

Report of a Distance Learning Course of Specialization in Information Technology at a Brazilian Public University

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Abstract—Despite the growing demand by Brazilian companies for well-qualified professionals in Information Technology (IT), the Brazilian educational system has not been able to meet this demand in a satisfactory way, especially the quality of vocational training question. One way to address this training problem has been the creation of specialized postgraduate courses in IT area focused on students already graduated and working in the IT market. To facilitate access to the course for these working students we opted for offering a Distance Learning model through a Web-based platform. Hence, this paper describes the structure and the experiments conducted over three offers of this course, in 2010, 2012 and 2014, which sought to resolve and measure various problems associated with Distance Learning, such as the sizing and scalability of teachers and tutors in relation to the number of students. Another problem tackled was student isolation, which was dealt with proactive attitudes and motivating actions by the tutors and teachers with tools such as chat, forums, FAQ and e-mails. The problem of "student authentication" was overcome with in-person periodical evaluations, plus continuous monitoring of the monograph thesis development by her/his supervising teacher and a final oral defense of the thesis.

Keywords—Distance Education; Computer Programming; Blended Learning; Professional Development; Curriculum Development.

I. INTRODUCTION

In an exceptional effort to expand the Brazilian university system, the federal government has created in a decade over a dozen public universities. The Federal University of ABC (UFABC) is a tuition-free public university that was established recently (2006) by the Brazilian federal government in order to be a university of excellence in technological and engineering education.

The UFABC, like most Brazilian public universities, hinges on three areas: education, research and extension. As an extension activity, Brazilian public universities have offered classroom courses of expertise regularly, but the adoption of distance education mode still faces some resistance from a considerable number of teachers. Many Brazilian private universities have adopted the Distance Learning as a way to lower costs, without giving much

attention to the quality of these courses. As a result, Distance Learning courses were seen as courses of poor quality, operated by ambitious entrepreneurs without any commitment to good professional training of students.

To overcome these prejudices and meet the aspirations of many professionals who wanted to recycle their technical expertise by supplementing and complementing their original graduation, a group of PhD teachers in Computer Science from UFABC decided to create a Distance Learning (DL) postgraduate course on IT with focus in quality and excellence. In fact, the federal government itself had created an Open University model [2], whose structure could be replicated in federal universities. The course was named as "Specialization in Information Systems and Technology (IST)" and was structured as a professional and terminal post-graduation degree study program (similar to MBA courses), with at least 360 class hours and a monograph as concluding graduation thesis. To those who successfully conclude the program, the university issues a "Specialization Degree Certificate", recognized and officially registered degree at Brazilian Ministry of Education. The quality of the course was assured by careful selection of teachers with specialized technical knowledge and teaching experience, mostly experts in their respective disciplines, who prepared the teaching material (courseware) and exercises, after their training in DL techniques and tools. Then, all the course was tested with the *tutors* (part of teaching staff who supports the teacher, with direct contact with the students) acting as *students*. This test was also used as training session for the *tutors*. The course preparation took one year before its first launch.

The project was integrally financed by CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior), a Brazilian government institution dedicated to promote postgraduation education, so it was possible to offer a tuition-free course for the students.

The boundary conditions set for the course involve not only the natural conditions of education and of the Brazilian educational system [3], but also the current conditions of the computing market and its corresponding professionals

working in it. From the beginning, the development of the course was characterized as a *research project* which, due to uncertainties of an unprecedented course format at the time, presented doubts about the format and parameters of the course, technology to be used, acceptance and adaptation of the students and teachers, as well as the effectiveness of the system on student learning. So, being a research project, several experiments and tests in the shape and course structure were conducted to evaluate its effects.

II. FORMAT AND STRUCTURE OF THE EXPERIMENT

A key differentiator in this project was the implementation of a system of continuous assessment of the course, through evaluation questionnaires answered by most of the students after every discipline. This system was essential for the quality evaluation of the course and the analysis of the experiments. In what follows, we present the results and the analysis of three offerings of the course, in 2010, 2012 and 2014, totaling more than 3.700 answered questionnaires. These questionnaires allowed us to use their results as reference and quality control to each of the offerings of the course, where we combined: 1) different student selection processes, 2) different students per teacher ratios, and 3) different use of *tutors*. We selected these factors as *experimental elements* to test as we believe they are most relevant parameters for the quality and the success to any DL course. Naturally, adequate training of the teachers and *tutors*, the quality of the teaching material, the availability of a reliable Internet connection and IT infrastructure, among other elements, are all fundamental issues for a successful DL course. But to scale up the course ten fold the number of students for example, the selected factors are more relevant for the cost and final quality of the course as the other factors are easier to scale up (DL training classes are easily available, for example).

