TEACHING INNOVATION PROJECTS ASSOCIATED WITH THE INTRODUCTION OF THE NEW INFORMATION TECHNOLOGIES (ICTS) IMPROVE EXPECTED EDUCATIONAL RESULTS: THE CASE OF ENGINEERING STUDIES AT THE UNIVERSITY OF OVIEDO.

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Abstract

The aim of Teaching Innovation Projects is to create working groups to develop innovative teaching methods and/or contents. The University of Oviedo published six calls for Teaching and Research Staff (Spanish acronym, PDI) projects at the University of Oviedo between 2001 and 2006.

During these calls, 342 Teaching Innovation Projects were awarded and implemented in all, with a total executed budget of € 794,285.73. 80% of the Teaching Innovation Projects carried out were related to the University of Oviedo's e-learning platform, *Aulanet*.

The purpose of this study is to quantify the impact of the implemented Teaching Innovation Projects related to the publication of subject matter on the e-learning platform on academic results (Efficiency Rate and Success Rate) in degrees awarded by the University of Oviedo in the Branch of Engineering.

Worth highlighting among the study's conclusions is the fact that there was a significant improvement in academic results in 26% of the subjects in the Branch of Engineering integrated in the University of Oviedo e-learning platform in the academic years subsequent to the implementation of the Teaching Innovation Project ($p<0.05$).

Keywords:

Teaching Innovation Projects, Virtual Classroom, Academic Results, Efficiency Rate and Success Rate.

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1. Introduction

Since the 1983 reform, Spanish universities have been making significant internal changes in order to improve the quality of teaching.

Teaching staff assessment by students was introduced in the 1980's. The method employed in this assessment was that of an opinion survey questionnaire on a number of items related to different aspects of university teaching.

The 1990's saw the first calls for the so-called *National Quality Assessment Plans (Experimental Programme, European Pilot Projects and the National Plan for the Quality Assessment of Universities).*

Since 2000, the University of Oviedo has issued six calls for *Teaching Innovation Projects* that show its determination to innovate educational methods and meet the challenge with a firm commitment to the incorporation of ICTs in academic habits and the teaching-learning process, all with the view *to meet the new demands of students, to modernize the university and to prepare for the new approach of the European Higher Education Area*.

The European Higher Education Area has been established around three basic principles: *transparency in learning processes, transfer between the different university systems of acquired learning and the Centre/Degree quality assurance system as a tool for monitoring and improvement* (*Royal Decree 1125/2003, of 5th September, Real Decree 55/2005 of 21st January, Royal Decree 56/2005, of 21st January, Royal Decree 1393/2007, of 29th October, and Royal Decree 861/2010, of 2nd July.*

The new organization of university studies has prompted a change in teaching methodologies, the central pillar of which is the student learning process within a context that now extends throughout life. A new way of conceiving academic education is thus required.

Students are responsible for their learning and lecturers are to provide the conditions for this personal learning to occur. This requires a teacher who should be a trained and highly motivated university lecturer, trained in methodology, new technologies, teaching skills and the development of competences associated with tutoring, monitoring and stimulating students (Michavila, 2005; Rodriguez, 2004; Roselló, 2006; Suarez, 2005; Zabalza 2004).

Everything focuses on ensuring learning methods that guarantee the *acquisition of the competences established in each degree*. Thus, orientation activities (Alvarez, 2001) and the teaching methodology employed, including e-learning, based on student work within and outside the classroom and the procedures used to assess the acquisition of these competences play a determining role.

2. Method.

The aim of the present study is to analyse the influence of Teaching Innovation Projects on the academic results of subjects in the Branch of Engineering at the University of Oviedo. The following reference information was employed in the study:

- *Proyectos de Innovación Docente 2001 – 2006* [Teaching Innovation Projects 2001 – 2006]. *April 2008.* Centre for Innovation, University of Oviedo.
- *Estudio de Rendimiento Académico de los cursos académicos del 2001/02 al 2007/08* [Academic Performance Study of the academic years 2001/02 to 2007/08]. Technical Unit for Quality, University of Oviedo.

Figure 1. ***Teaching Innovation Projects 2001 – 2006.***

The following chart lists the various initiatives launched at the University of Oviedo to improve degree courses in which Innovation Projects play an important role.

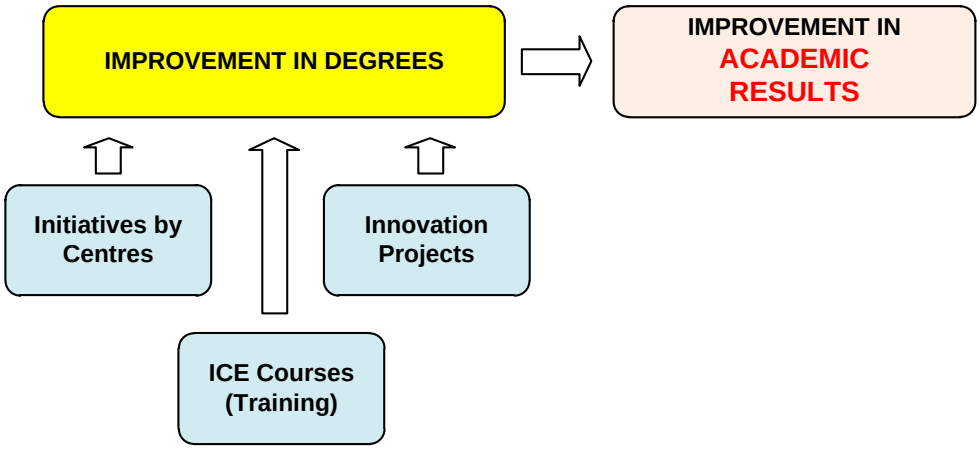

Figure 2. ***Scheme for improving degree courses.***

We next present a brief summary of the Teaching Innovation Projects and Academic Performance Study at the University of Oviedo so as to facilitate the reading and understanding of the study undertaken.

