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Dear Guests...

Welcome to the 4th International Conference of New Horizons in Education-2013.

"The International Conference of New Horizons in Education-2013 (INTE-2013)" is an international educational activity for academics, teachers and educators. It promotes the development and dissemination of theoretical knowledge, conceptual research, and professional knowledge through conference activities, the conference proceeding book. This year, INTE-2013 received almost 830 applications. The conference academic advisory board accepted 760 applications.

The International Conference of New Horizons in Education-2013 aims to diffuse the knowledge and researches among academicians and lead to development in educational sciences.

We have lots of participants from 38 different countries. Some of these countries are Austria, Australia, Brazil, Canada, Croatia, Czech Republic, China, Egypt, Denmark, Finland, Germany, Greece, Hungary, Malaysia, Mexico, New Zealand, Philippines, Poland, Portugal, Romania, Russian Federation, Saudi Arabia, Slovenia, Slovakia, Spain, Switzerland, South Africa, Turkey, United Kingdom and United States

Should you have any enquiries regarding INTE conference, please do not hesitate to contact with us for any additional information you may require.

Finally, we would like to wish you all a pleasant stay in Rome and safe return back home. I hope that INTE-2013 will be a meeting you will pleasantly remember.

We hope we will meet again at the International Conference of New Horizons in Education 2014 in Paris/France.

Thank you...

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New Horizons: Tourist or Traveler?

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Assessing Where it Matters Most - Your Instruction

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Anadolu University



Does Digital Age Guarantee Digital Citizenship

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Information Literacy Workshop How To Equip Information Literacy Skills To Students?

Academic achievement and sports involvement of Malaysian university athletes	
<i>Aminuddin Yusof¹, Chun Cheng Chuan¹, Parilah Mohd Shah²</i>	17
Academic motivation levels of technical high school students	
<i>S.Muge Yukseloglu^a, M.Hulya Karaguvan^b</i>	27
Academic Study of Religions in Secular Age - The Case of Czech Republic	
<i>Dušan Lužný^a, Petra Tlčimuková^b</i>	34
Accounting education for accounting educators evidence from Italy – the case of SISIS/TFA (2002-2013)	
<i>Massimo Costa^a, Patrizia Torrecchia^b, Alan Sangster^c</i>	40
Achievement and Motivation: A Different Perspective On Familiar Concepts	
<i>Ayşe Esra Aslan^a, Berke Kirikkanat^b</i>	53
Activating resources and its use in e-learning	
<i>Jiří Dostál^a, Milan Klement^b, Čestmír Serafín^c</i>	63
Addressing Spirituality in Experiential Learning	
<i>Pavel Veselský, Jiří Poslt, Petra Majewská, Michaela Bolcková</i>	76
Adult learning in the context of comparative higher education	
<i>Jonathan E. Oghenekohwo, Phd</i>	85
Analysis for why the emphasis of China's higher education research is theoretical speculative	
<i>Fan Wei-Wei</i>	97
Analysis of Latvian organizational culture in relation to leadership gender roles	
<i>Irena Kokina^a, Jelena Davidova^b</i>	102
Analysis of problematic mobile phone use, feelings of shyness and loneliness in accordance with several variables	
<i>T. Assist. Mustafa Öztunç</i>	115
An assessment of critical thinking skills based architectural project course in terms of student's outputs	
<i>Gözde Çakır^a, Bengi Yurtsever^b</i>	129
An assessment of teacher training programs in public and private university foreign languages department preparatory schools and the instructors' perception and relevance	
<i>Levent Balcioğlu^a, Orhan Kocaman^b</i>	138