In the context of the project, this experiment was also aimed to test the factors that could allow *scalability* and *flexibility* for the DL course. The *scalability* is the ability to increase the number of students without losing control or quality of the course, and the *flexibility*, is the ability to adjust and adapt the course for different regional contexts and resources. Both characteristics are important, considering the size and the population of Brazil.

This paper presents the main characteristics of the course as well as its process of development and continuous evaluation, and tries to establish some important conclusions. The Table II in the courses' description section presents the three offerings of the course with the different combination of *experimental elements* of: student section process, students per teacher ratio, and use of *tutors*. The *Results* section presents the impact of these factors on abandonment and fail rate of students and in the quality of the course, where the results of the 3.700 questionnaires were tabulated on Table V.

III. CONTEXT AND OBJECTIVES OF THE COURSE

Due the previous experience of our teachers with traditional classes, we opted to design the IST course using a mixed model, the Blended Learning (BL) [1; 9]. With this model, we tried to keep the best characteristics of distance and in-person learning, allowing a more comfortable transition for

our teachers as most of them had extensive experience in teaching with their respective disciplines.

In the design of the framework of our course, we tried to keep as much communication channels as possible between the students and the teachers and *tutors* [5], including the use of a "*classroom tutor*" (will be detailed later) to interact and motivate the students, and the insertion of interactive actions (real-time chats, forums, and posts in social media) in the critical points of classes. We also opted to keep the main evaluation tests in-person, to overcome the current relevant limitation of DL courses [9].

A. Context of UFABC

The UFABC is a new university founded in 2006, with a different pedagogical proposal from traditional Brazilian public universities. Currently it has about 500 teachers, all of them with doctoral degree (PhD) and full-time dedication. It has a system of differentiated stages, the first of which is characterized by three years of interdisciplinary basic studying, concluding with bachelor's degree in science and technology. The second stage corresponds to a course of professional training like Engineering, and the third stage is a more qualified education, which may be a postgraduate degree or specialization degree.

B. Course Objectives

The objective of the project is to offer high quality tuition-free course through Distance Learning for a public of working IT professionals that have difficulty in establishing a fixed time to study due to the demands of work and difficulty to attend classes due the distance from good schools or universities.

The advancement of broadband Internet access on most of the populated parts of the country provided the opportunity to use a Web-based DL technology to offer a high quality education for professionals who otherwise would not have access to our university's study programs. Attending classes from home and the flexibility to choose the time of the day to study are the main benefits of DL, but the problem was the lack of previous experience on this technology in our university to guarantee a successful course. To overcome this limitation, we addressed this problem by first selecting teachers strongly motivated on DL and then, training them in DL with courses from experienced universities which we made collaboration agreements.

C. Course Challenges

The format of DL course presents a pedagogical challenge, from the preparation of classes, selection of didactic material and its presentation technologies, adjustments in depth and clarity of the concepts, texts and exercises [4][5]. Our teachers dedicated one year prior to the first offer for preparing and adjusting teaching material for the course, among them the evaluation tests and exercises. But the most difficult part of this method is how to keep the attention and dedication of the students [6] that are in distant places and usually alone. Most of web-based DL tool creates an academic community environment, with forum, chat rooms and e-mail exchange facilities, but we thought that those were insufficient to create the necessary level of involvement in the classes. So we set up a "*classroom tutor*", a person with the responsibility to be a

representative of the group of students and to stay with them during the entire course. The main role of “*classroom tutor*” is to monitor the motivation of his/her students group (the class), and incentive their participation in the class activities. We also introduced a second type of tutor, the “*discipline tutor*”, usually a PhD program student who has the specialized knowledge associated to the discipline being taught by the teacher. His or her responsibility is to help the students to understand the lesson, answering their doubts and questions and helping them with the exercises. As a group of students concludes the discipline and changes to the next discipline, the “*discipline tutor*” and the teacher changes accordingly, but the “*classroom tutor*” doesn’t change, staying with the group.

