

AN ANALYSIS OF STUDENTS ENROLLED TO AN UNDERGRADUATE UNIVERSITY COURSE OFFERED ALSO ONLINE

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ABSTRACT

This paper analyzes the main characteristics of the students enrolled to a three-years undergraduate course on Security of Computer Systems and Networks, offered in traditional, classroom based fashion as well as online at the University of Milan (Italy). This allows to compare classroom and online students from several points of view, and gives useful information to institutions willing to exploit e-learning as a vehicle for extending the enrollment to already existing traditional courses.

KEYWORDS

E-learning, online bachelor degree, online students, classroom students.

1. INTRODUCTION

As deeply discussed in Milani (2014) and Damiani (2005) the “Corso di Laurea in Sicurezza dei Sistemi e delle Reti Informatiche” (from here on denoted as SSRI) is a three-years undergraduate course (bachelor level) on Security of Computer Systems and Networks, activated by the University of Milan (Italy) in a campus located in Crema (a small city 40 kilometers east of Milan) in academic year 2003/04 as a traditional, classroom based university degree and offered also online since 2004/05.

The online version of SSRI has been implemented through a design process which required a deep revision of all teaching materials already prepared for classroom lectures by teachers – as suggested e.g. in Anderson (2008) – to obtain the best possible result in terms of students learning.

This revision – coordinated by CTU (the e-Learning Centre of the University of Milan) and initially supported by consultants from Isvor Knowledge System (an Italian company specialized in the production of e-learning courses) and described in details in Milani (2014) – can be summarized as follows:

- online courses are structured in modules composed by different activities: lectures, exercises, tests;
- lectures are mainly constituted by slide sequences and/or desktop capturing synchronized with teacher's voice, or blackboard-like effects recording teacher's voice and handwriting (almost no teacher's video recording);
- as suggested e.g. in Salmon (2000) and Rivoltella (2006) students tutoring has been carefully considered, and SSRI online is supported by:
 - one Course expert tutor for each single course of SSRI and for each group of 40/50 students;
 - a Process tutor, who acts as e-moderator, process facilitator, adviser/counsellor for the whole community of online students, as recommended e.g. by Berge (2000) and Moisey (2008).

The following sections of this paper compare the two “families” of SSRI students (i.e., classroom students physically following lectures at the university campus vs. online students accessing e-learning materials through the web platform implemented by CTU) to evaluate their most important characteristics and to identify possible critical aspects to be considered when planning the e-learning offer of a complete university degree.

2. PERSONAL CHARACTERISTICS OF SSRI STUDENTS

In academic year 2009/10, SSRI has been partially re-designed, both to tune the curriculum on the basis of the results of the first five years of its offer, and to be compliant with the new recommendations coming from the Italian Ministry of University. Such a renewed version of SSRI has been furtherly modified in academic year 2014/15, again to be compliant with additional requirements coming from the Ministry.

For these reasons, in Sections 2. and 3. we restrict our analysis to students who enrolled to SSRI in the five-years period beginning with academic year 2009/10 and ending with academic year 2013/14. Moreover, we include in our analysis only students who started their university studies enrolling to the first study year of SSRI, thus not considering students already enrolled in other university courses who decided to move to SSRI with some exams already registered and validated.

2.1 SSRI Student Population

The number of students enrolling to the first study year of SSRI in the considered period is given in Table 1. As it can be seen, the two populations (classroom and online students) are almost equivalent except for academic year 2013/14, when online students doubled the classroom ones: this is mainly due to an initiative aimed at publicizing the existence of SSRI (the unique Italian undergraduate course dedicated to computer security) through social networks: as a result, several people decided to take the opportunity of the online version to enroll to SSRI.

Table 1. Total number of students enrolling to the first year study of SSRI

Academic year of enrollment	Classroom students	Online students	Total
2009/10	57	59	116
2010/11	67	56	123
2011/12	45	51	96
2012/13	32	46	78
2013/14	46	98	144
Total	247	310	557

An interesting characteristic of SSRI students is their age when enrolling, represented in Figure 1, where enrollments have been grouped by age intervals.

