THE DESCRIPTION OF THE FIRST INTEGRATED EXAMINATION OF THE COMPUTER ENGINEERING PROGRAM

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Abstract *– The present paper describes the first integrated examination, denominated AVIN (from the Portuguese, AValiação INtegradora), of the Computer Engineering Program at UnicenP. The AVIN is applied in the junior and senior years of the program and includes all subjects covered in the program, up to the student´s current year.*

The examination is composed by Computer Engineering Faculty, and contains questions about the basic courses, such as, calculus, physics, geometry and algebra, as well as questions about professional subjects, i.e., hardware and software.

The results, nevertheless, were important, since they serve as an indicator of the integration of contents and courses, permitting adjustments for better integration in the program.

The examination was also positive in the students' point of view, because they had the opportunity to demonstrate their knowledge in a multi and interdisciplinary examination.

Index Terms – Computer Engineering, multidisciplinary examination, teaching-learning process.

INTRODUCTION

The construction of instruments to evaluate the teaching-learning process which can supply information that may lead to improvement in the quality of teaching, constitutes a constant challenge to educators worldwide.

The Integrated Examination - AVIN, subject of the present paper, is an examination whose form is based on Brazil´s National Exam of Programs, and is applied to undergraduate junior and senior Computer Engineering students at UnicenP, with the following objectives:

- diagnose the abilities (the knowledge of how to process the information) and competencies (domain of the specific contents) of the students, without substituting the regular examination in each course;
- evaluate the integration of the curricular courses, in order to compare the actual learning demonstrated by the students and the professional profile sought and defined in the Program´s Pedagogical Project [4];
- promote a reflection about the program pedagogical direction, promoting a commitment among the faculty, students and the institution.

The AVIN/2001 was applied to 3rd year students of the Computer Engineering Program on October 20th, 2001, from 7:30 am to 12:30 pm. This 5-hour examination was taken by 11 students, 100% of the junior class. It should be noted that first and second year students to a different kind of multidisciplinary evaluation, viz., the UnicenP Engineering Games, described in [1], [2] and [3].

The AVIN examination included contents of all courses taught in the program, from first to third year.

The basic definition of the process was that each question should include subjects of more than one course, working in a multi and inter disciplinary form. Each question consisted of a separate project, with detailed reasoning of the answers being required, which allowed the analysis of the process employed in the solution.

The contents of each question are indicated below, where it is possible to verify the inclusion of theoretical aspects of several areas, such as hardware (Electronics, Digital Systems and Computers' Architecture), software (Algorithms, Programming and Database), and basic analysis (Calculus, Physics, Geometry, Algebra and Statistics).

The contents or topics involved in each question were:

- Q1 - Calculus + Computers' Architecture
- Q2 - Physics + Algorithms
- Q3 - Algorithms + Programming
- Q4 - Electronics + Statistics
- Q5 - Electronics
- Q6 - Digital Systems
- Q7 - Algebra
- Q8 - Database + Programming
- Q9 - Electronics + Computers' Architecture + Programming
- Q10 - Physics

RESULTS OF AVIN 2001

Three points must be considered in this AVIN: first, the AVIN was conducted for the first time for the Computer Engineering Program, and the level of difficulty may have been exceedingly high; second, the AVIN was applied only to one group (3rd year), not allowing any type of multi-year comparative analysis; and, third, the students did not demonstrate the necessary commitment to the resolution of the AVIN, because they were, according to themselves, overloaded with academic activities.

The AVIN 2001 distribution of grades is shown in Figure 1 in the form of a frequency distribution (histogram). In a scale of 0 to 10, the average was 3.4, with 55% of the marks below this value.

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The grade distribution ranges from 2 to 7 points, indicating that the exam was not easy. On the other hand, the Faculty considered that the performance of the students was satisfactory.