An assessment on media literacy education in Turkey and the problems experienced in practice	
<i>Sibel Karaduman^a</i>	153
An automatic maximum word alignment of parallel corpus for ESL learners	
<i>Jee Eun Kim^a, Kong Joo Lee^b</i>	162
An evaluation of the educational software about precipitation titrations	
<i>Nilgün Secken^a, Nazan Kunduz^a</i>	170
An investigation of goodness of model data fit	
<i>Gülşen Taşdelen Teker^a Hülya Kelecioğlu^b Melek Gülşah Eroğlu^c</i>	180
An investigation of the relationship between performance in the problem-solving laboratory applications and views about nature of science of pre-service science teachers	
<i>Hatice Güngör Seyhan^a, Gülseda Eyceyurt Türk^b</i>	188
An investigation on the compulsory Arabic preparatory program in the faculties of theology in turkey	
<i>Yakup Çoştu^a Feyza Ceyhan Çoştu^b</i>	200
An unaddressed issue in art education: Review of a children's art book	
<i>Kibar Evren Bolat Aydoğan</i>	208
Applied research - the best bridge between school and industry through post graduate research centre	
<i>Lubomír Šooš</i>	231
Approaches to teachers' performance assessment for enhancing quality of education at universities	
<i>Maria Luskova^a, Maria Hudakova^b</i>	241
Art in the eyes of six-year-old children. Children's semantic hypallages regarding paintings of great masters	
<i>Małgorzata Karczmarzyk, Anna Wasilewska</i>	254
Aspects of Teaching Economics for Students of Informatics	
<i>Emese Tokarčíková</i>	264
Assessment of Contextual Dimensions in Early Childhood Education	
<i>Sofia Andrade^a, Paula Santos^b</i>	274
Assessment of nutritional status of 10-14 years old adolescents using mediterranean diet quality index (kidmed)	
<i>Neşe Toktaş Torun^a, Yasin Yıldız^a</i>	285

Attention capture preferences in teachers and pupils: differences and similarities	
<i>Katarína Cabanová</i>	294
Attitudes and knowledge of students undergraduate a university in Mexico about distance education.	
<i>Juan Ignacio Barajas-Villarruel</i>	299
Attitude and approaches of faculty members regarding formal education and distance learning programs	
<i>Murad Karaduman^a, Mustafa Sami Mencet^b</i>	304
Autopoiesis and dance in the teaching-learning processes.	
<i>Nicolina Pastena^a, Cristiana D'anna^b, Filippo Gomez Paloma^a</i>	315
A behaviour study on ablution ritual among Muslim in Malaysia	
<i>Nor Haliza Johari^a, Oskar Hasdinor Hassan^b, Rusmadiyah Anwar^c, Muhamad Fairus Kamaruzaman^d</i>	320
A calculation scheme for measuring the efficiency of knowledge texts for vocational education	
<i>Tereza Rauchová^a, Milan Houška^a</i>	325
A case study on primary science teacher candidates' perceptions towards alienating from nature	
<i>Mustafa Kahyaoğlu^a</i>	337
A classroom experiment on social responsibility	
<i>Penélope Hernández^a, Amalia Rodrigo^b María Caballer^c</i>	343
A comparison of self confidence levels and personal growth initiative skills between managers and employees	
<i>Ramazan Abaci^a, Büke Okyay^b</i>	356
A comparative analysis of conservatories and departments of music education in terms of the place of technology use in their music education	
<i>Hatice Selen Tekin</i>	363
A comparison of the education systems in Turkey and Singapore and 1999-2011 timss tests results	
<i>Lect. Dr. Senem Seda Şahenk Erkan</i>	377
A comprehensive quality academic project for a bachelor's degree with accredited program and certified laboratories. The case of the degree of civil engineering in the FES Aragón UNAM	
<i>Martín Ortiz</i>	385
A content analysis of educational technology research in 2011	
<i>Ebru Kiliç-Çakmak^a, Ayça Çebi^b, Pınar Mihçi^c, Mustafa Serkan Günbatar^a, Murat Akçayır^d</i>	397

A hierarchical-precedences model for the analysis of teaching process	
<i>Josef Botlík^a, Milena Botlíková^b, Zuzana Palová^c</i>	410
A Mathematics Intervention: The case of 4 year-old Rylan and Hilda!	
<i>Marina PAPIĆ</i>	418
A mixed-method approach for the assessment of fundamental movement skills in physical education.	
<i>F. Sgrò^a, R. Schembri^a, S. Nicolosi^a, G. Manzo^b, M. Lipoma^a</i>	429
A mobile-based learning tool to improve writing skills of efl learners	
<i>Kong Joo Lee^a, Jee Eun Kim^b</i>	438
A Multidisciplinary Design Measurement: EIS method, its application and use in all form of education in college	
<i>Jana Pařílková^a, Jaroslav Veselý^a, Marie Fejfarová^a</i>	447
A multidisciplinary design exercise: Myndos Excavation Site	
<i>Yavuz Taneli^a, Selay Yurtkuran^a, Gözde Kırıl^a, Mustafa Şahin^b, Derya Şahin^b, Serkan Gündüz^b</i>	458
A multidisciplinary design studio: designing an eco-house project on Burgazada, Istanbul	
<i>Zafer Sagdic^a, Ipek Kosova^b</i>	470
A new horizon in logopaedics: Speech therapeutic story – innovative use of a story in the therapy of children speech impediments	
<i>Dorota Bełtkiewicz</i>	479
A new paradigm: correlation between laboratory and field tests of Coordination	
<i>Asuman Sahan^a, K.Alpaslan Erman^b, Burak Ağaoğlu^c</i>	491
A new type of phonetic alphabet and its applications in language teaching: From practical phonetics to morphology	
<i>Snejina Sonina</i>	497
A paths of success in administration of feminine administrator.	
<i>Krittima Kukkong^a, Arkom Eungpuang^b</i>	510
A pilot study on the role of emotions through the body in the educational context	
<i>Rosa Conte^a, Marzia Candela^a, Cristiana D’anna^a, Nicolina Pastena^b, Filippo Gomez Paloma^b</i>	516
A possible interaction between mind, corporeality and language	
<i>Rosalba Barbato^a, Stefania Milite^a, Cristiana D’anna^a, Filippo Gomez Paloma^b</i>	526