As it can be seen, more than two thirds of the classroom students (68.8% of them) are “conventional” students, entering the university just after finishing their high schools; there is a significant number of students between 21 and 25 years old (24,3%) but looking in details most of them are 21 and 22 years old, thus again students entering the university soon after finishing their high schools, maybe with some delays due to repeated high school years.

On the contrary, online students are definitely “unconventional” students, coming back to university far after the completion of high schools. In fact, almost half of them (44,5%) are more than 30 years old, and just 10% of them can be considered “conventional” students aged 18 to 20. It seems then very reasonable to conclude that SSRI online is selected by just few young students living far from Crema, while it attracts mainly older students, most likely characterized by a job position and interested in improving it through a course that gives the advantages of a final university degree without requiring physical presence.

In fact, a questionnaire distributed in 2014 showed that 73.9% of online students are full time employees (vs. 5,9% of classroom students) and most of them decided to enroll to SSRI online both for its utility in the job they already have and for the possibility of studying while working.

From the above, we can then state that the e-learning version of a classroom university course does not “compete” with its traditional, classroom version in terms of enrolling students: on the contrary, it attracts a significant number of additional students that would never come to the university without the chance of distance learning. In other words, the investment necessary to implement such a distance learning environment is rapidly compensated by the additional incomes deriving from tuition fees of online students, as quantified in Milani (2014).

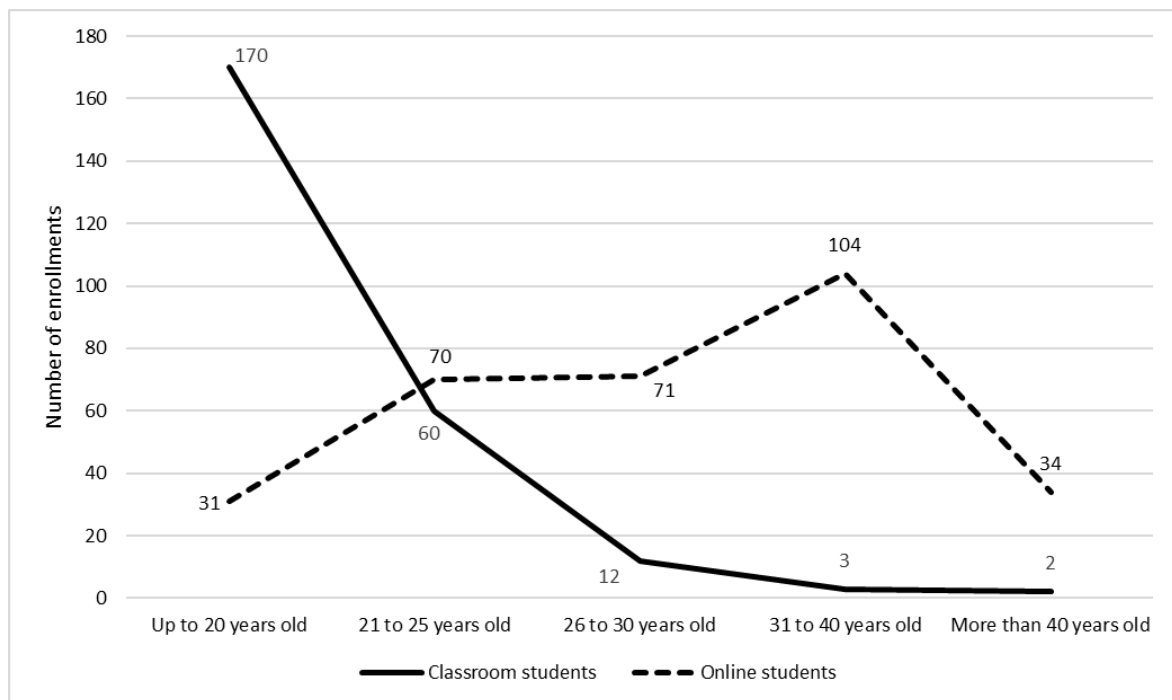


Figure 1. Age of students enrolling to SSRI

2.2 Economic Situation of SSRI Students

A first look at the economic situation of SSRI students can be derived from Table 2., reporting their average economic indicator. This indicator (called ISEEU: Equivalent Economic Situation Indicator for University enrollment) is used to compute the actual fee each student is expected to pay each year to the University of Milan. It takes into account not only the total incomes and properties of the family the student belongs to, but also the number of persons and their job position (worker, retired, full time student, etc.).