2.1. Teaching Innovation Projects[4].

The aim of the calls for Teaching Innovation Projects is to create working groups to develop innovative teaching methods and/or contents that facilitate the process of European convergence, furthering the necessary renovation of teaching methods with special emphasis on student-centred learning. During these calls, 342 Teaching Innovation Projects were awarded and implemented in all, with a total executed budget of € 794,285.73 (€ 210,000 maximum grant corresponding to the Branch of Engineering). Three types of actions have been developed:

Action A: Incorporation of subjects in the Virtual Classroom.

Projects of this type are aimed at incorporating subjects from the first, second and third cycles, as well as other subject matters of non-formal university education, in the University of Oviedo's e-learning platform, *Aulanet*, so that they can be followed in part or entirely over the Internet.

Action B: Grants to support the incorporation of innovative teaching materials in the Virtual Classroom.

Actions of this type are aimed at creating working groups to develop teaching content in the first, second and third cycles, as well as other matters of non-formal university education, so as to have complementary study materials that may be followed over the Internet, on the University of Oviedo's e-learning platform, *Aulanet*.

Action C: Grants to support educational innovation.

This type of action aims to foster educational innovation through the training and consolidation of working groups that undertake research and develop experiences within the framework of the EHEA aimed at producing changes that lead to improved education, with special reference to those that affect the different ways of working and the teacher/student relationship.

The main aim of the University of Oviedo's Virtual Campus is to facilitate the education and preparation of students in a flexible environment that adapts to their needs.

Since it was created in 1999, it has taken shape as a virtual university community in continual progress and evolution that currently includes over 2,000 subjects, as well as involving more than 1,200 lecturers and over 25,000 students.

[4] *Information from the University of Oviedo publication: Proyectos de Innovación Docente [*Teaching Innovation Projects*] 2001-2006.*

The development of Innovation Projects fosters:

- **In teachers:** their work as facilitators of the student learning process, the evaluation of their participation to achieve joint goals, their willingness to learn from people, opinions or ideas different from their own and individual fulfilment of assigned tasks in joint activities, in accordance with high standards.
- **In students:** their participation and accountability in the results obtained in the teaching-learning process, both their own as well as that of the classmates with whom they undertake joint activities, as well as their ability to reconcile differences and achieve group agreements.

2.2. Academic Performance Study[5].

The main aim is to report on the status and evolution of University of Oviedo degrees as regards the progress and results of student learning (De Miguel, 2001). The indicators used as estimators of academic results considered in the study are:

Regarding graduated students:

Efficiency Rate (ER): the percentage ratio between the total number of credits that those students who graduated from among those in their final year should have enrolled in to obtain their degree and the total number of credits in which they did actually enrol in.

Regarding all the students in the academic year:

Success Rate (SR) the percentage ratio between the total number of credits passed and the total number of credits for all students.

[5] *Information from: Estudio de Rendimiento Académico de Titulaciones [*Academic Degree Performance Study*] prepared by the Technical Unit for Quality.*

3. Results and discussion.

The following table presents information on the Teaching Innovation Projects undertaken between 2001 and 2006 by department.

DEPARTAMENT	2001	2002	2003	2004	2005	2006	Total
Business Administration and Accounting	1	0	2	1	3	6	**13**
Organisms and Systems Biology	0	1	2	2	1	0	**6**
Functional Biology	0	0	3	4	4	2	**13**
Education Sciences	8	2	0	2	6	3	**21**
Basic Legal Sciences	0	0	1	0	0	0	**1**
Surgery and Medical-Surgical Specialties	5	0	0	0	1	2	**8**
Construction and Manufacturing Engineering	5	3	5	7	6	5	**31**
Private and Business Law	0	0	0	1	2	2	**5**
Public Law	1	1	0	2	0	0	**4**
Economics	0	0	1	4	3	0	**8**
Applied Economics	6	5	4	4	6	0	**25**
Quantitative Economics	0	3	3	2	1	1	**10**
Energy	2	1	1	1	3	0	**8**
Statistics and Operational and Educational Research in Mathematics	0	0	0	0	1	1	**2**
Mine Workings and Prospection	2	2	3	3	6	5	**21**
Anglo-Germanic and French Philology	2	1	2	1	2	1	**9**
Classical and Romance Philology	2	3	1	3	1	0	**10**
Spanish Philology	3	0	0	0	1	0	**4**
Philosophy	0	1	0	0	0	0	**1**
Physics	1	0	0	4	3	2	**10**
Geography	0	0	0	0	0	2	**2**
Geology	5	0	3	0	0	0	**8**
History	0	0	0	0	2	0	**2**
Art History and Musicology	0	0	0	0	1	0	**1**
Information Technology	2	1	1	2	4	4	**14**
Chemical Engineering and Environmental Technology	2	0	1	1	1	0	**5**
Electrical Engineering Computer and Systems Electronics	10	12	7	10	17	8	**64**
Mathematics	1	0	3	2	2	2	**10**
Medicine	1	0	0	0	1	0	**2**
Cell Morphology and Biology	0	0	0	1	3	1	**5**
Psychology	1	1	1	2	2	1	**8**
Physical and Analytical Chemistry	0	0	2	3	2	1	**8**
Organic and Inorganic Chemistry	1	0	0	0	1	1	**3**
Total UO	**61**	**37**	**46**	**62**	**86**	**50**	**342**

Table 1. Distribution of Projects by Department.

Note: Departments belonging to the Field of Engineering are shaded.

Next we present the data on the evolution –from the academic year 2001/2002 to that of 2007/2008– of the results for the Success Rate and Efficiency Rate for the subjects in which Teaching Innovation Projects were implemented (Branches of Knowledge established in Royal Decree 1393/2007, of 29th October, establishing the regulating of official university studies) (Tejedor, 2007).