D. Description of Structure of the Course

The structure of the specialization course in Information Systems and Technology (IST) is very close to an equivalent traditional in-person course, composed by 12 disciplines of 30 class-hours each, selected to have a solid conceptual and technical training to the students covering major professional areas of IT. None of the disciplines is optional or elective. The total of 400 class-hours of the course includes 10 hours of training of DL web tools and a Research Methodology discipline of 30 class-hours to prepare the students for the development of graduation thesis monograph. Table I presents the list of the disciplines.

The classes are taught in synchronized way, meaning that the class starts and progresses simultaneously for all the students of the group, one discipline at time. Each discipline’s class takes approximately one month to run, and after three disciplines there is an in-person evaluation test. The test happens at examination centers previously selected, in the same day for all the students, usually on weekends, with the supervision of our teachers and tutors. The results of these evaluation tests compose the *majority* of the points for the final grade of the discipline. With this, we expected to avoid the problem of student authentication [7], i.e., ensure that the student submitting evaluation activities is the enrolled student.

Each group of three disciplines defines a phase (“T_”) of 4 months, and the entire course of two years is composed by six phases, four phases dedicated for the discipline’s classes and the last two phases for graduation thesis.

TABLE I. LIST OF IST COURSE DISCIPLINES.

Table of Disciplines		
T1	1	Computer Systems
	2	Mobile Computing
	3	Multimedia Technologies
T2	4	Internet and Web Technologies
	5	Data Modeling and Applications
	6	Free Software
T3	7	Intelligent Systems
	8	Software Design
	9	Information Security
T4	10	Corporate Information Systems
	11	Software Projects and Quality
	12	IT Management and Governance

As a government financed and tuition-free course, we are very strict and rigorous on our evaluations and approval requirements. Once reproved in any discipline, as it is offered only once during the course, the student is automatically excluded from the course. This rule was one of the main reasons for the students failing to conclude our course.

The students are grouped in “virtual classrooms”, i.e., thought of as belonging to the same student group in spite of living in different cities nearby, associated with an *actual school* in selected major cities spread in São Paulo State. The idea is to offer the course in cities far from the capital to bring specialization opportunities to those who could not afford to access this kind of education. In this project we intentionally selected some cities that are close to the capital to be used as reference and for comparison purposes. The actual school associated to a virtual classroom is used as *examination center* for periodical in-person evaluation tests of students.

IV. COURSE METHODOLOGY

The project started in 2009 with the design of the course and preparation of the teaching materials for classes. In total, there were three editions or offerings of the course, in 2010, 2012 and 2014, each course lasting two years. The number of student vacancies was 200, 200 and 150 respectively. All three editions used basically the same teaching material and the same activities, exercises and evaluation sets, with minor corrections and adjustments. We also tried to keep the same teachers to teach the same disciplines but in a group of 15 teachers during 7 years of project it was almost impossible task. The turnover of teachers was about 50% and we think that was good enough to keep the uniformity and quality of the teaching during the three editions.

A. Abandonment and Fail Rate

For projects using public resources, a key success parameter is the number of students it graduates. Every student that fails to conclude the course represents a loss of public money. DL courses in general have poor performance history in this regard.

The causes some students fail to conclude the course are based on two basic factors: the first is abandonment of the course for many reasons: loss of interest, the course didn’t meet the expectations, change in personal priorities, and changes in time availability to dedicate to the course due to work or family demands. In two years of duration of the course, lots of professional and personal events may happen to the student, forcing him or her to abandon the course. Sometimes they send a letter of notice requesting the cancel of enrollment with proper justification, but most of times they simply stop accessing the DL tool and attending the classes. The second (and most significant) factor is the failure to get sufficient grade to be approved in the discipline. As stated before, this means him or her to be excluded from the course. There is no single discipline that is predominantly difficult for the students, with the exception for the graduation work’s monograph.

In all the three offerings of the course, the abandonment and the fail rate of students were carefully tracked and registered as important control parameter.

B. Evaluation Questionnaire

From the beginning of the project we measured and recorded several key quality elements of the course, through an electronic questionnaire to be answered anonymously by every student after concluding a discipline. Each item of the questionnaire received a score from 0 to 5, with 0 meaning "insufficient" and 5 "fully satisfied". The main items evaluated among others were: the teacher, the *discipline tutor* and *classroom tutor*, teaching material (courseware), activities during the discipline, web resources, dedication of the student (established as minimum of 2 hours/day), self-assessment, prior knowledge in the discipline, acquired knowledge in the discipline, and overall rating of the discipline (These are items that compose the entry of Table V).