It seems reasonable to have lower indicators for “conventional” students (usually living with their parents) with respect to online students, whose age suggests they are people already occupied and with their own family, most likely smaller and younger.

However, it must be noticed that students enrolling to SSRI online have to pay an extra fee of 1,500 euros per year with respect to classroom students (for the extra services provided online, like tutorship, exams during weekends to facilitate workers, etc.). This can to some extent justify higher economic indicators for students able of affording the online extra costs.

Table 2. Economic indicator of students enrolling to SSRI

Academic year of enrollment	Classroom students	Online students
2009/10	€ 25.492	€ 30.410
2010/11	€ 21.970	€ 27.165
2011/12	€ 26.256	€ 27.356
2012/13	€ 25.745	€ 33.639
2013/14	€ 25.644	€ 26.524
Total	€ 24.720	€ 28.533

2.3 Previous Studies of SSRI Students

As far as the type of high school attended by SSRI students is concerned, we may refer to Figure 2. In this case, the two populations (classroom and online students) show a very similar behavior: most of them

(around 40%) come from Industrial Technical Institutes (where ICT is frequently a fundamental topic) and summing up also Commercial Technical Institutes (preparing accountants) and other types of Technical Institutes the total exceeds 70%.

Only around 20% of SSRI students come from Scientific Lyceums: the general-purpose high school preparing to scientific university courses. This is a common problem for ICT university courses, whose scientific aspects are usually underestimated. A very small minority comes from Classical Lyceums.

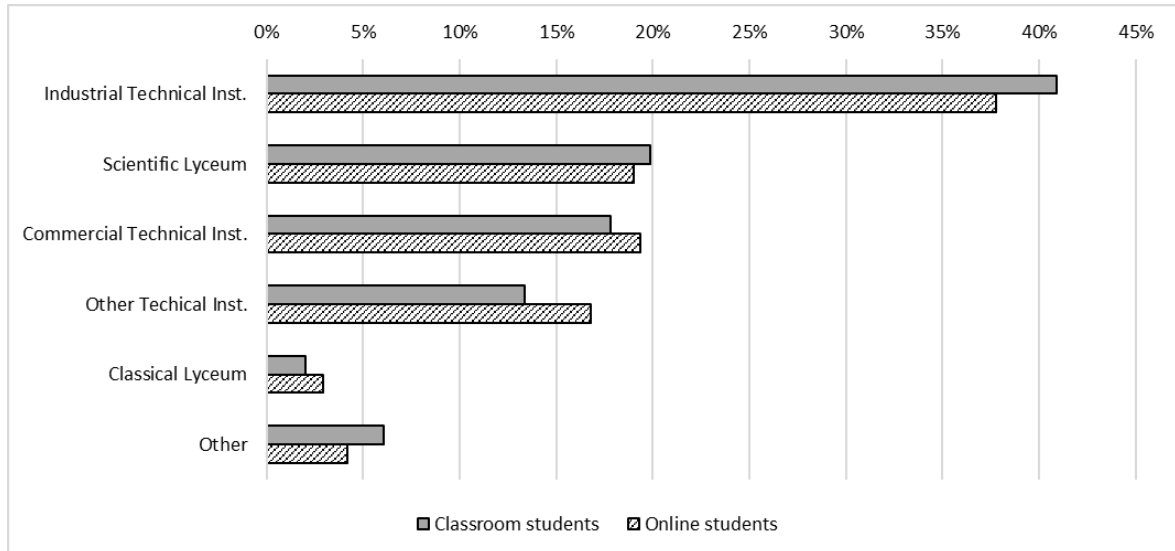


Figure 2. Type of high school attended by SSRI students

3. STUDY PERFORMANCE OF SSRI STUDENTS

3.1 Graduation

A first, rough indication of the performance of SSRI students about their studies is given in Figure 3., where four possible student situations are shown:

- students already graduated, i.e., who obtained the final degree (“laurea”);
- students still enrolled and “active”, taking exams at their own pace;
- students who decided to quit SSRI feeling it too difficult, probably after failing the first exams;
- students who moved to other undergraduate courses, at the University of Milan or elsewhere.