A proposal of design education assistance system with design process visualization reflecting competitive evaluation	
<i>Yumi Song^a, Yoon Choe^a, Sung-Ah Kim^{a,b}</i>	532
A research on the impact of leadership style preferences of teachers on their teaching strategies	
<i>Ferah Gürbüz^a, Kürşat Özdaşlı^b</i>	542
A review on processes of writing about art from the perspective of visual arts	
<i>Aygül Aykut</i>	554
A study on multiple linear regression analysis	
<i>Gülden Kaya Uyanıkⁱ, Neşe Gülerⁱⁱ</i>	561
A study on the consistency between university entrance exam (ÖSS) and questions published in examinations at schools on the subject of determinant	
<i>Nilgün Aygör, Hülya Burhanzade</i>	570
A study on the multiple intelligences of kindergarteners from different socioeconomic backgrounds	
<i>Semra Erkan^a, M. Burcu Öztürk^b</i>	580
A survey on the cognition of the teacher for continuity of elementary and secondary english education in South Korea	
<i>Won, Eun-Sok^a, Lee, Jong-Bok^b</i>	587
A training model for “typesetting operator” profession in the publishing industry (design - implementation - evaluation)	
<i>Orhan Sevindik^a, Seçil Gürün Karatepe^b, Akif Kemal Karatepe^c</i>	593
Barrier-free education at the Czech Technical University in Prague - modern European university	
<i>Jan Krcaľ^a, Michal Jerabek^a, Lucie Krcaľova^a</i>	602
Being Digital Citizen	
<i>Aytekin ISMAN^a, Ozlem CANAN GUNGOREN^b</i>	611
Brazilian technical report on higher education and national education plans: reflection tools in building an inclusive society.	
<i>Prof. Dra. Denise Candal^a,</i>	617
Breaking the chains: autonomous learners	
<i>Deniz Ezgi Avcı Vile^a, Ilke Buyukduman^b</i>	628

Bridging the gap between educational research and school practice through cooperation of university and primary school teachers	
<i>Katarina S. Wisiak Grm, Vesna Ferik Savec.....</i>	<i>636</i>
Building networks of care: Volunteers partnering with teachers in supporting vulnerable children	
<i>Ronél Ferreira, Liesel Ebersöhn, Maesala Thabe & Willie Pietersen.....</i>	<i>645</i>
Can education help to reduce information asymmetry?	
<i>Jindřich Vaněk^a, Josef Botlík^b</i>	<i>652</i>
Cinematography education in Turkey: current situation, new perspectives and suggestion	
<i>Mustafa Sozen.....</i>	<i>659</i>
Collaborative strategic reading practice with adult EFL learners: a collaborative and reflective approach to reading	
<i>Ferhan Karabuga^a, Ebru Sire Kaya^b</i>	<i>669</i>
Commercialization of education in Russia in the first decade of the 21st century	
<i>Sergey Shirin^a.....</i>	<i>680</i>
Communication of School and Family in Relation to the Form Teacher	
<i>Irena LOUDOVÁ^a.....</i>	<i>690</i>
Community support of schools: what kind and with what success?	
<i>Linda Valli^a, Amanda Stefanski^b, Reuben Jacobson^c.....</i>	<i>697</i>
Comparing the predictive and classification performances of logistic regression and neural networks: a case study on timss 2011	
<i>Oykum Esra Askin^a, Fulya Gokalp^b.....</i>	<i>707</i>
Comparison of social events in regional boarding primary schools and others primary schools (Malatya sample)	
<i>I. Bakır Arabacı, Tulin Akgul, Ceyda Akilli^c, Mahmut Karaca^d</i>	<i>718</i>
Computer Aided Industrial Design Software Selection in Industrial Product Design Education at Turkey Using Expert Choice Program	
<i>Saliha Dönmez.....</i>	<i>724</i>
Concept education by art education and an investigation on the opinions of teacher candidates about the "different" concept*	
<i>Oya Abacı^a.....</i>	<i>734</i>

