Athens Department through the National Entry Examinations.

This works aims at identifying the diversity of the first-year student population and at correlating this diversity with the following features:

1. The students' performance at the National Entry Examinations, according to which the students are admitted to the Department of Electronic Engineering of the TEI of Athens, or similar regional departments.
2. The students' performance at a rating test which checks the required background knowledge.
3. The students' performance of the final examinations of the module "Introduction to Electronic Physics" which is one of the core modules of the first semester of studies at the Department of Electronic Engineering.

Last, the authors suggest a course of actions to support those students who initially find it difficult to meet the requirements of the first semester of studies in the Department, through the development of an educational setting that enhances learning, assimilation of knowledge and critical thinking, thus enabling them to successfully continue their studies.

2 THE PROFILE OF A DIVERSE CLASSROOM

Four groups of students can be identified in the Department of Electronic Engineering of the TEI of Athens, thus constituting a diverse classroom in the first semester. The data presented concern a sample of 244 newly-admitted students, whose academic progression has been monitored for a period of three consequent academic years, i.e. 2007 to 2009. Table 1 describes these four groups of students. Two of these groups are divided to 3 subgroups, depending on the performance at the National Entry Examinations. Table 1 shows the percentage distribution of these groups and subgroups.

The students of the groups C and D have attended a different high school curriculum from that of the students of A and B groups. Furthermore, they have entered the Department trough different Entry Examinations. The main feature of the C and D student groups is the limited background in Mathematics and Physics. Also, the Entry Examinations for the C and D groups is focused on a couple of specialty modules, rather than emphasizing on Mathematics and Physics. Furthermore, the amount of knowledge obtained through these specialty modules is actually poor, as the material is only superficially covered. For example, although the students from C and D groups that enter the TEI Department of Electronic Engineering have attended introductory courses on Electronic Physics and Telecommunications, this does not prove to contribute to their smooth academic transmission to the Department.

Table 1: Groups and subgroups description, in a diverse classroom.

Group	Group description	Subgroup: Grade at the National Entry Examinations	Percentage Group / Subgroup
A	General High School Graduates	A1: >14/20 A2: 13-14/20 A3: 12-13/20	6% 19% 23%
B	General High School Graduates (transferees)	B1:11-12/20 B2:10-11/20 B3: <10/20	10% 7% 8%
C	Vocational High School graduates	14-16/20	19%
D	Vocational High School graduates (transferees)	10-14/20	8%

The background knowledge in Mathematics and Physics of A and B student groups is also inadequate, as the courses they have attended have only covered a narrow range of topics. Hence, they do not seem to command all basic concepts of Mathematics and Physics. All the above constitute a complex issue which the instructors have to address when teaching the first semester students. They have to take certain actions in order to facilitate all students to promptly adapt and assimilate the curriculum.

3 IDENTIFICATION OF THE PROBLEM

A rating test of multiple choice questions on Mathematics and Physics has been designed in order to address the particular and individual weaknesses of the newly-admitted students at the Department of Electronic Engineering of the TEI of Athens. The questions were simple and focused on basic and core knowledge which is deemed indispensable and is not supposed to be covered by the instructor during the first semester of studies. Two sets of multiple choice

questions - including pairs of crosschecking - (Ventouras, Triantis, Tsiakas & Stergiopoulos, 2010; Ventouras, Triantis, Tsiakas & Stergiopoulos, 2011), were used in order to ensure the credibility of the test results.

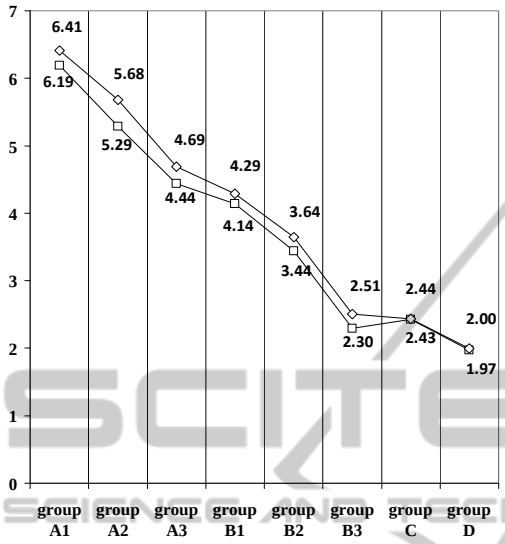

Figure 1: Average performance of students in the rating test, (□: Physics - ◊: Mathematics).

A special assessment algorithm has been drawn to best reflect the academic level of the examinee (Ventouras, Triantis, 2011). The test was divided into two units. The first unit is related to Physics, with emphasis on Electricity, while the second unit is related to Mathematics.

