

Engineering Education Research in Spain

A review through the Education Awards of CESEI - IEEE

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Abstract—In this paper, a review of the educational research that is being developed in Spain is realized in the areas of Electrical, Electronics, Telecommunications and Informatics through the works presented to the prizes CESEI (Spanish Chapter of the Education Society of the IEEE) in his three editions. There are two categories of candidates to the prizes, one for the Doctoral Thesis and the second for the Final Degree (or Master) Projects. An analysis of the working areas, the subjects covered as well as the conferences and journals where the results are published has been done. The main goal of this paper is to have a general vision about the work done in such areas of educational research in Spain that will be very interesting for academic staff and researchers.

Keywords- *doctoral thesis; educational research; engineering*

I. INTRODUCTION

The University plays a very important role in the Society as responsible for the education of future engineers and staff members of companies and Administration. University teachers must split their work in three fields: academic, research and management. For this reason, not always they can devote enough time to the academic activity.

Nevertheless, in the last years an effort for empowering the research and innovation in education is being observed. This effort has been reflected in the increase of the number of reviews and conferences dedicated to the higher education, as well as in the number of papers published and research projects developed in this field.

In the present paper, a review has been done about the research in education carried out in Spain in the areas of Electrical, Electronics, Telecommunications and Informatics through the works presented to the CESEI prizes (Spanish Chapter of the Education Society of the IEEE) in its three editions 2007, 2008 and 2009 and for both categories, best Doctoral Thesis and best Final Degree (or Master) Projects.

In section II Spanish Chapter of the Education Society of the IEEE, organizer of these prizes will be presented. In section III, the works (doctoral thesis and final degree projects) presented to the three editions of the prizes will be analyzed. An analysis of the working areas, the subjects covered as well as the congresses and journals where the results are published will be done.

In section IV other reviews and conferences, not mentioned by the candidates to the prizes, but of great interest in the fields of research of the IEEE Education Society will be reviewed.

Finally, section V presents the conclusions of the work.

The main objective of this paper is to have a general vision about the work done in such areas of educational research in engineering areas in Spain, that we think could be very interesting for academic staff and researchers.

II. CESEI PRESENTATION

The IEEE is a non-profit organization and is the world's leading professional association for the advancement of technology. The IEEE name is an acronym for the Institute of Electrical and Electronics Engineers, Inc. Today, the organization's scope of interest has expanded into so many related fields such Automation, Telecommunication or Informatics, but it continues to be referred to by the letters I-E-E (pronounced Eye-triple-E) [1].

IEEE includes many unique technical societies, active in the areas of publications, conferences and building technical communities. Between these organizations, the Education Society (EdSoc), was created with the main aim of "shall be scientific, literary, and educational in character. The Society shall strive for the advancement of the theory and practice of electrical and computer engineering and of the allied arts and sciences, and the maintenance of a high professional standing among its members and affiliates, all in consonance with the Constitution and Bylaws of the IEEE and with special attention to such aims within the field of interest of the Society" [2].

Its fields of interest are: "Educational Methods, Educational Technology, Instructional Materials, History of Science and Technology, and Educational and Professional Development Programs within Electrical Engineering, Computer Engineering, and allied disciplines" [2].

In Spain in the year 2004 was created the Spanish Chapter of the Education Society of the IEEE (from now on CESEI). The CESEI has the same interests and aims that the IEEE EdSoc has and to whom it belong, but the CESEI tries to develop its interest and aims in Spain and in Spanish language [3].

At the moment, the CESEI is constituted by a Directive Board with a Director and three committees:

- Technical Committee of Accreditation and Evaluation (CTAE in Spanish).
- Committee of Activities, Dissemination and Web (CADW in Spanish).
- Committee of Members and Relationship with Associations (CMRE in Spanish).

and four work teams as shown in Fig. 1.

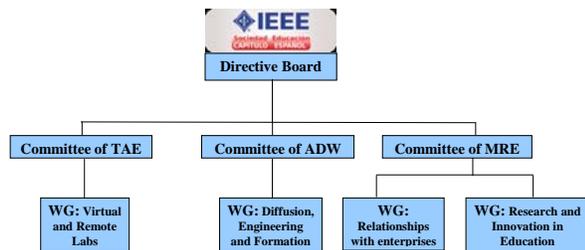


Figure 1. Structure of the Spanish Chapter of the Education Society of the IEEE (CESEI).