Conflicts between students as interculturally incompetent behavior	
<i>Michaela Jurtikova</i>	740
Constraints and shortcomings in the development of marketing professionals in Romania	
<i>Dorian-Laurențiu Florea^a, Silvia-Mihaela Pavel^b, Alexandra-Elena Poștoacă^a</i>	748
Construction of the nations in post-Soviet on the condition of Russian diasporas “post imperial syndrome”	
<i>Kuanyshbayeva Zhazira^a, Imanbayeva Sandugash^b, Kaldibay Kainar^c, Salikhova Slushash^d</i>	757
Continuity in educational supervision: a case study	
<i>Esen Altunay^a, Didem Arlı^b, Yakup Öz^c, Münevver Yalçinkaya^d</i>	765
Corporate Social Responsibility Education in the Czech Republic	
<i>Pavel Adámek</i>	772
Creation and Innovation of Study Programmes with Emphasis on the Needs of Labour Market and Knowledge Society	
<i>Mária Lusková^a, Katarína Buganová^b</i>	783
Criteria for second foreign language preference	
<i>Orhan Kocaman^a, Nurgül Kocaman^b</i>	791
Cultural differences of international students in Turkey and problems they experience	
• <i>Yaser Snoubar, Gizem Celik^b</i>	809
Cultural safety in university teaching and learning	
<i>Elena Hunt, Phd</i>	815
Decentralization in –and of- education	
<i>Aygül Oktay</i>	826
Deepening the skills of staff in public administration	
<i>Milena Botlíková^a, Josef Botlík^b, Klára Václavíková^c</i>	832
Depression levels of the elementary school teachers	
<i>Mücahit Dilekmen^a, Buket Erdem^b</i>	843
Design, development and evaluation of flash software that could be used in vehicles for the education of autistic students	
<i>Hayrettin Evirgen^a, Metin Çengel^b</i>	854

Design within the historic environment: A survey on admiration preferences	
<i>Assist.Prof.Dr. Süheyla Birlik</i>	867
Determination of the Mental Cutting Ability of Prospective Mathematics Teachers	
<i>Nazan Sezen Yüksel^a, Ali Bülbül^b</i>	875
Determination of university students' metacognitive beliefs (Gazi University sample)	
<i>Pınar Bilasa^a</i>	886
Developing an Intelligent Tutoring System for Vehicle Dynamics	
<i>Carlos Huertas, Reyes Juárez-Ramírez</i>	893
Development of a self-assessment questionnaire for basic technical drawing skills: a preliminary study	
<i>Riccardo Metraglia^a, Gabriele Baronio^a, Valerio Villa^a, Riccardo Adami^a</i>	904
Development of motivation scale for teachers	
<i>Elif Akdemir^a, Ali Arslan^a</i>	917
Development of the professional competence in the ethics teachers	
<i>Miroslav Valica, Terezia Rohn</i>	922
Digital and interactive learning and teaching methods in descriptive geometry	
<i>Francesco Di Paola^a, Pietro Pedone^b, Maria Rita Pizzurro^c</i>	931
Distributional assumptions in educational assessments analysis: Normal distributions versus generalized beta distribution in modeling the phenomenon of learning	
<i>José Alejandro González Campos</i>	947
Doctoral students' competences of using online resources for research purposes in network society	
<i>Eridiana Olehnovica, Mārīte Kravale-Pauliņa, Ingrīda Bolgzda</i>	958
Drawing children into reading: studies of art lessons' effects on literacy	
<i>Wendy Anderson Halperin^a, Marlene L. Smith^b And Robert L. Smith^b</i>	963
Editor for creating and applying computerise surveys	
<i>Humberto Blanco^a, Martha Ornelas^a, José Leandro Tristán^b, Armando Cocca^c, Daniel Mayorga-Vega^c, Jeanette López-Walle^b, Jesús Viciano^c</i>	983
Educational and autoeducational value of autobiographical writings	
<i>Gabriella Aleandri^a, Alessia Checchi^b</i>	989