YEAR	2001-2002		2002-2003		2003-2004		2004-2005		2005-2006		2006-2007		2007-2008	
BRANCH OF KNOWLEDGE	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR
Arts and Humanities	42.34	85.45	41.83	86.17	40.38	86.68	40.65	87.15	43.61	88.57	44.55	88.95	46.12	89.22
Sciences	37.75	79.67	37.97	79.42	36.20	78.09	38.30	79.00	36.37	77.03	35.86	78.75	35.56	78.73
Health Sciences	67.17	93.12	68.62	92.46	68.66	92.21	66.48	90.90	66.50	91.78	66.00	91.01	64.45	90.23
Social and Legal Sciences	37.64	79.52	37.50	80.29	35.35	79.65	37.32	80.44	37.06	80.79	39.48	81.44	41.31	81.96
Engineering	**30.48**	**77.74**	**32.10**	**77.69**	**37.44**	**79.46**	**36.40**	**78.16**	**39.01**	**80.40**	**34.97**	**79.05**	**34.03**	**78.60**
Total Subjects with Projects	**34.54**	**76.23**	**35.72**	**77.28**	**37.18**	**79.30**	**38.62**	**79.39**	**39.62**	**80.59**	**38.02**	**79.11**	**38.84**	**79.82**
Total UO	**36.84**	**80.45**	**37.71**	**80.92**	**38.29**	**81.02**	**39.02**	**81.01**	**39.97**	**81.86**	**39.87**	**82.01**	**40.48**	**82.12**

Table 2. ER and SR results in the different Branches of Knowledge.

The Branch of Engineering was chosen because the teaching staff belonging to this branch has more experience in using the virtual campus and in publishing content online. The study was conducted on 25 out of the 68 subjects in the Branch of Engineering in which Type A, B and C Teaching Innovation Projects were implemented in all the cases related to the University of Oviedo's e-learning platform.

The following is a list of topics related to the Projects undertaken in the 25 subjects selected for the study:

- 4 projects focus on adapting the subject to the EHEA.
- 18 projects focus on extending the scope of e-Teaching.
- 8 projects focus on support for teaching through new technologies.
- 3 Projects are devoted to coordination between subjects.

Note: There are cases in which more than one Project was implemented in a subject and also in which one Project was implemented in several subjects.

SUBJECT	PROJECT THEME
AUTOMATA AND DISCRETE MATHEMATICS	Adaptation to the EHEA.
MOBILE AND SATELLITE COMMUNICATIONS	Support for teaching through the new technologies.
CONSTRUCTION	Interdisciplinary coordination of subjects.
PHOTONIC DEVICES	Expansion of the scope of e-teaching.
ANALOG ELECTRONICS	Support for teaching through the new technologies.
GRAPHIC EXPRESSION	Expansion of the scope of e-teaching. Coordination between subjects.
PHOTOGRAMMETRY I	Adaptation to the EHEA. Expansion of the scope of e-teaching.
FUNDAMENTALS OF ELECTRONICS	Support for teaching through the new technologies.
GEOLOGICAL ENVIRONMENTAL ENGINEERING	Support for teaching through the new technologies.
CHEMICAL ENGINEERING AND ENVIRONMENTAL TECHNOLOGY	Expansion of the scope of e-teaching.
OFFICE SYSTEMS IN PROJECT MANAGEMENT. THE PROJECT AND QUALITY ASSURANCE	Support for teaching through the new technologies. Interdisciplinary coordination of subjects.
FLUID MECHANICS	Expansion of the scope of e-teaching.
PROGRAMMING METHODOLOGY I	Expansion of the scope of e-teaching.
MICROWAVES	Expansion of the scope of e-teaching.
RADAR AND RADIOLOCATION	Expansion of the scope of e-teaching.
RADIATION AND RADIOPROPAGATION	Expansion of the scope of e-teaching.
AUTOMATIC CONTROL	Expansion of the scope of e-teaching. Support for teaching through the new technologies.
TELECOMMUNICATION SYSTEMS	Expansion of the scope of e-teaching.
OPERATING SYSTEMS	Expansion of the scope of e-teaching. Support for teaching through the new technologies.
ELECTRONIC TECHNOLOGY AND INSTRUMENTATION	Adaptation to the EHEA. Expansion of the scope of e-teaching.
ELECTRONICS TECHNOLOGY	Expansion of the scope of e-teaching. Support for teaching through the new technologies.
REMOTE SENSING	Expansion of the scope of e-teaching.
TOPOGRAPHY AND CARTOGRAPHIC SYSTEMS	Expansion of the scope of e-teaching.
HEAT TRANSFER	Adaptation to the EHEA. Expansion of the scope of e-teaching.
DIGITAL SIGNAL PROCESSING	Expansion of the scope of e-teaching.

Table 3. Teaching Innovation Project Themes.

The study results show a marked improvement in academic results in 7 of the 25 selected subjects incorporated in the Virtual Campus.

Even though they may have some long-term relationship, the Success and Efficiency Rates are ratios may reflect conflicting results because they are independent rates. This is because the Success Rate is calculated using data that affect a single academic year, while the background of the students related to the subject in question is examined to calculate the Efficiency Rate. The accumulation of students adversely affects the Efficiency Rate, but has no influence on the Success Rate. See the definition of both these rates in the Methods section of the study.

The following table shows the evolution from the academic year 2001/2002 to that of 2007/2008 of Success Rate and Efficiency Rate results for the subjects under study.