3.1 The Results of the Rating Test

The total number of students to undergo the test during the three academic years was 201. Fig. 1 presents the average grade in the test on a 10 point scale, while Fig. 2 shows the corresponding success rates (grade >5) for each student group. Fig. 2 also shows the percentage contribution of each student group/subgroup in the total number of students who took the rating test. Both figures depict the test performance for each test unit separately (Physics and Mathematics).

The results indicate a satisfactory performance only for group A, and particularly for the subgroups A1 and A2. The results of the rest student groups are disappointing and reflect a poor background in Mathematics and Physics among the newly-admitted students. A systematic discrepancy is also observed for all student groups regarding their performance in Physics and Mathematics, with the performance in Mathematics being considerably lower.

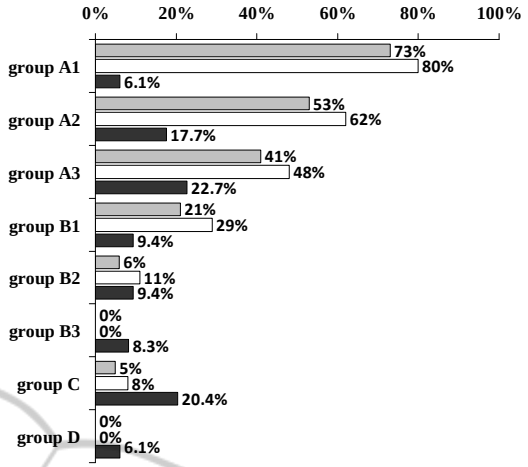

Figure 2: Success rates in the rating test (grade >5) for each student group (grey bar: Phys. test, white bar: Math. test, black bar: % contribution of group/subgroup in the total number of students who took the rating test).

This fact addresses the inefficiency of the Examination System via which the admission of undergraduate students to the Higher Educational Institutions is administered. It is worth to be noted that the range of material on which the students are examined for the Entry Examinations in Physics is quite narrow, and does not include topics such as Electricity and Optics, which results in a poor background of students admitted in departments of Electrical and Electronic Engineering. It should be mentioned that the instructors of the first semester of studies would expect the success rate to the test to definitely exceed 50%, given that it only required a basic academic level. A success rate of less than 50% indicates a substantial difficulty of these students to effectively attend the lectures of the first semester of studies. These students usually feel they lack the necessary academic level, get quite disappointed during the first semesters of their studies and are eventually led to passive drop-out (non attendance of lectures). These students seem to constitute a cohort of students who fail to follow a consistent study programme and significantly extend their duration of studies.

3.2 Course of Action to Address the Issue

In addition to the multiform teaching material that was made available for every module of the curriculum (Tsiakas, Stergiopoulos, Kaitsa & Triantis, 2005), access to extra teaching material, specially designed to cover the gaps form high school knowledge was offered to the first year

students. A special set of self-evaluation tests of multiple choice questions was made available on-line. These tests covered introductory concepts to support certain modules of the curriculum of the Department of Electronic Engineering. Each self-evaluation test consisted of five sets of questions and could be repeated for an indefinite number of times. After the completion of a set of questions, the student got a report including his success rate, and an indication of the wrong answers along with the correct ones. The self-evaluation tests were also accompanied by a set of problems with typical answers and guidelines enhancing critical thinking.

3.3 Students' Performance in "Introduction to Electronic Physics" Module

The module "Introductions to Electronic Physics" is one of the basic modules of the current curriculum of the Department of Electronics and is delivered during the first semester of studies. Knowledge obtained through this module is essential and fundamental for the subsequent study of analog and digital electronics (Triantis, et all, 2007).

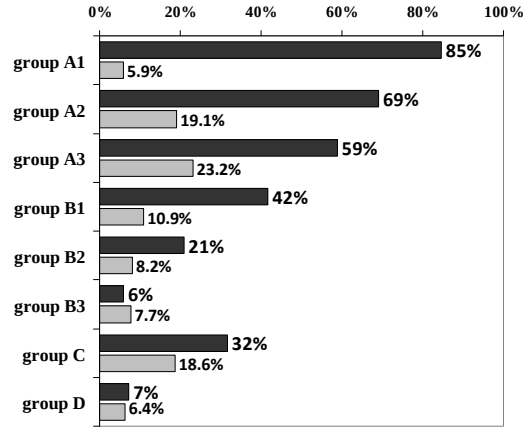

Figure 3: Success rates of students in the final examination of the module "Introduction to Electronic Physics": black bar. % contribution of group/subgroup in the total number of students who took the module exam: grey bar.