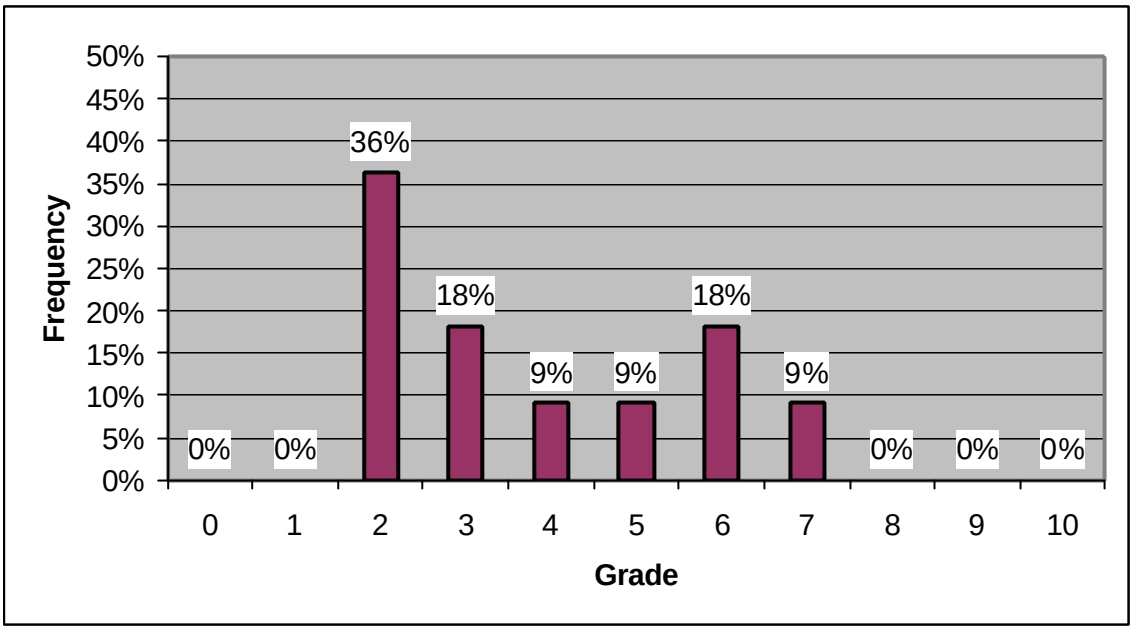

FIGURE 1
GRADE HISTOGRAM

Figure 2 shows the frequency distribution (histogram) of the marks obtained in each question in the AVIN/2001, which allowed an analysis of each question.

Table I shows the students' marks in each question and the total mark of each student.

TABLE I
RESULTS OF AVIN/2001

Student	Total	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
# 1	**6,8**	4,3	2,7	10	5	6	10	9	2,5	8	10
# 2	**5,6**	0,8	2,8	10	7	6	1	10	4	8	6
# 3	**5,2**	2	4,8	10	7,5	0	0	10	7	6	4,5
# 4	**4,5**	3,8	3	6	10	1	8	6	1	6	0
# 5	**4,0**	1,5	1,6	6	9	2	7	8	5	0	0
# 6	**2,7**	2,8	2,7	0	6	0	0	9	0	6	0
# 7	**2,6**	1,3	1,2	0	3	6	2	4	3	6	0
# 8	**2,0**	3	1,8	4	2	3	0	0	3	3	0
# 9	**2,0**	1,5	1,3	4	6	0	0	6	1	0	0
# 10	**1,1**	2	0	4	0	1	0	4	0	0	0
# 11	**1,1**	0	0,8	4	3	2	0	0	1	0	0

INTERPRETATION OF THE RESULTS - EASINESS AND DISCRIMINATION INDICES

The investigation of the quality of the examination involved the verification of its content validity and the item characterization, according to the easiness and discrimination indices.

The easiness index of each question (EI) is represented by the ratio between the sum of points obtained in the question for all the students, and the product of the value of the question by the total number of students, as defined by INEP [5].