Since his creation in 2004, the CESEI has tried to be a meeting point for the responsible from the University as from the Enterprise that work for the improvement of the teaching of engineering and computing .

For that reason, between others, promotes the next activities:

- Edition of the International Review, edited in Spanish and Portuguese, IEEE-RITA (Latin-American Learning Technologies Journal) [4].
- Edition of the book: TICAI (TICs applied to learning of Engineering) [5]
- Collaboration with different congresses and workshops related with Higher Education.
- The prize to the best doctoral thesis and to the best final year project “Premios CESEI”.

In the next section, the results of the last activity will be analysed.

III. THE CESEI AWARDS

Among the activities promoted by the CESEI in the year 2006 one of the most relevant was the prize for the best doctoral thesis and for the best final degree (or master) project, being the thematic related totally or partially with the research or technological applications with the education in the frame of the disciplines of the IEEE, areas of Electrical Engineering, Electronics, Telecommunication Engineering and Informatics.

Since then, three editions of the prizes have taken place, covering the works developed between October 2004 and September 2008. The fourth edition, covering from October 2008 to September 2009, is running now. In those prizes, a total of 85 final year projects (PFC) and 21 doctoral theses have been presented, as it can be seen in the table I.

The number of works received as candidates to the prizes allow to do an analysis about the educational research that is being developed in Spain in the fields of interest of the IEEE and, in consequence, in the CESEI.

TABLE I. SUMMARY OF NUMBERS OF PFC AND THESIS IN THE PERIOD

Year	PFC	THESES
04/06	19	5
06/07	39	8
07/08	27	8

First of all, the analysis of the working areas and the subjects covered by the works will be considered. In table II, data corresponding to the final degree projects are shown. With respect to the fields of interest, clearly three lines of work are more relevant: Tools and Strategies applied to the education, Special education and Virtual instrumentation-Remote laboratories.

Moreover the two first fields are very related with the area of Higher Education, it is important to remark the interest generated in Spain for the elaboration of educational materials to facilitate the education of disabled people (12% of the projects).

As well, the 35% of the total of the works is dedicated to education (tools, strategies, laboratories or virtual instrumentation).

TABLE II. SUBJECTS – FINAL YEAR PROJECT (PFC)

Topic	Percentage
Tools / Strategies applied to Education	24,7
Special Education	11,8
Remote laboratories – Virtual instrumentation	10,6
Several	10,6
Signal theory	7,1
Networks	5,9
Image Processing	4,7
Not related with the areas of CESEI	4,7
Computer architecture	3,5
Informatics Security	2,4
Web Semantics	2,4
Domotics	2,4
Electronics – Electronic Systems	2,4
Programmable Logic Devices	2,4
Electricity/ EMC	2,4
Antennas	2,4

In Figure 2, the fields of work of the doctoral thesis are shown. 76% of the thesis corresponds to Computer Engineering and Telematics-Telecommunications (38% for each one).

Up to now doctoral theses from the field of Electronics have not been received and only a 5% belong to the Electrical Engineering field. This can be due to two reasons:

- In these fields there is less research in educational topics related with engineering.
- Researchers of these fields are not interested in the prize.

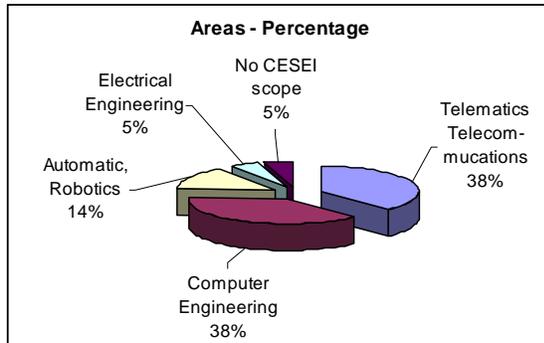


Figure 2. Percentage of doctoral theses in function of the field.

With respect to the doctoral theses, it could be of interest to know the journals in which the results of the research have been published. This information could help to the dissemination of the results of the research in education to other researchers.