ACADEMIC YEAR	2001-2002		2002-2003		2003-2004		2004-2005		2005-2006		2006-2007		2007-2008		PROJ
SUBJECT	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	INN
1 AUTOMATA AND DISCRETE MATHEMATICS	25.39	46.43	16.72	32.70	23.77	50.71	17.14	40.00	22.12	55.37	26.42	67.52	25.00	64.29	2005
2 MOBILE AND SATELLITE COMMUNICATIONS	--	--	--	--	--	--	75.86	84.62	95.74	100	94.87	100	88.89	100	2005
3 CONSTRUCTION	84.62	100	84.89	97.95	74.60	100	79.10	100	68.24	100	60.58	100	77.08	100	2005
4 PHOTONIC DEVICES	79.17	88.37	79.17	89.41	76.47	93.98	72.22	91.55	56.04	75.00	37.11	64.29	47.92	82.14	2005
5 ANALOG ELECTRONICS	--	--	--	--	55.10	81.82	34.94	58.00	31.01	70.18	26.58	60.87	29.05	74.29	2004 2002
6 GRAPHIC EXPRESSION	22.58	51.38	23.74	66.95	20.56	64.32	16.79	57.20	17.75	59.85	13.98	68.24	19.50	68.78	2002 2003 2005 2006
7 PHOTOGRAMMETRY I	24.70	73.21	20.99	65.38	17.54	61.29	15.30	67.50	10.86	65.15	7.61	45.45	27.77	77.97	2006
8 FUNDAMENTALS OF ELECTRONICS	--	--	--	--	--	--	64.03	83.96	58.51	94.02	48.54	96.67	43.82	93.22	2004
9 GEOLOGICAL ENVIRONMENTAL ENGINEERING	56.35	88.70	47.22	95.77	59.63	91.73	43.81	88.46	48.80	95.31	39.36	94.87	43.22	96.23	2005
10 CHEMICAL ENGINEERING AND ENVIRONMENTAL TECHNOLOGY	40.53	84.25	33.64	71.29	28.41	66.67	26.72	75.61	27.20	77.27	26.61	72.50	27.14	74.51	2003
11 OFFICE SYSTEMS IN PROJECT MANAGEMENT THE PROJECT AND QUALITY ASSURANCE	--	--	88.46	100	72.73	100	75.51	97.37	63.89	100	76.79	100	63.64	100	2005 2006
12 FLUID MECHANICS	35.37	88.21	36.53	94.36	26.11	79.79	35.72	90.04	39.83	88.77	34.92	75.33	44.67	88.91	2005
13 PROGRAMMING METHODOLOGY I	16.64	53.30	21.68	64.89	19.95	69.12	23.50	76.02	23.22	75.51	16.38	49.48	21.01	70.42	2005
14 MICROWAVES	--	--	--	--	50.00	64.29	40.26	58.49	47.10	89.04	29.05	65.15	24.46	66.18	2004
15 RADAR AND RADIOLOCATION	--	--	--	--	--	--	73.68	87.50	77.27	94.44	100	100	100	100	2005
16 RADIATION AND RADIOPROPAGATION	--	--	--	--	47.37	66.67	39.73	76.32	37.84	76.36	28.93	77.97	30.32	89.06	2003
17 AUTOMATIC CONTROL	38.93	90.65	32.22	85.58	50.96	85.38	55.78	97.24	24.56	90.32	40.43	100	36.54	100	2002
18 TELECOMMUNICATION SYSTEMS	--	--	--	--	--	--	71.43	88.24	56.86	78.38	26.32	45.45	36.11	81.25	2006
19 OPERATING SYSTEMS	49.12	60.87	38.24	65.00	51.05	75.56	52.00	82.98	39.17	81.73	30.17	76.07	29.11	89.38	2005
20 ELECTRONIC TECHNOLOGY AND INSTRUMENTATION	--	--	65.00	100	52.38	100	66.67	100	80.00	100	66.67	100	38.46	100	2005

ACADEMIC YEAR	2001-2002		2002-2003		2003-2004		2004-2005		2005-2006		2006-2007		2007-2008		PROJ
SUBJECT	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	INN
21 ELECTRONICS TECHNOLOGY	93.75	100	53.85	67.12	41.95	68.38	27.09	58.70	29.67	70.94	24.34	66.52	25.67	64.68	2005
22 REMOTE SENSING	75.86	100	52.17	76.60	59.09	93.98	59.02	93.51	45.11	76.92	43.36	84.93	56.52	94.79	2005
23 TOPOGRAPHY AND CARTOGRAPHIC SYSTEMS	42.94	71.29	30.49	72.10	19.31	67.39	12.54	71.69	14.20	70.22	6.94	38.79	18.18	83.06	2006
24 HEAT TRANSFER	--	--	--	--	68.09	85.33	48.04	80.33	42.70	75.00	37.76	74.42	34.76	68.78	2005
25 DIGITAL SIGNAL PROCESSING	--	--	--	--	66.67	86.96	60.26	75.81	39.47	70.31	34.55	76.00	29.03	75.00	2005
Total Subjects in Study	**31.09**	**69.71**	**28.97**	**68.26**	**30.81**	**71.72**	**32.31**	**74.82**	**30.66**	**76.22**	**26.72**	**70.17**	**30.92**	**79.19**	

Table 4. ER and SR results in the different Subjects.

The table below shows the evolution of Success Rates in relation to the Branch of Engineering.

YEAR	2001-2002		2002-2003		2003-2004		2004-2005		2005-2006		2006-2007		2007-2008	
	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR
Total Subjects in Study	31.09	69.71	28.97	68.26	30.81	71.72	32.31	74.82	30.66	76.22	26.72	70.17	30.92	79.19
Total Branch of Engineering	**30.48**	**77.74**	**32.10**	**77.69**	**37.44**	**79.46**	**36.40**	**78.16**	**39.01**	**80.40**	**34.97**	**79.05**	**34.03**	**78.60**
Total Subjects with Projects	**34.54**	**76.23**	**35.72**	**77.28**	**37.18**	**79.30**	**38.62**	**79.39**	**39.62**	**80.59**	**38.02**	**79.11**	**38.84**	**79.82**
Total UO	**36.84**	**80.45**	**37.71**	**80.92**	**38.29**	**81.02**	**39.02**	**81.01**	**39.97**	**81.86**	**39.87**	**82.01**	**40.48**	**82.12**

Table 5. ER and SR results in general.