The discrimination index (DI) indicates the ability of a question to differentiate students that achieve better results from those whose performance was poorest. A very easy question, for instance, cannot attain a high index of discrimination because almost everybody will get it right. A similar situation may occur with a very difficult question, which most of the students will get wrong.

In order to compute the discrimination index, the students are separated in three performance groups, according to the grades obtained in the exam:

- The superior group, represented by the top 27% scores;
- The inferior group, represented by the lower 27% scores;
- The intermediary group, represented by remaining 46%.

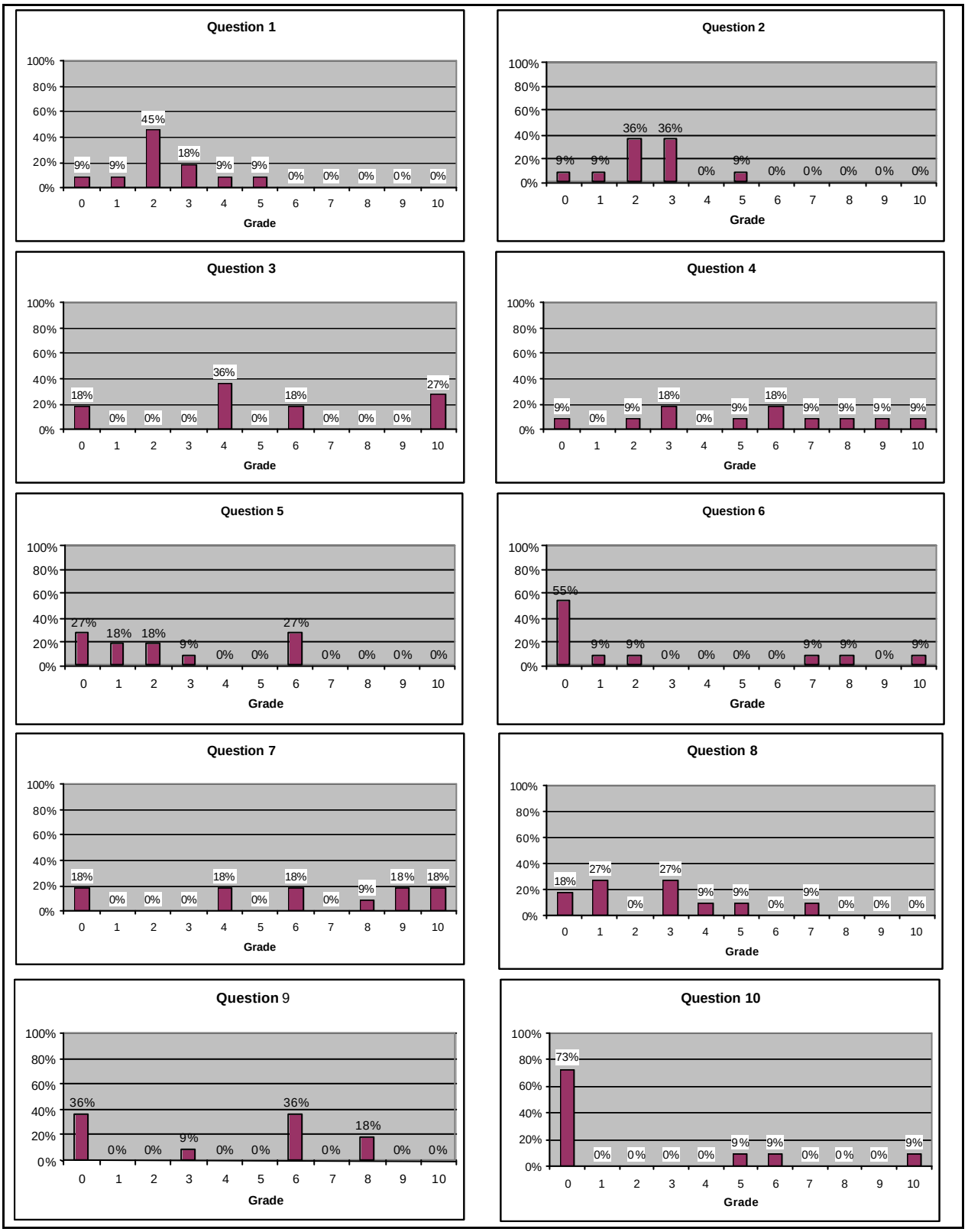

FIGURE 2
GRADE HISTOGRAM OF EACH QUESTION

The discrimination index is calculated, for each question, by the difference between the easiness index of the superior and inferior groups. The better results are obtained when the index of a question is close to 1 (one), reflecting a more discriminating question and indicating that the success was greater in the superior group - that really knows the subject - than in the inferior group - that do not know enough.

The discrimination index also shows the quality of the questions in relation to the population examined. In order to classify each question a scale defined by INEP[5] was used. Coefficients greater than 0.40 indicate questions highly discriminating (excellent), while coefficients equal to or lower than 0.19 suggest questions with problems in their statement or very high, or, conversely, very low, level of difficulty.

The values of the two indices (DI; EI) presented in Table II were obtained from Table I, where SG (Superior Group) represents the first 27% students' average in each question, and IG (Inferior Group) the last 27% students.

TABLE II
TABLE OF INDICES

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
SG	0,2	0,3	1,0	0,7	0,4	0,4	1,0	0,5	0,7	0,7
IG	0,1	0,1	0,4	0,3	0,1	-	0,3	0,1	-	-
DI	0,1	0,3	0,6	0,4	0,3	0,4	0,6	0,4	0,7	0,7
EI	0,2	0,2	0,5	0,5	0,2	0,3	0,6	0,3	0,4	0,2

Figure 3, obtained from the data in Table II, shows the relationship between the easiness and discrimination indices.