If we consider that – for students enrolled in 2009/10 – the last opportunity for graduating “in time” (i.e., without having to register for one or more extra years) was spring 2013, the percentage of classroom students already graduated is very low, but extremely low for online ones. The result is not surprising: Italian students enrolled in ICT university courses frequently start having some occasional work opportunities before graduating; moreover, since – as already discussed (Section 2.3) – they have in general a technical background, theoretical exams often cause unexpected delays in their career. Finally, online students already employed have to study during evenings and weekends, thus forcedly reducing their study performance.

However, if we concentrate on graduated students, we obtain the results shown in Table 3. It may be seen that for the first years of enrollment – when the numbers of graduated students are statistically more significant – the final marks (on the Italian scale in one hundred and tenths, where the maximum mark is 110/110) are definitely higher for online students.

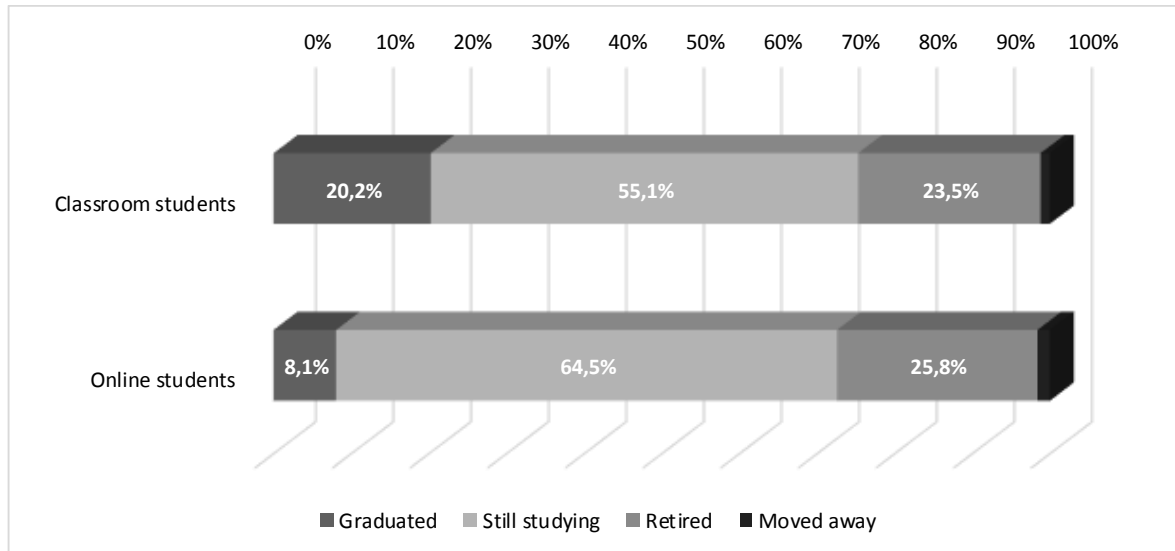


Figure 3. Present situation of SSRI students enrolled from 2009/10 to 2013/14

Table 3. Final marks of SSRI graduated students

Academic year of enrollment	Classroom students		Online students	
	# of graduations	average mark	# of graduations	average mark
2009/10	19	93,53	8	96,88
2010/11	15	93,13	9	102,78
2011/12	10	93,60	4	93,50
2012/13	6	103,50	4	100,50
Total	50	94,62	25	99,04

A possible explanation of the above is the fact that online students capable of finishing their studies without delays even while working – thus drastically reducing free time available for family and hobbies – have to be particularly motivated, high-quality students, comparable with their classroom counterparts.

3.2 Results in Exams

The considerations just made about the final graduation mark can be repeated if we look at the marks obtained by SSRI students when passing their exams during the course, as summarized in Table 4.

It is easy to see that the average mark for online students (on the Italian scale in thirtieths, where the maximum mark is 30/30 and the minimum mark for passing an exam is 18/30) is more than 1.5 higher than the one of classroom students (corresponding to 13% of the mark interval $18 \div 30$ for passed exams).