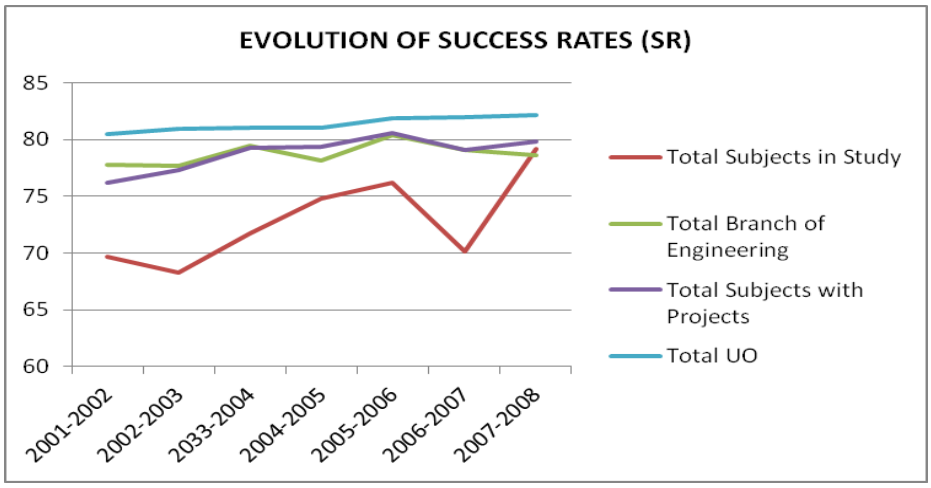

Figure 3. Evolution of Success Rates in Engineering.

Analysing these rates, it can be seen that the Success Rate improved right from the moment when Teaching Innovation activities were implemented at the University of Oviedo.

To analyse the correlations between the results and the influence Teaching Innovation Projects have on these, a statistical study was carried out in accordance with the following phases:

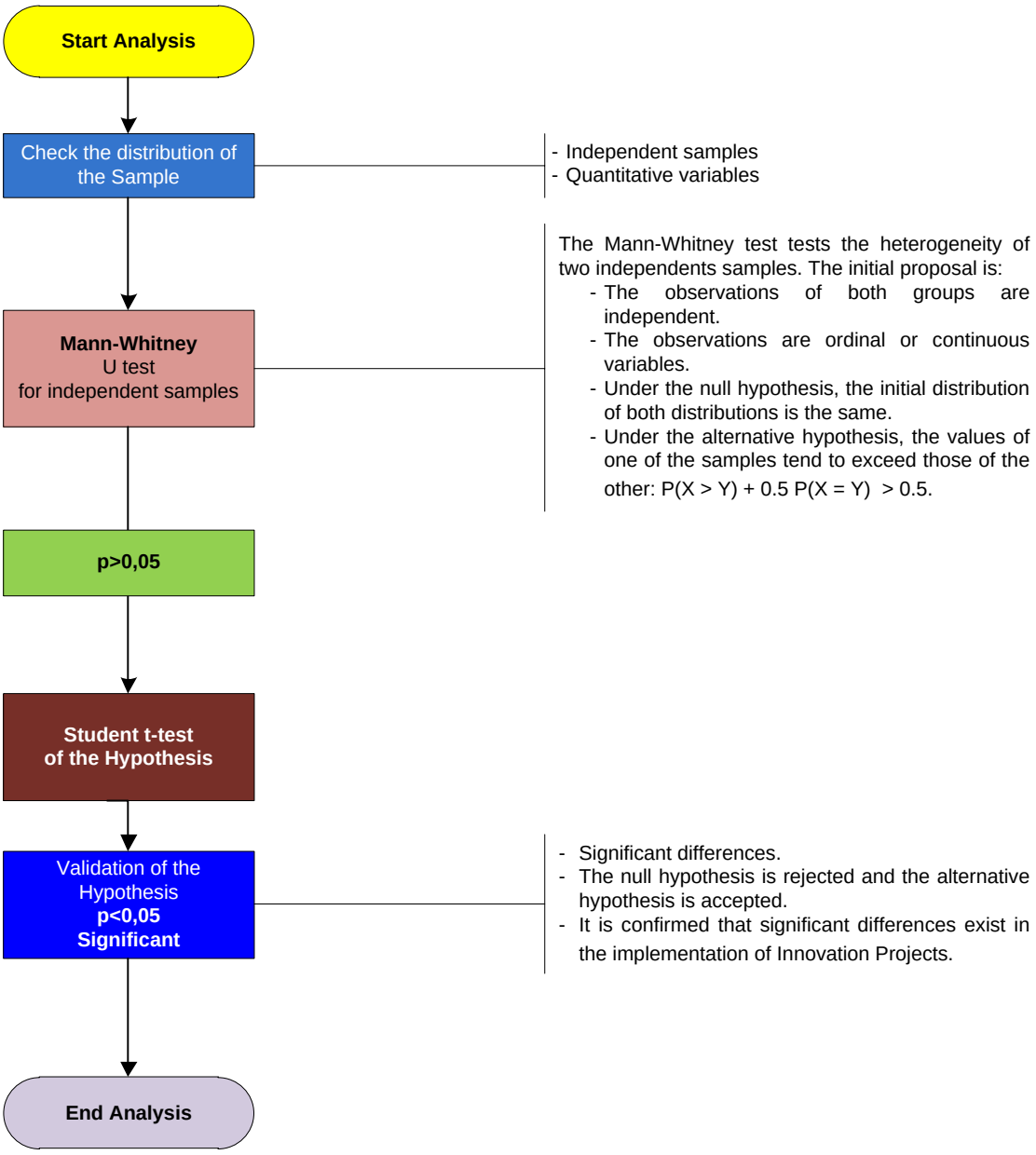

Figure 4. Sequence of analysis for validating the study.

Following the completion of the above phases, it can be seen that significant differences exist ($p<0.05$) as a result of the implementation of the Teaching Innovation Projects, both in the case of the Success Rate and in the Efficiency Rate in the academic years 2004/2005 and 2005/2006 (the distribution meets the Mann-Whitney U test of normality).