Figure 3 shows the success rates of 220 students in the final examination of the module "Introduction to Electronic Physics", and the percentage contribution of each student group/subgroup in the total number of students who took the module exam. The Study Regulation of the TEI of Athens provides that a student is considered to succeed in a module if he achieves grade of at least 5 out of 10 in the final exam. Figure 4 shows the average final exam grade and the maximum grade achieved in the module "Introduction to Electronic Physics" for each student group. The performance of the A group clearly exceeds that of the other groups. Group A students present an overall success rate of above 50%, which gradually decreases across the subgroups A2 and A3. All subgroups of group B exhibit success rates less than 50% and tend to decrease. Only one student from the group C has passed the exam, while the performance of group D students is totally disappointing. The overall success rate for the module is merely 45%. It should be noted that the success rate for group A is 66%.

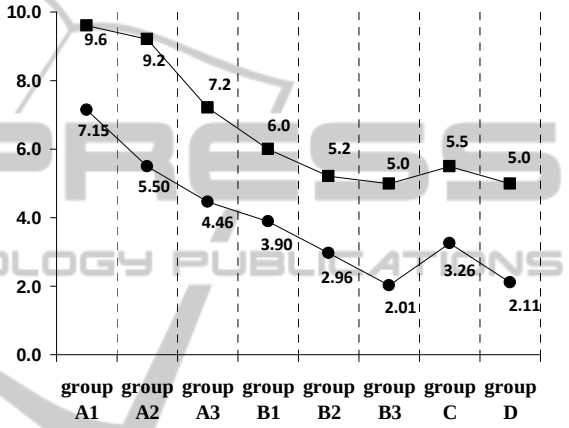

Figure 4: Average grade (solid circle) and maximum grade (solid square) in the module exam.

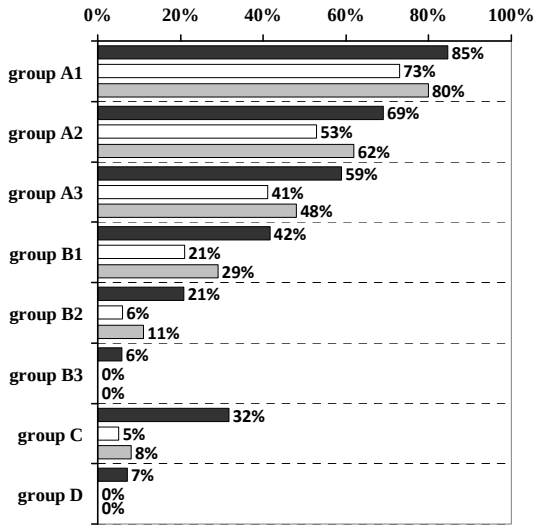

Figure 5: Comparative success rates in the module (black bar) and the rating test (Physics: white bar, Mathematics: grey bar) for each group/ subgroup.

We will now attempt to correlate the performance in the rating test and in the final

examination of the module "Introduction to Electronic Physics" for each group. Figure 5 presents this correlation in terms of success rates (where a successful performance is that of >5 out of 10). The conclusion drawn is that a certain percentage –although low- of group B and C students have passed the module, although they had inadequate background knowledge, as shown by their performance in the rating test. The fact that one out of three students of group C (which represent the 20% of the newly-admitted students) has succeeded in the module is considered satisfactory. However, the success rates of groups B, D, and C remain quite low and are approximately 22%. The exam records of the other four modules taught in the first semester of studies show a similar image, with a declination of 5%.

4 CONCLUSIONS – IMPROVEMENTS

The Department of Electronics of the TEI of Athens has recognized and addressed the issue of complexity and diversity in classrooms of the first semester of studies. A significant part of the admitted students have considerably lower background in core courses than others. Primarily, this is a matter that needs to be addressed centrally, by applying a uniform entry examination system for the Higher Education Institutions. However, the problem will still exist as long as a percentage of students are transferred from similar departments for social reasons.

Consequently, it rests with the administration of the School to manage students who enter the department with a limited or inadequate academic background, and make sure that they get the highest possible qualifications and career perspective. In the same time, the aim is to enhance student motivation and support systematic attendance of studies.

The accumulated experience leads to the following action: Upon their admission, the newly-registered students will have to undertake a rating test on fundamental knowledge, as described above. Students who have a poor performance in this test should attend and successfully complete a tutorial course of one semester in duration, prior to joining the regular curriculum. Although it seems incompatible with the current academic practice in Greece, the supportive tutorial course, will prove to be an invaluable tool in the medium and long term

This programme of supportive tutorials has the following advantages: the students attending will be able to cover the gaps in the basic courses and have a normal progression towards graduation, without loading their individual timetable with re-examinations of modules. Disappointment, lack of interest and drop-out rates will decline. Furthermore, the average time to graduation and the number of idle students is going to decrease. Last but not least, the establishment of a supportive tutorial course for the students of inadequate previous training is expected to largely contribute to the effective assimilation of new knowledge, enhance systematic attendance and lead to qualified graduates, ready to pursue a successful career.

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