The questionnaire was kept simple and easy to answer, but it was always difficult to get all the students answering it. We had to insist many times through the teacher and tutors to have it answered, but after a couple of times it became a habit, and was easier to have all the students answering the questionnaire. Most of the times during the project we got all the potential answers to the questionnaire but one of the limitations of this method was that we got the feedback only from the students active in the course but none from the ones that abandoned the course or the ones that was expelled from the course. We tried to get some feedback through a specific questionnaire but with very poor results, with less than 10% of potential respondents.

C. Differences between 3 course offerings

In order to evaluate and understand the characteristics of DL courses, we changed intentionally some key *experimental elements* in the three editions of the course to see its effects, as we explained in previous sections.

The first element was the student selection method: in the first offering the selection was by means of the curricular analysis of candidates. In the second and third offering there was an in-person admission test, where we evaluated the candidate's knowledge in the IT field. The objective was to verify the effect of quality of students in the course offerings.

The second element was the students per teacher ratio. The teacher is our most expensive resource, and this experiment has the objective to evaluate the scalability of the project. We kept the same rate for students per tutor during the project to evaluate only the effect of the teacher. In the first offering, the rate was 50 students per teacher so, as we had 200 students, the teacher had to teach the same discipline four times, each time for different "virtual classroom" students. In the second offering, the ratio was changed to 200 students per teacher, meaning that the discipline was taught only once for all 200 students simultaneously. In the third offering, we returned the ratio to 50 students per teacher. In this offering, we also changed the size of "virtual classroom" from 50 to 25 students per class, to see its effects on motivation and performance in

smaller groups. To keep the same ratio, the teacher taught to two "virtual classrooms" at the same time.

The last element we changed was the elimination of "*classroom tutor*" in the last offering. The role of this tutor was to keep the motivation of the group of students, and we assumed that postgraduate and more mature students are more self-motivated, and that probably this role could be incorporated by the "*discipline tutor*". Eliminating one of the tutors means important cost savings for the course and also was eliminating a source of conflict of responsibilities between two tutors over the same "virtual classroom".

Table II resumes the main differences between the three course offerings.

TABLE II. DIFFERENCE FROM COURSE OFFERINGS

	IST-2010	IST-2012	IST-2014
Number of virtual classrooms	4	4	6
Number of students per classroom	50	50	25
Total of vacancies offered	200	200	150
Students selection process	CV analysis	Entrance Exam	Entrance Exam
Number of candidates	1.079	1.172	880
Candidate/Vacancy Rate	5,40	5,86	5,87
Students per teacher	50	200	50
Students per " <i>discipline tutor</i> "	50	50	50
" <i>classroom tutor</i> "	Yes	Yes	No

V. RESULTS

This section presents the consolidated results of seven years of this Distance Learning project, with comments on relevant values.

A. Abandonment and Fail Rate

Table III shows the total of accumulated student exclusion rate (abandonment and cancellations plus failures from insufficient grades) in 2010, 2012 and 2014 offers. These data consolidate every phase (4 months – "T") of the course. Table III presents the number of accumulated excluded students and Table IV presents the proportional percentage from total number of students for each offering.

TABLE III. TOTAL OF ACCUMULATED STUDENT EXCLUSIONS IN 2010, 2012 AND 2014: ABSOLUTE NUMBERS

	T1	T2	T3	T4	Thesis	Approv.	Total
IST-2010	50	67	73	89	104	95	199
IST-2012	33	57	69	88	101	100	201
IST-2014	21	47	75	85	91	55	146

TABLE IV. TOTAL OF ACCUMULATED STUDENT EXCLUSIONS IN 2010, 2012 AND 2014: PERCENTAGE

	T1	T2	T3	T4	Thesis	Approv.
IST-2010	25,1%	33,7%	36,7%	44,7%	52,3%	47,7%
IST-2012	16,4%	28,4%	34,3%	43,8%	50,2%	49,8%
IST-2014	14,4%	32,2%	51,4%	58,2%	62,3%	37,7%

Figure 1 shows the same data of accumulated exclusion in percentage in graphic form.

VI. DISCUSSION

This section will analyse the results from the previous section and discuss some findings from the project.