As an example, we next present three graphs with the results obtained in the studies carried out for the Branch of Engineering. These graphs represent the evolution of the Efficiency Rate and Success Rate between the academic years 2001/2002 to 2006/2007 (depending on the information available on these rates; see previous tables) for the selected subjects incorporated in the Virtual Campus by means of Teaching Innovation Projects. **The green vertical line represents the academic year in which a Teaching Innovation Project was implemented**. The influence of the publication of the subjects on the Virtual Campus on the aforementioned rates can be thus be appreciated, in addition to a clear comparison of the performance of each subject.

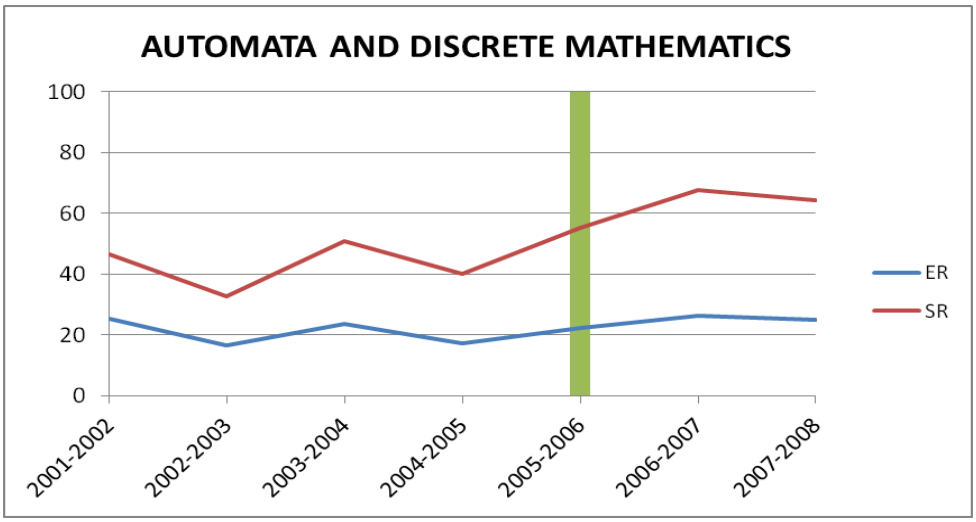

Figure 5. Automata and Discrete Mathematics

As regards the Department of Computer Science subject *Automata and Discrete Mathematics*, an increase in the value of the Efficiency Rate can be appreciated from the academic year in which the Teaching Innovation Project "**Pilot Experience for Integrating the Subject *Automata and Discrete Mathematics* in the 3-year Computer Engineering Degree in the European Higher Education Area**". This increase means a rise of slightly more than 7 percentage points between the academic years 2004/2005 and 2007/2008 (17.14% to 25% growth during the academic year 2007-2008).

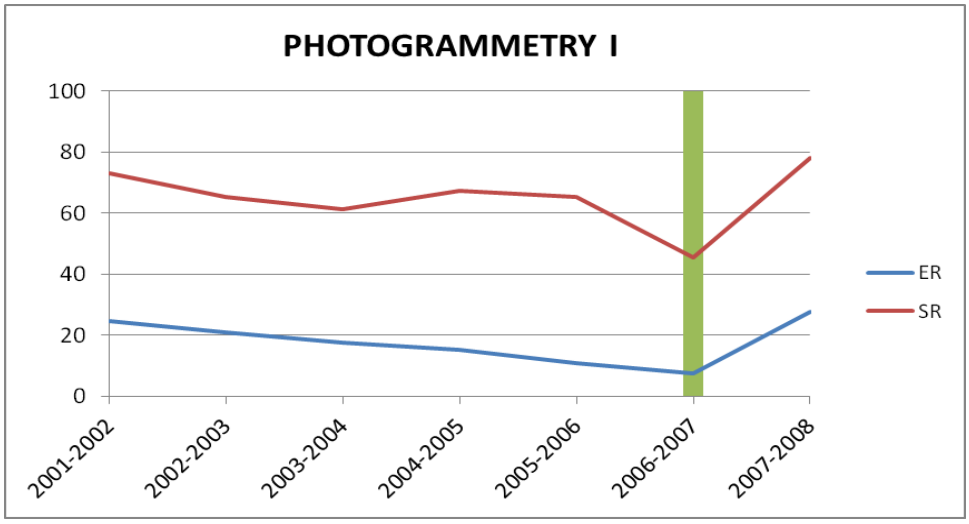

Figure 6. Photogrammetry I.

In the Department of Mine Workings and Prospection subject *Photogrammetry I*, a marked improvement in the values of the Efficiency Rate and the Success Rate can be seen from the academic year in which the Teaching Innovation Project "**Application of Complementary Teaching and Assessment Methodologies, based on the use of ICTs, and Adaptation of the Content of the Subject *Photogrammetry I* to the Current Career Prospects of Technical Engineers in Topography**". This increase represents more than 30 percentage points in the Success Rate and 20 percentage points in the Efficiency Rate.

The increase in the aforementioned rates in the academic year 2007/2008 is also a consequence of self-assessment in the 3-year Technical Engineering Degree in Topography within the ANECA 2005/2006 Institutional Assessment Programme, which resulted in an improvement plan for the degree.