Table 4. Average marks obtained by SSRI students during the course

Academic year of enrollment	Classroom students	Online students
2009/10	23,0	24,9
2010/11	22,8	24,3
2011/12	22,8	24,4
2012/13	23,7	24,0
2013/14	22,4	24,8
Total	22,9	24,5

A better insight into student behavior can be obtained by considering the mandatory courses offered at the first year of SSRI, namely: Computer architecture (6 credits) Computer law (6 credits) Discrete mathematics (9 credits) Mathematical analysis (12 credits) Computer programming (12 credits) Probability and statistics

(6 credits) and Physics (6 credits). The 3 missed credits necessary to reach the standard amount of 60 ECTS credits per academic year are obtained by demonstrating a B1-level knowledge of the English language.

Exams of these courses can be taken at the end of their offering period. For classroom students, the academic year is organized in two semesters, while for online students – deserving to concentrate on fewer topics at a time – it is organized in three four-months periods.

As shows in Table 5., the percentages of classroom students who passed these exams are reasonably regular, while they lower significantly for the online student population, that shows an immediate decrease in the number of students able to maintain the expected study pace after the first study period.

Table 5. Behavior of students regarding first year exams of SSRI

1st year courses	Classroom students			Online students		
	year period	passed exams	av. mark	year period	passed exams	av. mark
Computer architecture	1 st semester	55,1%	24,3	1 st period	38,4%	25,9
Computer law	1 st semester	78,1%	23,2	1 st period	40,3%	24,7
Discrete mathematics	1 st semester	53,8%	22,4	2 nd period	30,3%	23,9
Mathematical analysis	2 nd semester	51,0%	23,1	2 nd period	31,9%	23,7
Computer programming	2 nd semester	44,5%	24,6	2 nd period	22,9%	25,2
Probability and statistics	2 nd semester	42,9%	25,4	3 rd period	19,7%	26,8
Physics	2 nd semester	48,2%	21,2	3 rd period	21,3%	23,3

But if we consider the time elapsed between the beginning of the first year (September 1st) and the date when the exams are passed – as shown in Table 6. – we found a similar behavior of the two populations of SSRI students (with the exception of Probability and statistics, for some reason significantly delayed by classroom students). In other words, online students capable of quickly adapting themselves to the required study pace are able to pass exams as their classroom counterpart, and e-learning materials designed for the online version demonstrate their quality and effectiveness.

Table 6. Days between beginning of first year and passing date of first year exams

1st year courses	Classroom students	Online students
Computer architecture	387	338
Computer law	252	311
Discrete mathematics	325	574
Mathematical analysis	471	403
Computer programming	462	505
Probability and statistics	1189	797
Physics	599	682

4. A LOOK AT GRADUATED STUDENTS

To complete our analysis, we can now consider SSRI students graduated from 2010 to 2013 and interviewed one year later to know their experiences after graduation. A first aspect – shown in Table 7. – regards the work condition of SSRI students during their university course.

As expected, most of the classroom students had no or little work experiences during their studies (less than 20% of them had full time employments) while more than two thirds of the online students had a full time job even following the university course. This confirms the results already outlined in Section 2.1: the two student populations have significant differences in terms of age and work position when enrolling to SSRI.

Table 7. Work condition of SSRI students during their studies

Work condition	Classroom students	Online students
Full time employed	19.4%	70.9%
Part time employed	36.1%	16.4%
Unemployed	44.4%	12.7%
Total	100%	100%

Another confirmation of the above comes from the monthly salary declared by graduated students, given in Table 8. Classroom students can clearly be defined as “fresh” workers, who entered the job market after graduation and earn salaries generally lower than 1,500 euros per month. On the contrary, a large part of online students is already present in the job market, thus their salaries are significantly higher.

Table 8. Monthly salary of SSRI students one year after graduation

Monthly salary	Classroom students	Online students
Less than 1,000 euros	30,0%	4,9%
Less than 1,500 euros	53,3%	31,7%
Less than 2,000 euros	16,7%	41,5%
Less than 2,500 euros		17,1%
More than 2,500 euros		4,9%
Total	100%	100%

We may also consider in Figure 4. the level of satisfaction of SSRI graduated students about:

- the coherence between topics studied during SSRI and competences required by the job;
- the adequacy of the level of preparation acquired during SSRI to the job requirements;
- the general satisfaction about the present job.