Table III shows these journals. An analysis of this table allows concluding that the dissemination of the research results has been realized through specialized education journals, but as well, through other kind of technological journals non related directly with education. The reasons could be different:

- Several technical publications allow works related with the education.
- Researchers have separated the technical aspects of their doctoral theses from the educational aspects, sending each part of the work to a kind of review.

The number of journals where it is possible to publish a work in educational research for our areas of interest is very large (44 different journals identified).

TABLE III. JOURNALS

1	ACM Journal on Educational Resources in Computing
2	ACM SIGPLAN Notices
3	Advanced Technology for Learning
4	Artificial Intelligence Review
5	Automatica (Automatics)
6	Computer Applications in Engineering Education
7	Computers and Chemical Engineering
8	Computers and Education
9	Computers in Human Behavior
10	Computer Standards & Interfaces
11	Educational Technology & Society

12	Electronic Notes in Theoretical Computer Science
13	Expert Systems with Applications
14	Future Generation Computer Systems
15	IE Communications
16	IEEE Computer
17	IEEE- RITA (Revista Iberoamericana de Tecnologías del Aprendizaje)
18	IEEE Transactions on Education
19	IEEE Transactions on Circuits and Systems for Video Technology
20	Informatics in Education International Journal
21	International Journal of Electrical Engineering Education
22	International Journal of Engineering Education
23	International Journal of Modeling, Identification and Control (IJMIC)
24	International Journal on Advanced Technology for Learning
25	Journal of Interactive Media in Education
26	Journal of Process Control
27	Journal of Universal Computer Science
28	Lecture Notes in Artificial Intelligence
29	Lecture Notes in Computer Science
30	Lecture Notes in Informatics
31	Mathematical and Computer Modeling of Dynamical Systems
32	Novática. Revista de la Asociación de Técnicos de Informática
33	Pattern Recognition
34	Revista Iberoamericana de Educación a Distancia (RIED)
35	Revista Iberoamericana de Informática Educativa
36	Revista Iberoamericana de Inteligencia Artificial
37	Revista Latinoamericana de Investigación en Matemática Educativa (Relime)
38	Revista Latinoamericana de Tecnología Educativa
39	Science of Computer Programming
40	Software - Practice and Experience
41	The European Journal for the Informatics Professional
42	Upgrade. The European Journal for the Informatics Professional
43	Virtueller Campus
44	WSEAS Transactions on Systems

With respect to conferences the information is relevant. In Table IV the conferences related directly with the education have been selected. Nevertheless, the authors of the doctoral thesis have published their work in more than 50 conferences not related directly with education.

It is important to note that, in Tables III and IV, it is possible to find English language publications as well as Spanish publications, so it is very easy for authors to publish the results of their work.

TABLE IV. EDUCATIONAL - CONGRESSES

1	Advances in Web-Based Learning (ICWL)
2	Conference of the International Group for the Psychology of Mathematics Education
3	Conference on Educational Uses of Information and Communication Technologies – IFIP Conference
4	Conference on Innovation and Technology in Computer Science Education (ITiCSE)
5	Conference on New Technologies in Science Education
6	Conference on Technology Enhanced Learning (ECTEL)
7	Congreso de la Red Estatal de Docencia Universitaria (RED-U)
8	Congreso Iberoamericano de Informática Educativa
9	Congreso Internacional de Ensino da Matematica
10	Congreso Internacional EDUTEC
11	Congreso Internacional Virtual de Educación (CIVE)
12	Congreso Multimedia Educativo
13	Congreso Universitario de Innovación Educativa en las Enseñanzas Técnicas (CUIEET)
14	Computers and Advanced Technology in Education
15	International Computer Supported Collaborative Learning Conference (CSCL)
16	Frontiers in Education Conference (FIE)
17	EAEIE Conference on Innovations in Education for Electrical and Information Engineering
18	E-COMM-LINE
19	EDEN Conference
20	Educational Innovations in Electrical and Information Engineering
21	EduTech
22	E-Learn
23	Encuentro SCM-FEEMCAT sobre la enseñanza de las matemáticas
24	European Conference on Technology Enhanced Learning
25	IASTED Int. Conf. on computers and Advanced Technology in Education
26	IASTED International Conference on Web-Based Education (WBE)
27	IEEE International Conference on Advanced Learning Technologies (ICALT)
28	IFIP World Conference on Computers in Education
29	Informing Science & Education Conference
30	Interactive Aided Learning Experiences and Visions (ICL2001)
31	International Conference on Artificial Intelligence in Education (AIED)
32	International Conference on Engineering and Computer Education (ICECE)
33	International Conference on e-Learning and Distance Learning
34	International Conference on Information Technology Based Higher Education and Training (ITHET)
35	International Conference on Multimedia and Information & Communication Technologies in Education (m-ICTE)
36	International Conference on New Educational Environments
37	International Conference on Virtual University
38	International Seminar on Innovative Teaching and Learning in Engineering Education
39	International Symposium on Computers in Education (ISCE)