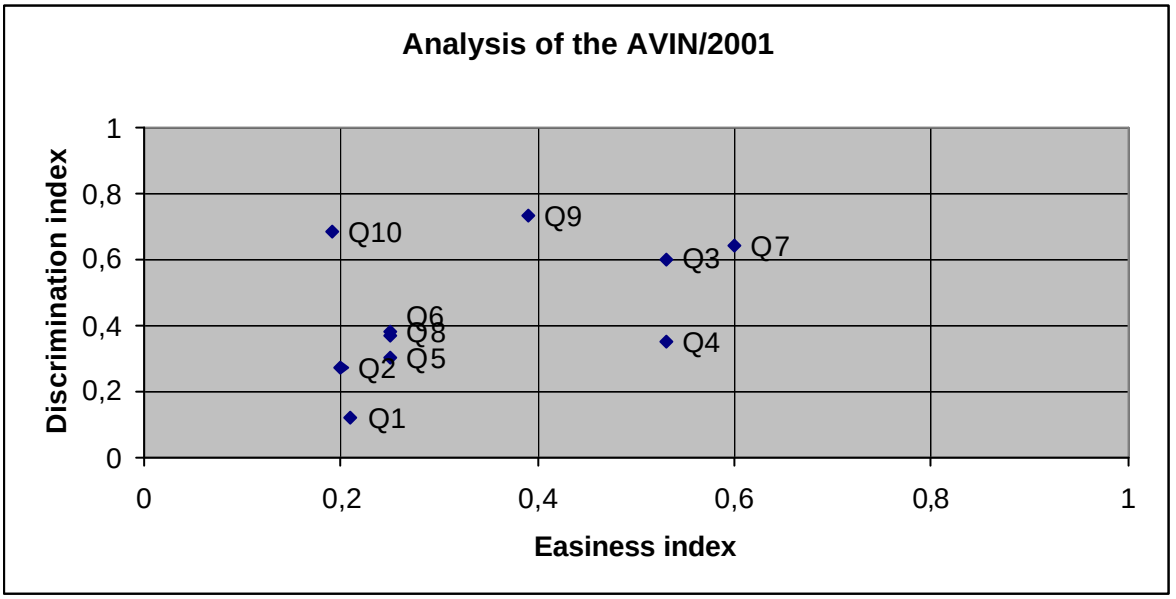

FIGURE 3
EASINESS AND DISCRIMINATION INDICES

Based on this plot, it is noticed that the questions that present the highest easiness and discrimination indices were Q3 and Q7; on the other hand, the most difficult questions, and that did not provide a good discrimination, were Q1 and Q2.

The other questions were classified inside of a medium range of discrimination and easiness indices, normally expected in a test of this nature.

One way of analyzing the plot in Figure 3 is to divide it in four quadrants, as shown in Figure 4.

Based on Figure 3, one may conclude that the best results for each question would be concentrated in the first quadrant, which indicates the highest easiness and discrimination indices.

The second quadrant concentrates questions with a good discrimination index, but with a high degree of difficulty.

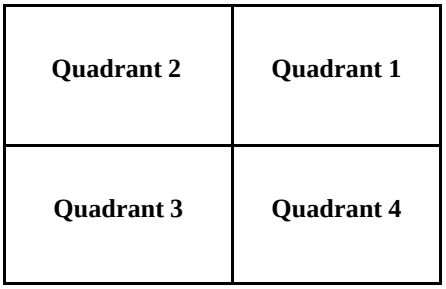

FIGURE 4
QUADRANTS

The third quadrant shows the worst possible cases, with questions both difficult and with a low discrimination index.

The fourth quadrant contains questions with a high easiness index, but with a low discrimination index.

In this way, the ideal result would be the distribution of the questions in the first, second and fourth quadrants, leading to an adequate analysis of the AVIN results.

However, the questions falling into the third quadrant must also be analyzed, because these can indicate problems that must be solved, such as exam clarity or even the approach adopted in the exam preparation.

GENERAL IMPRESSIONS ABOUT THE TEST

Using the same strategy adopted by the INEP´s National Exam of Programs, the students answered a questionnaire where they expressed their general impressions about AVIN.

Based on these results, it can be concluded that AVIN showed a medium degree of difficulty, was long and provided enough time for the solution. Additionally, it was considered by the students as mildly adequate with respect to the contents previously defined.