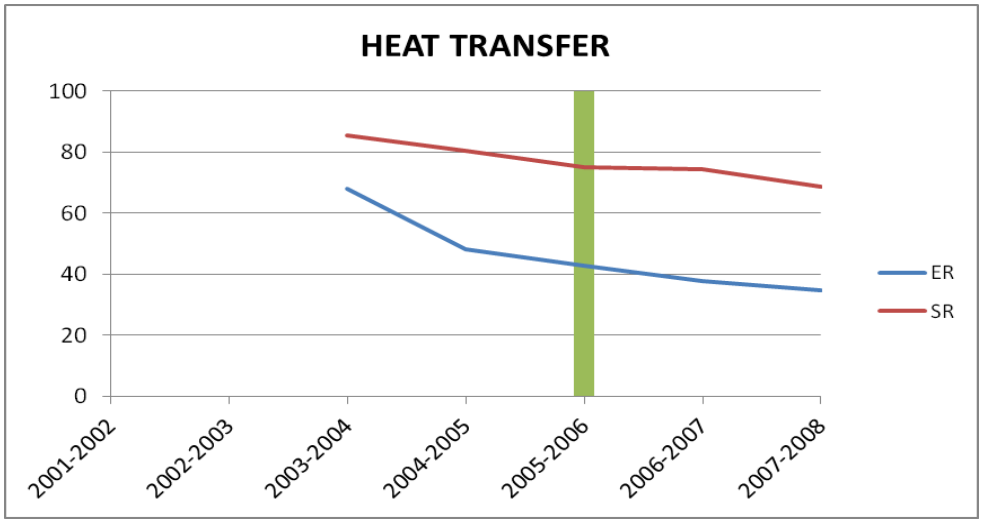

Figure 7. Heat Transfer

Regarding the Department of Energy subject *Heat Transfer*, a slight decrease in the results for both rates (Efficiency and Success) can be appreciated from the academic year in which the Teaching Innovation Project "**Preparation and Web Implementation of Teaching Materials for Heat Transfer**" was implemented, because the actions carried out did not have a direct impact on the subject's teaching-learning methodology.

4. Conclusions.

The study provides evidence that Teaching Innovation Projects based on publishing subjects on the virtual campus platform has had a direct and relevant impact on improving academic results in subjects in the Branch of Engineering at the University of Oviedo, as reflected in Efficiency Rates and Success Rates. This improvement in academic achievement is most clearly evident when analysing the available information on subjects, which shows a variable increase in rates, depending on each subject, from the academic year in which a Teaching Innovation Project is implemented.

The following conclusions that may be drawn from the study are worth highlighting.

1. 28% (7 out of 25) of the subjects in the Branch of Engineering incorporated in the University of Oviedo's e-learning platform improved markedly in terms of academic results (Success Rate and Efficiency Rate) in the academic years subsequent to the implementation of Teaching Innovation Projects.
2. 56% (14 out of 25) of the subjects in the Branch of Engineering incorporated in the University of Oviedo's e-learning platform improved markedly in terms of the Success Rate in the academic years subsequent to the implementation of Teaching Innovation Projects.
3. 16% (4 out of 25) of the subjects in the Branch of Engineering incorporated in the University of Oviedo's e-learning platform worsened in terms of the Success Rate in the academic years subsequent to the implementation of the Teaching Innovation Projects due to not having had a direct effective impact on the student teaching/learning process.
4. The hypothesis that significant differences exist in the improvement in Success and Efficiency Rates with the implementation of Innovation Projects in the academic years 2004/2005 and 2005/2006 is confirmed.
5. Students have made a highly positive assessment of the changes introduced in the different subjects involved in the implemented projects. Furthermore, a high percentage of students participated in the proposed alternative form of assessment, which has likewise led to increased teacher-student and student-student communication, fostering metacognitive processes of learning and introducing changes in the role of the student and the lecturer with respect to traditional methods.
6. It has been shown that students have taken on a very active role in their own education, becoming more involved in the development of the subject via the use of active methodologies, as required by the European Higher Education Area. They have needed to resort to educational instruments outside the classroom, in libraries, over the Internet, etc., which has redounded in a theoretical-practical view of the teaching received.

7. Students have assumed responsibility for and become more autonomous in their own learning process, thereby acquiring a great potential for their future permanent development throughout life (Lifelong Learning).
8. The use of the University of Oviedo's e-learning platform (Virtual Campus) has increased and been improved by expanding the content and improving the interface and access to contents (see Figure 8).

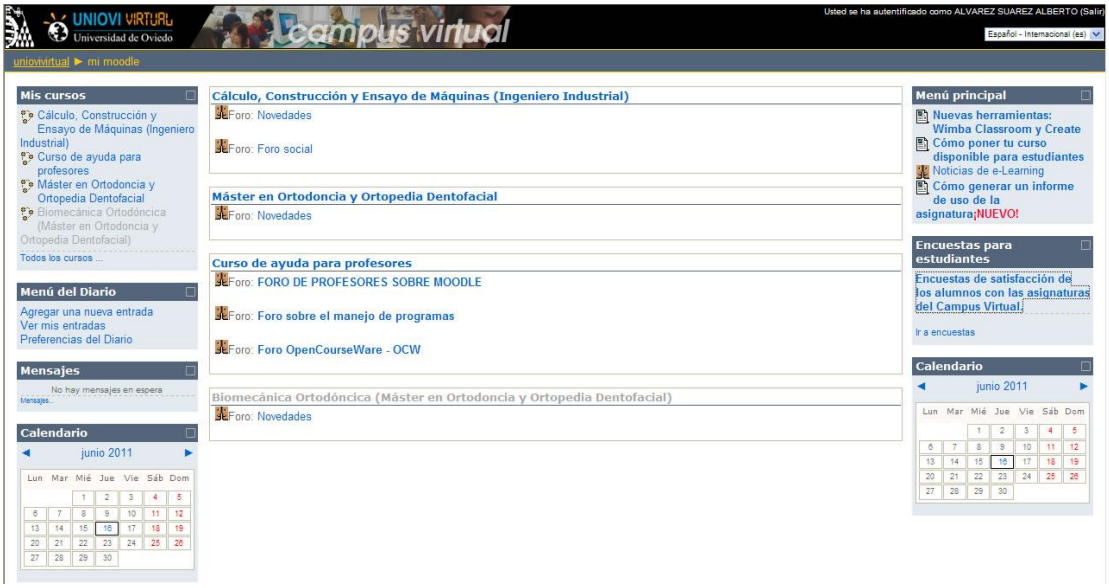

Figure 8. Virtual Campus user screen.