Educational inequality during primary school	
<i>Cornelia Riedel, Hartmut Ditton</i>	994
Educational technology and human capital: a model and simulations	
<i>Ahmet Kara</i> ^a	1000
Education and education practices among quilombolas: the school and the cultural diversity	
<i>Aguiar, C.M.^a; Adam, J.M.^b</i>	1012
Education as a factor of income differentiation of the population in Latvia within the period from 2000 to 2011	
<i>Ilgā Lavrinoviča^a, Olga Lavrinenko^b</i>	1018
Effects of applying Webquest learning activities to disaster prevention education for 8th grade students	
<i>Shi-Jer Lou^a, Yu-Ju Chang^a, Chun-Chung Lee^a, Ru-Chu Shih^a, & Tsai-Feng Cheng^b</i>	1028
Effects of applying blended teaching approach to English sentence translation for vocational high school students	
<i>Shi-Jer Lou^a, Tsung-Ching Lin^a, Tien-Hsin Hsin^a, Ru-Chu Shih^a, Tsai-Feng Cheng^b</i>	1034
Effects of computer technology on formation of illustrations in children's books in pre-school education and application example on educational aspects	
<i>Vesile Aykaç</i>	1039
Effects of total quality management on teachers and students	
<i>Lütfiye Dahil^a, Abdurrahman Karabulut^b</i>	1049
Effect of a computerized visual feedback on the adjustment of time in planning physical education	
<i>Jesús Viciana^a, Daniel Mayorga-Vega^a, Humberto Blanco^b, Martha Ornelas^b, José Tristán^c And Jeanette López-Walle^c</i>	1061
Effect of inquiry based learning method on students' motivation	
<i>Zeki Bayram^a, Özge Özyalçın Oskay^b, Emine Erdem^b, Sinem Dinçol Özgür^b, Şenol Şen^b</i>	1070
Efficiency Measurement in Higher Education: Concepts, Methods and Perspective	
<i>Maja Mihaljević Kosor^a</i>	1081
Elearning content 'usability': semiotic and didactic parameters in digital texts and textuality	
<i>Elisabetta Zuanelli</i>	1090
Elements of science in cypriot folk stories	
<i>Hatice Kayhan^a</i>	1104

Embodiment cognitive science in educational field	
<i>Filippo Gomez Paloma^a, Cristiana D'anna^b, Laura Rio^b, Nicolina Pastena^a</i>	1108
Employers' needs on competences, knowledge and skills for sustainable development as a reference framework for higher education in life sciences	
<i>Erika Quendler^a, Jannie Van Der Luit^b, Massimo Monteleone^c, Pedro Aguado^d, Manou Pfeiffenschneider^e, Klaus Wagner^f, Francesca Valente^g, Cristina Cunha-Queda^h</i>	1117
Environmental worldviews in higher education: a case study of Turkish college students	
<i>Nazmiye Erdogan</i>	1140
Esq education for children character building based on phylosophy of Javaness in Indonesia	
<i>Erick Ferdiawan^a, Wira Eka Putra^b</i>	1151
Essentials of the education on democracy	
<i>Mehmet Evkuran(Prof. Dr.)</i>	1158
Evaluating the effectiveness of students' active learning in chemistry	
<i>Vesna Ferk Savec^a And Iztok Devetak^b</i>	1168
Evaluation of scientific process skills of teacher candidates	
<i>Ilhan Silay^a, Pinar Çelik^b</i>	1176
Evaluation of Student Surveys Based on Lectures	
<i>Başak Zengin^a</i>	1185
Evaluation of the new secondary school curriculum in Turkey from the point of mathematical models and mathematical modeling	
<i>Alper Çiltaş^a, Büşra Çelik^a, Nizamettin Bilen^a, Kübra Yılmaz^a, Muhammet Doruk^a, Ferhat Öztürk^a</i>	1198
Evaluation of the music workbook and teachers' guide books' of the 4th grade of the primary school from the perspective of the ability of creative thinking by the opinions of the classroom teacher candidates	
<i>Asist. Prof. Dr. Ayşen Arslan</i>	1205
Evaluation the impact of environmental education veřká fatra national park to students grammar and secondary schools in the operating area	
<i>Peter Repka</i>	1212
Examining academic achivement in pisa 2003, 2006 and 2009 Turkey implementation by using mathematic common items	
<i>Mustafa Kose^a, Duygu Anil^b</i>	1223