The questions, according to the students' answers, presented clear and objective statements with enough information for their resolution.

Finally, the students pointed out in their answers two items in particular: the inadequate knowledge of some contents and a lack of motivation for the solution of the questions.

CONCLUSIONS

Based on this analysis, it is concluded that the AVIN reached the proposed objectives, which were: first to provide an inter and multidisciplinary view of the several subjects covered in the program; and, second, to give a design backdrop to problems.

Another important point was a change of paradigm, because the students had to employ, in each question, concepts taught in several courses, which, previously, might have conveyed the impression of existing solely in "isolated knowledge boxes" and whose relationship was not always visible.

AVIN is also useful to the Computer Engineering Program, and to the Institution, by supplying information that allows the evaluation of course and content sequence and integration, which will lead to fine tuning that shall provide better cohesion in both an intra and an inter-yeas sense. Another aspect analyzed in view of the AVIN results is the coherence between the conduction of the Computer Engineering Program with the objectives stated in the Program´s Pedagogical Project [4].

Finally, it is suggested that the methodology employed in the analysis of the exam questions, utilizing the easiness and discrimination indices, be adopted in all regular exams in the engineering programs at UnicenP, since it allows an efficiency analysis of each question in the teaching-learning process. Questions with easiness and discrimination indices below 0.20 should be avoided; its occurrence may, eventually, lead to their elimination of the examination process.

ACKNOWLEDGMENTS

The participation of the Computer Engineering Faculty was fundamental in the planning and execution of the First Integrated Examination.

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