In direct relation to the results of the study, the University of Oviedo's Virtual Campus platform is progressing towards a web 2.0 (e-learning 2.0), which is characterised by offering information on what will be studied in all teaching units and the associated objectives right from the start.

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6. APPENDIX I: Tables of Statistical Results

Resumen de contrastes de hipótesis

	Hipótesis nula	Prueba	Sig.	Decisión
1	La distribución de TEF20012002 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,358	Conserve la hipótesis nula.
2	La distribución de TEX20012002 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,727	Conserve la hipótesis nula.
3	La distribución de TEF20022003 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,244	Conserve la hipótesis nula.
4	La distribución de TEX20022003 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,104	Conserve la hipótesis nula.
5	La distribución de TEF20032004 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,999	Conserve la hipótesis nula.
6	La distribución de TEX20032004 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,986	Conserve la hipótesis nula.
7	La distribución de TEF20042005 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,142	Conserve la hipótesis nula.
8	La distribución de TEX20042005 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,035	Rechace la hipótesis nula.
9	La distribución de TEF20052006 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,113	Conserve la hipótesis nula.
10	La distribución de TEX20052006 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,116	Conserve la hipótesis nula.
11	La distribución de TEF20062007 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,003	Rechace la hipótesis nula.
12	La distribución de TEX20062007 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,001	Rechace la hipótesis nula.
13	La distribución de TEF20072008 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,010	Rechace la hipótesis nula.
14	La distribución de TEX20072008 es la misma entre categorías de PRYT.	Prueba U de Mann-Whitney para muestras independientes	,003	Rechace la hipótesis nula.

Se muestran significaciones asintóticas. El nivel de significación es de ,05.

Figure 9. Summary of the tests of the hypotheses.

Prueba de muestras independientes

		Prueba de Levene para la igualdad de varianzas		Prueba T para la igualdad de medias						
									95% Intervalo de confianza para la diferencia	
		F	Sig.	t	gl	Sig. (bilateral)	Diferencia de medias	Error típ. de la diferencia	Inferior	Superior
TEF20012002	Se han asumido varianzas iguales	1,477	,225	1,018	1042	,309	2,76155	2,71242	-2,56088	8,08399
	No se han asumido varianzas iguales			,985	174,038	,326	2,76155	2,80340	-2,77149	8,29460
TEX20012002	Se han asumido varianzas iguales	2,341	,126	-,009	1030	,993	-,01673	1,81114	-3,57066	3,53721
	No se han asumido varianzas iguales			-,009	170,763	,993	-,01673	1,88150	-3,73072	3,69727
TEF20022003	Se han asumido varianzas iguales	2,702	,100	1,338	1274	,181	3,37567	2,52360	-1,57519	8,32653
	No se han asumido varianzas iguales			1,292	222,219	,198	3,37567	2,61231	-1,77240	8,52373
TEX20022003	Se han asumido varianzas iguales	,117	,733	1,239	1236	,216	1,99357	1,60905	-1,16320	5,15033
	No se han asumido varianzas iguales			1,233	216,808	,219	1,99357	1,61667	-1,19284	5,17997
TEF20032004	Se han asumido varianzas iguales	3,516	,061	-,041	1280	,967	-,10392	2,51645	-5,04074	4,83290
	No se han asumido varianzas iguales			-,043	224,677	,965	-,10392	2,39816	-4,82969	4,62185
TEX20032004	Se han asumido varianzas iguales	,253	,615	,022	1240	,982	,03538	1,58407	-3,07237	3,14314
	No se han asumido varianzas iguales			,022	210,722	,982	,03538	1,60057	-3,11979	3,19056
TEF20042005	Se han asumido varianzas iguales	5,611	,018	-1,416	1307	,157	-3,62780	2,56173	-8,65335	1,39774
	No se han asumido varianzas iguales			-1,489	221,695	,138	-3,62780	2,43639	-8,42926	1,17365
TEX20042005	Se han asumido varianzas iguales	,008	,928	-1,499	1263	,134	-2,36890	1,58061	-5,46981	,73201
	No se han asumido varianzas iguales			-1,440	204,192	,151	-2,36890	1,64466	-5,61158	,87379
TEF20052006	Se han asumido varianzas iguales	8,492	,004	-1,675	1244	,094	-4,37294	2,61051	-9,49442	,74855
	No se han asumido varianzas iguales			-1,769	211,534	,078	-4,37294	2,47202	-9,24589	,50002
TEX20052006	Se han asumido varianzas iguales	,002	,964	-1,407	1208	,160	-2,16872	1,54123	-5,19250	,85507
	No se han asumido varianzas iguales			-1,320	192,438	,189	-2,16872	1,64356	-5,41043	1,07299
TEF20062007	Se han asumido varianzas iguales	11,064	,001	-3,192	1172	,001	-8,71843	2,73157	-14,07775	-3,35912
	No se han asumido varianzas iguales			-3,468	183,639	,001	-8,71843	2,51407	-13,67861	-3,75825
TEX20062007	Se han asumido varianzas iguales	6,530	,011	-3,237	1145	,001	-5,14203	1,58850	-8,25873	-2,02533
	No se han asumido varianzas iguales			-3,029	166,962	,003	-5,14203	1,69745	-8,49326	-1,79080
TEF20072008	Se han asumido varianzas iguales	7,176	,007	-2,600	1149	,009	-7,17748	2,76094	-12,59453	-1,76043
	No se han asumido varianzas iguales			-2,812	180,637	,005	-7,17748	2,55286	-12,21475	-2,14021
TEX20072008	Se han asumido varianzas iguales	6,125	,013	-3,171	1095	,002	-5,04575	1,59137	-8,16823	-1,92326
	No se han asumido varianzas iguales			-2,758	159,576	,006	-5,04575	1,82956	-8,65902	-1,43247

Figure 10. Independent sample test results.