40	Jornada sobre Aprendizaje Cooperativo (JAC)
41	Jornadas sobre el Aprendizaje y Enseñanzas de las Matemáticas
42	Modeling in Science Education and Learning.
43	Online Educa
44	RIBIE (Red Iberoamericana de Informática Educativa)
45	Seminario de Investigación en Tecnologías de la Información Aplicadas a la Educación (SITIAE)
46	Simposio Internacional de Informática Educativa (SIE)
47	Simposio Nacional de Tecnologías de la Información y las Comunicaciones en la Educación (SINTICE)
48	Simposio Pluridisciplinar sobre Objetos y Diseños de Aprendizaje Apoyados en la Tecnología
49	TELearn 2008
50	TENCompetence Open Workshop on Current research on IMS Learning Design and Lifelong Competence Development Infrastructures
51	UICEE Annual Conference on Engineering Education
52	Virtual Educa
53	World Conference on Educational Multimedia, Hypermedia and Telecommunications

IV. OTHER PUBLICATIONS

Moreover the high quantity of conferences and reviews mentioned in previous paragraphs, there are other important publications where it is possible to publish the results of the research work in education and that can be of interest to the researchers.

Some of them are listed below [6]:

A. Journals

- International Journal of Technology and Design Education.
- Journal of Engineering Education.
- Journal of Educational Technology & Society.
- Revista Electrónica de Investigación Educativa (REDIE).

B. Conferences

- CAFVIR: Congreso Iberoamericano sobre Calidad de la Formación Virtual.
- CSCL: Computer Supported Collaborative Learning.
- CUIEET: Congreso Universitario de Innovación Educativa en las Enseñanzas Técnicas.
- ICCE: International Conference on Computers in Education.
- ICEER: International Conference on Engineering Education & Research.
- ICLS: International Conference of the Learning Sciences.
- IEEE - EDUCON: IEEE Engineering Education Conference.

- TAAE: Tecnologías Aplicadas a la Enseñanza de la Electrónica.

V. CONCLUSIONS

During the last years it has been possible to observe an increase of the interest for the research in education in particular in engineering areas. In this sense, since 2004 the Spanish Chapter of the Education Society of the IEEE (CESEI) is working for improving both teaching and learning of engineering and computing.

Among the activities promoted by the CESEI in the year 2006, the prize to the best doctoral thesis and to the best Final Degree (or Master) Project, being the thematic related totally or partially with the promotion of the research or technological applications in the education in the frame of the areas of Electrical Engineering, Electronics, Telecommunication Engineering and Informatics.

The number of works received as candidates to the prizes (106) allows performing an analysis about the educational research that is being developed in Spain in the fields of interest of the IEEE.

In the Final Degree (or Master) Project, in spite of the great variety of themes, there are three main areas of work: Tools and Strategies applied to the education, Special education and Virtual instrumentation-Remote laboratories. The second one represents the 12% of the total final year projects, that reveal the importance that this field is gaining in Spain in the last years.

The 76% of the doctoral theses received deal with Computer Engineering and Telematics-Telecommunications (38% respectively for each one). No doctoral theses have been received from the area of Electronics Engineering and only 5% of Electrical Engineering.

The results of the doctoral theses have been published in a large number of technical reviews and conferences (53 about education) so in English language as in Spanish or Portuguese.

The data allows encouraging the academic staff to work in this research field because they have a lot of possibilities to show and discuss the results of their work at the same time they increase the results for both areas of work the education and the research.

The main objective of this paper has been to show a general vision about the work done in such areas of educational research in Spain, that we think that could be very interesting for academic staff and researchers.

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