In general, SSRI graduated students are very or enough satisfied about their study experience related to the job they found. And – even more encouraging – online students are more positive than classroom ones regarding the competences acquired during SSRI, thus implicitly asserting the high quality of the e-learning approach.

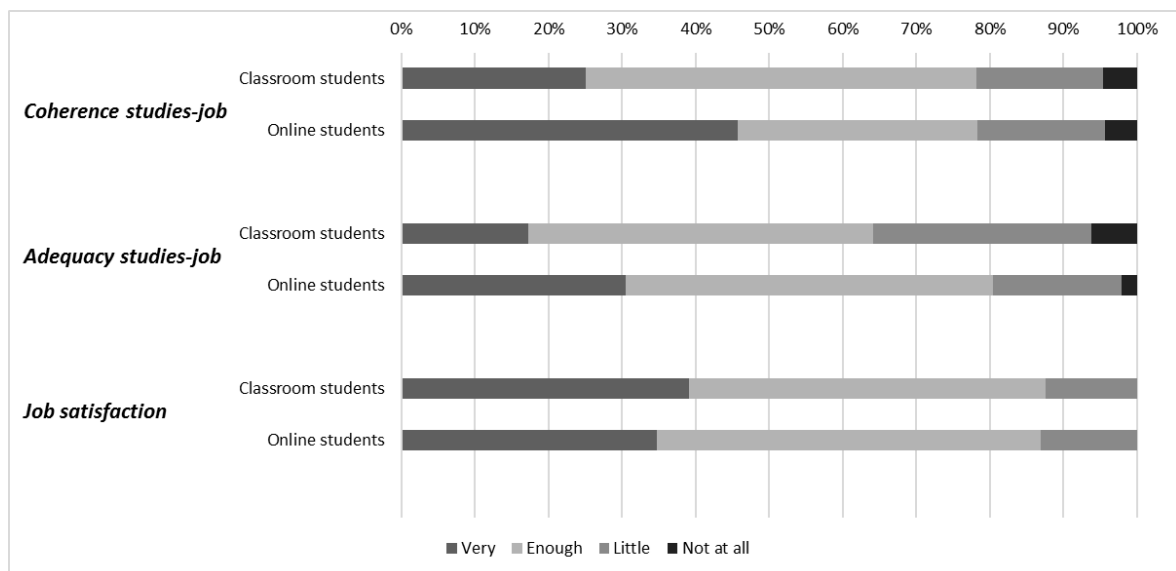


Figure 4. Level of satisfaction of graduated SSRI students

A feedback about the quality of the teaching material provided to online students – deeply discussed in Milani (2014) – can be derived also from the opinions collected from graduating students about their university experience: all online students are fully or enough satisfied of the choice they made, and 80% of them (vs. 76% of the classroom students) would repeat the same choice.

5. CONCLUSIONS

In this paper, we analyzed the characteristics of students enrolled from the first year to the undergraduate course on Security of Computer Systems and Networks (SSRI) offered both in classroom based fashion and online at the University of Milan, and some information given by graduated students one year after obtaining the final degree. Main conclusions we can draw from such analysis are the following.

Students enrolling to the online version of SSRI are definitely different from “normal” students following lectures in classroom; in fact:

- online students are significantly older;
- they are in general already occupied in a job when enrolling and during the course;
- they show a better economic situation;

thus there is almost no overlapping between the two student populations, and no “competition” between the two versions of the course. This means that the activation of an e-learning version of a university course does not steal students to the traditional, classroom version.

For several reasons – all related to their personal situation – the progression in studies of the online students is definitely slower than the one of classroom students, even if the best and most motivated online students show results in line with the classroom counterpart. This suggests the opportunity to concentrate on didactic supports aimed at helping online students to keep the correct study pace since the beginning of their university experience.

The opinions of graduated students show – perhaps surprisingly – a better feeling about the quality of the university course by people who followed the online version: this is a very positive message about the possibility of building a successful complete university course in e-learning. A better insight about the cognitive ability of both classroom and online students, their motivation, the factors that influence the effectiveness of the two modes of learning will be the subject of a future investigation.

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