A. The Problem of Abandonment and Fail Rate

This problem probably is the most difficult to deal with in DL projects. The flexibility and availability that comes from the new educational technology comes at the expense of less involvement and compromise from the students, and this lack in motivation results in high abandonment and exclusion rates. The comparison of exclusion rates in the beginning of the three courses (first phase - T1) shows a 10% higher rate in the first offer (IST-2010). We called this “first month phenomenon” since in the first month of this offer almost 20% of students abandoned the course, apparently from losing interest or having difficulty to adapt to DL methods. As a tuition-free course with no financial compromise for the student, it is easy to them abandon the course after the first difficulty. So, in the following offers, we used a in-person entrance selection exam and demanded an approval in the DL tool training discipline as requirements to enroll in the course. These tasks were not intended primary to select more qualified candidates but to filter out more compromised candidates. As the number of candidates was five times the number of vacancies, the competition worked to our favor. This strategy resulted in the clear reduction of “first month phenomenon”, from 20% to 7%, although this decision was insufficient to completely eliminate the problem.

Comparing the exclusion rate of first two offerings (IST-2010 and IST-2012), we notice that there is a constant 7 to 8% exclusion rate per phase (T1 to T4 and Thesis) during the course. We believe that this is the “normal” rate of loss of students, from abandonment and failure to get the necessary grades in the disciplines. The change in selection process from curriculum analysis to entrance exam did affect the “first month phenomenon” but didn’t change the exclusion rate per phase. This could indicate that the change in selection process didn’t change the quality of the students. One possibility to get lower exclusion rates is to re-offer the disciplines again for those who failed it, but this is a scope for another project.

The exclusion rate of the third offering (IST-2014) needs a more detailed explanation. Figure 1 shows that although the student loss of IST-2014 in the first phase (T1) was as good as the IST-2012 (12 to 14%), in only two phases T2 and T3 the student exclusion rate reached 50%. If supposedly most of relevant parameters were kept unchanged and the overall rating of the offer was good, what could possibly have been the cause of this very fast abandonment rate in the third offer? The questionnaire didn’t detect any internal problem so our guess is that it was an external problem that affected the IST-2014’s exclusion rate.

The year of 2014 was the beginning of an economic crisis in Brazil that resulted in a strong economic recession in 2015, the first since 1992 [8]. The figure 2 shows a graphic with the Brazilian GNP growth in recent years.

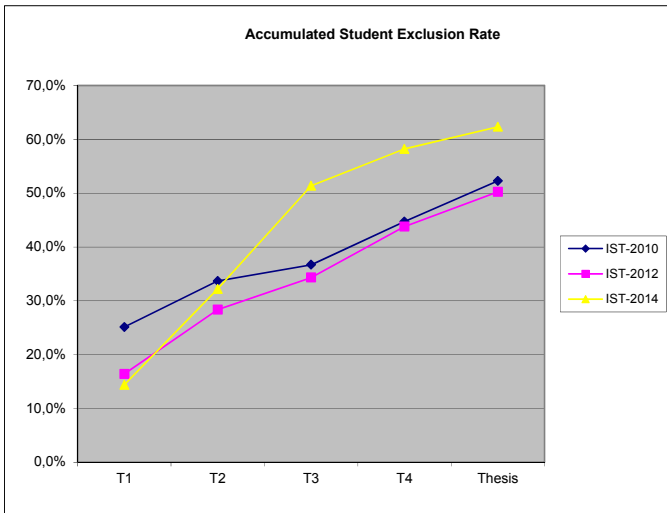


Fig. 1. Accumulated Student Exclusion Rate in Percentage.

Some important points to notice are the high loss of students in the first period (T1) in the first offering IST-2010 (about 25%) and the fast rate of exclusion in the third offering IST-2014, that resulted in the worst approval rate of the three offerings: only 37,7% of initial students concluded the course. These points will be discussed in the next section.

B. Student Evaluation Questionnaire

The degree of satisfaction of students was analyzed and the approval rating in all three editions of the course was tabulated from the answers to the questionnaires.

The Table V shows the consolidated data and the numbers of answers obtained from each offerings, with the total of 3.748 answers obtained in all the project. Note that the third offering had less answers (total of 976). This is because the last offering started with less students: 150 instead of 200.

It is also easy to notice that the second offering had a consistently lower evaluation (in a scale from 1 to 5), although not significantly lower (7 to 8% lower). We also will discuss these results in the next section.