Examining secondary school students' scientific process skills in terms of some variables	
<i>Fulya Zorlu^a, Yusuf Zorlu^a, Fatih Sezek^b</i>	1232
Examining secondary school students' perceptions of computer self-efficacy in terms of gender and class level variables	
<i>Tamer Kutluca^a, Burçin Gökkurt^b</i>	1243
Experience And Existence Revisited Something Essential On A Philosophical Education In Film Art	
<i>Matti Itkonen</i>	1251
Exploring the impact of diversity-infused content and structural diversity on students' attitudes towards marginalized groups	
<i>Marni Westerman^a, Kristin Wagner^b</i>	1272
E-Accessibility for Students with Visual Impairment at Universities in Czech and Slovak Republic	
<i>Regec, Vojtech^a, Pastieriková, Lucia^b</i>	1282
Facebook literacy in education	
<i>Nazire Burçin Hamutoğlu, Mubin Kiyici^b, Aytekin İşman^c</i>	1290
Factors and conditions impacting teacher leader influence	
<i>Kristen A. Clarke</i>	1294
Field activities, science education and problem-solving	
<i>Luís Dourado, Laurinda Leite</i>	1304
From "telling" to "engaging": a brief study of the educational role of museum in China	
<i>Jing Sun</i>	1316
From a tourist's conception to a graphic image A case study in practice-based research	
<i>Silja Nikula</i>	1325
From mekteb-i tibbiye-i adliye-i şahane to present day an overview to pharmaceuticals education	
<i>Adnan Ataç^a, Engin Kurt^b, Ahmet Keser^c</i>	1335
Gender gap and stem career choices in 21st century American education	
<i>Gheorghita M. Făitar^a, Silviu L. Făitar^b</i>	1342
Good stories: using metaphors to teach philosophy	
<i>Thomas Wall</i>	1352

Higher education and development: the role of private higher education institutions to accomplish fundamental purposes of the republic

Vinicius Figueiredo Chaves1361

High school paper textbooks usability: leading and satisfaction

Alexander P. Sergeev^a, Dmitry A. Tarasov^a,.....1372

How can i be a better teacher? Development of Finnish adult pre-service teachers' pedagogical thinking.

Valli, P^a ., Perkkilä, P^b . & Valli, R^c1382

How can teacher's pragmatic speech help to initiate and develop the sense of verbal interactions of language learners?

Tilda Saydi1394

How do teachers evaluate their training on the new Portuguese language curriculum in basic education?

Susana Mira Leal, José Carlos Pereira^b, Filomena Morais1404

How should be a good faculty of education and a good student in the faculty of education?

Tuba Kaplan^a, Ahmet Işık^a, Ferhat Öztürk^a.....1415

How Technology helps to create new learning environments by use digital museum resource

Vincenza FERRARA^a, Sonia SAPIA^b1427

How the teacher e-evaluation system enhances the professional development of k-12 teachers: the case of Taiwan

Liyia Feng^A, Yahui Su^B, Chang-Hui Hsu^C, Chao-Chin Yang^D1434

How to turn the epostl into an electronic setting: the e-epostl

Ismail Hakki Mirici^a, Sinem Demirbas^b.....1446

Hpcs: a web based homework & project control system

M. Fatih Adak^a, Nejat Yumuşak^a1457

Human Capital, Education and the Labor Market: Evaluation of Interaction in Latvia

Viktorija Šipilova^a1463

Human Rights As A Dimension Of Social Work Education

Eda Beydilli^a, Buğra Yildirim^b,.....1472

Identity status, coping strategy and decision making process among Italian university students

Monica Pellerone.....1478

Impact (s) of doctoral degrees held by faculty members in Portuguese higher education	
<i>João Carlos Pereira Mira Leitão</i>	1489
Impact of EU education programmes on challenging “otherness”: Turkish case	
<i>Dr. Mehmet Nurettin Alabay^a, Melih Rüştü Çalikoğlu^b</i>	1499
Impact of external examinations on high school curricula: document analysis	
<i>Hicran B. Fırat^a, Hüseyin Yaratın^b</i>	1509
Impact of mobile technologies at the University in Argentina	
<i>Alejandro Spiegel, Georgina Rodríguez, Melina Salviolo, Alicia Peña, Susana Ferrarasi</i>	1517
Improving the quality of disabled people’s life at work via iso 9001 standard	
<i>Martin Fink, Libuše Ludíková</i>	1525
Increasing retention and student satisfaction utilizing an online peer mentoring program: preliminary results	
<i>Michelle Mollica, Ms, Rn, Ocn And Abigail Mitchell, Dhed, Msn, Rn, Cne</i>	1534
Infidelity as a Threatening Factor to the Existence of the Family	
<i>Irena Loudová^a, Kamil Janiš^a, Jiří Haviger^b</i>	1541
Influence of the higher education on the investment climate	
<i>Alina Ohotina^a, Olga Lavrinenko^b</i>	1550
Innovations in seniors' education at the Czech Technical University in Prague Faculty of Transportation Sciences	
<i>Lucie Krčalová^a</i>	1556
Innovative course for future math teachers	
<i>Natalia Cheredeko, Zohreh Shahbazi</i>	1561
Innovative curricular change and contextual factors	
<i>Metin Timuçin</i>	1571
Institutional Repositories of Open Access: A paradigm of innovation and changing in Educational Politics	
<i>Nikos KOUTRAS and Maria BOTTIS</i>	1577
Integrated enterprise management system for higher education institutions based on strategic and process management: the case study of Sakarya University	
<i>Tuba Canvar Kahveci^a, Harun Taşkın^a</i>	1583