TABLE V. EVALUATION FROM THE STUDENTS

	IST-2010	IST-2012	IST-2014
Number of Answers	1.347	1.425	976
Teacher	4,26	3,82	4,25
Discipline Tutor	4,23	3,87	4,35
Classroom Tutor	4,39	4,38	—
Teaching Material	4,00	3,72	4,06
Activities	4,02	3,74	4,05
Web Resources	4,05	3,72	4,06
Effort and Dedication	3,89	3,73	3,89
Self-assessment	4,01	3,88	3,98
Prior Knowledge	3,36	3,32	3,25
Acquired Knowledge	4,08	3,85	3,98
Overall Rating	4,12	3,82	4,13

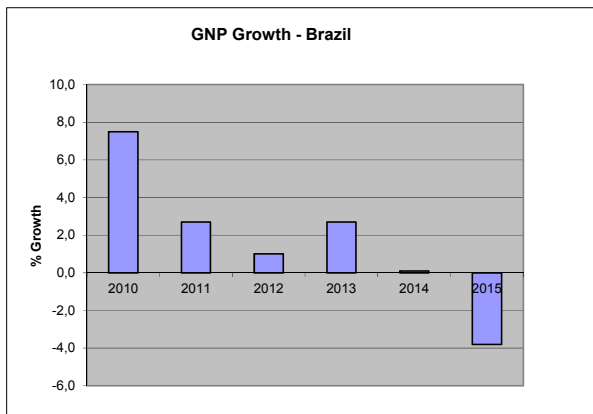


Fig. 2. Brazilian GNP Growth (from [8]).

As most of our students are professionals working in the IT field, they probably chose to concentrate their efforts in keeping their jobs and this change in priorities reflected in the exclusion rate of IST-2014 offer.

B. The Effect of Student per Teacher Ratio

In the second offer (IST-2012) we changed the student per teacher ratio from 50 to 200, and returned again to 50 in IST-2014 (Table II). The students noticed the effect of this change in the course and this perception was captured by the questionnaire. Table V shows clearly the drop of 8% in the overall rating of the course and the return to the previous level in the third offer, when student to teacher ratio returned to 50.

The drop of overall rating of IST-2012 however, didn't affected the exclusion rate when compared to IST-2010 (Table V). We could conclude that although the quality drop was noticeable, it wasn't enough to affect the exclusion rate of the IST-2012 offering.

C. The Effect of Classroom Tutor

The "classroom tutor" had since the beginning of the project a non-educational role, and this was the reason that was always very difficult to justify its cost. His or her sole responsibility was to keep the group of students motivated and active. The "classroom tutor" was usually the first to notice the absence of the student in the class activities and also the first to send an e-mail to ask if he/she had any problem. It is very important to the "classroom tutor" be proactive and positive, to keep the good mood of the group. They stay together for two years, so this result in a strong bond between the "classroom tutor" and the students of the "virtual classroom", reflecting in high ratings in the evaluation questionnaire. They had the highest rating even in IST-2012 when every other evaluated items received lower rating than the previous offering.

Even with "classroom tutor", the final exclusion rate of IST-2010 and IST-2012 offerings was about 50%, establishing the limits of motivation factor.

In the IST-2014 offering we eliminated the position of "classroom tutor" to observe the effects in motivation and performance of the students in the course. As the "classroom

tutor" doesn't have any educational role, the evaluation results will not be affected by the absence of "classroom tutor", and we can confirm that comparing the ratings in the Table V.

But the motivation is a strong factor responsible for abandonment and cancelation of the students of the course. The IST-2014 had a fast and strong exclusion rate as we can see in the Figure 1, mostly due to external factors. Is there any possibility that the elimination of "classroom tutor" was one of the reasons that contributed for this result? It is difficult to answer this question because it is almost impossible to isolate the influence of external factors to evaluate only the effect of "classroom tutor".

VII. CONCLUSION

The positive assessment of the courses shows that a public, state owned university can supplement the professional training of hundreds of students through high quality Distance Learning courses.

The experiments we conducted and its results provided important reference points that can be used in future DL projects. After six years and three editions our teaching material is becoming obsolete, as the technological evolution on IT field is very fast.

We intend to start a new project using the lessons learned from this project and the experience gained in these three offerings. The new design will have to incorporate new experiments because there is still much efficiency to be achieved.

Acknowledgment

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