Integrating learning technologies and autonomy: a CLIL course in Linguistics	
<i>Elisa Pellegrino^a, Maria De Santo^b, Giuseppina Vitale^c</i>	1592
Integrating mobile setting into modern classroom: a multi-user, platform-independent, mobile content management system	
<i>Hasan Can Sara^a</i>	1602
Integrating sustainability in interior design studio	
<i>Umut Tuğlu Karslı^a</i>	1612
Interdisciplinary collaboration between interior architecture and industrial product design programs in Turkey	
<i>Özge Erkan</i>	1620
Intergenerational programs implemented in the Czech Republic	
<i>Jana Kitlinska</i>	1628
Internationalization and Quality Control of Education in TEI of Athens. Evaluation of the Erasmus Programme.	
<i>Panagiota Pappa^a, Konstantinos Sflomos^b, Georgios Panagiaris^c</i>	1635
International accreditation as a transformational change: Case study of business school in Kazakhstan	
<i>Yelena Istileulova</i>	1646
Introducing basic programming concepts to elementary school children.	
<i>Goran Zaharija^a, Saša Mladenović^a, Ivica Boljat^a</i>	1659
Investigation of Prep School Students' and Instructors' Preferences for Error Correction	
<i>Seçkin Can</i>	1668
Investigation Of Pre-service Teachers' Mathematics Teaching Efficacy Beliefs In Terms Of Their Reflective Thinking Tendencies	
<i>Meltem Sari Uzun^a, Nazan Sezen Yüksel^a, Şenol Dost^a</i>	1679
Investigation of required qualifications of instructors by means of pair-wise comparison method	
<i>Çiğdem Akin Arikan^a Selahattin Gelbal^b</i>	1688
Investigation of the pre-service physics teachers' learning approaches	
<i>Deniz Gurcay</i>	1702
Investigation of the relationship between self-esteem and metacognitive awareness level of 9th grade students	
<i>Fatma Elif Kılınç</i>	1711

Investigation on perception of mothers about social support who have children with physical disabilities	
<i>Pelin Piştav Akmeşe^a, Akmer Mutlu^b, Nilay Kayhan^c</i>	1719
In art education, soul of materials: soap sculptures	
<i>Asist. Prof. Dr. Nermin Özcan Özer</i>	1722
Is every kind of play suitable for the child?	
<i>Giorgio Bartolucci Ghelli</i>	1727
Is Gender Important On Understanding Construction Course In Architectural Education?	
<i>Z. Ozlem Parlak Bicer</i>	1730
Knowledge analysis of entrance examination knowledge by registered students at the University of Economics, Prague	
<i>Petr Doucek^a, Milos Maryska^b, Hana Mikovcova^c, Lea Nedomova^a</i>	1743
Knowledge and attitudes of university students on consumer rights	
<i>Gulden Gok^a, Ufuk Ozen^b, Erdal Yoruk^c</i>	1751
L2 learning challenges and needs of university students: A preliminary study	
<i>Parilah M. Shah^a, Nor Haslinda Hashim^b, Aminuddin Yusof^c, Rosseni Din^d, Aidah A. Karim^e, Ghazaliyusri Abd Rahman^f</i>	1767
Laboratory activities, science education and problem-solving skills	
<i>Laurinda Leite, Luís Dourado</i>	1777
Laboratory Experiences in Software Engineering from a Constructivist Perspective	
<i>Sara Zuppiroli, Maurizio Gabbrielli, Paolo Ciancarini</i>	1788
Language awareness enhancing strategies for efl learners	
<i>Metin Timuçin</i>	1793
Language learner beliefs from an attributional perspective	
<i>Zehra Gabillon^a</i>	1798
Language Learning Strategies: A general Overview	
<i>Abdalmajod A Hardan</i>	1812
Latvian music teachers' survey on the assessment criteria of mastering improvisation	
<i>Jevgenijs Ustinskovs, Svetlana Ignatjeva</i>	1830

Learning and Growing in Indigenous Amazon: the Education System of French Guiana Wayana-Apalai communities

Maurizio Ali^a, Rodica Ailincă^b1847

A sample program offer “the music in pre-school teaching” in post graduate programs in music education

Gülşen G.Erdal1858

Communication models and sensitivity approaches for intercultural peace education

Bilgehan Gültekin^a, Tuba Gültekin^b.....1863

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Digital and interactive learning and teaching methods in descriptive geometry

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Abstract

During the course of “Fundamentals and applications of Science of Representation - Geometric drawing” (held at the Faculty of Engineering at the University of Palermo) we successfully tested the adoption of informatics tools to enhance the comprehension and the critical analysis of complex figures in the geometrical space. The peculiarity in the teaching methodology was the adoption of interactive software products (*Cabri Géomètre* and *GeoGebra* concerning dynamic and geometrical constructions; the well-known *Rhinoceros* plug-in, *Grasshopper*, about generating algorithms; *Linceo* regarding implementing the graphic display of complex solids in augmented reality). According to our experience within didactic laboratories, the adoption of ICT allowed us to stimulate and interest students towards subjects of descriptive and projective Geometry and the expected results are very satisfactory. In this paper we show some of the most interesting examples of geometric constructions created by students.

Keywords: digital and interactive learning tools, dynamic geometry, generative algorithms, augmented reality.

1. INTRODUCTION

The integration of Information and Communication Technologies (ICT) in the field of teaching offers the opportunity to enrich and widen the learning environments, spaces where the structures of knowledge can be articulated.

In literature several experiences can be found, which describe the results and the possible developments of the couple education/technology in the learning/teaching processes.

At national level, over the last few years, the Ministry of Education, University and Research (MIUR) has promoted, financed and implemented, in partnership with the National Agency for the Development of School Autonomy (A.N.S.A.S.) and a network of associated universities, a teaching project of digital School called “Cl@ssi 2.0”, aimed particularly to the development of the ICT applied in the educational field.

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The national project involved several schools in the area, connected with each other and provided with multimedia devices and technological equipment, with the aim of experimenting possible changes and innovations of the learning environment through the use of technologies in support of traditional teaching (Falcinelli & Laici, 2013).

At European level, the process of renewal of the teaching methodologies has developed a series of similar projects, for example “Escuela 2.0” in Spain and the Project “Capital” in England.

In our university context, the educational path started five years ago in the *Drawing* courses (in the degree programme of *Building Engineering – Architecture* and that of *Environmental and Territory Engineering* of the Faculty of Engineering at the University of Palermo) allowed us to experiment teaching strategies which employ new hardware/software technologies. During the development of the lessons it was found that the exclusive use of analogical – traditional procedures slows down the students’ learning processes and limits the understanding of the objects of geometric space and, consequently, their encoding in a plane of reference.

On the basis of these critical issues observed during the development of the teaching laboratory exercises, it was decided to structure teaching/learning strategies allowing the synergic integration of traditional methods with new interactive procedures. The use of hardware (PC, tablets, IWB, graphics tablets, virtual and augmented reality devices) and software digital tools (dynamic geometry, modelling and programming programs) has significantly shortened the times of reception of educational contents, contributing to an active and conscious participation of the students.

The purpose of this paper is to describe a possible renewal path for the teaching/learning processes of the subject, moving on three levels of investigation:

- Organizing and structuring of the didactic educational environment;
- Identification of the most effective methodological – digital tools for the acquisition of the subject contents, aimed at the achievement of certain skills;
- Verification of the cognitive and practical abilities to apply the acquired knowledge, through the creation of digital models and their virtual display.

The main aim is to investigate the innovation and enhancement dynamics, which can be triggered in the learners, without focusing on the technologies in the strict sense (Fig. 1).

2. A DIGITAL CLASSROOM/LABORATORY FOR THE TEACHING OF DESCRIPTIVE GEOMETRY

Before reporting some significant applications elaborated by our students, which summarize the teaching innovation process, we propose an ideal and desirable configuration of a university classroom adopting and promoting the integration of the digital and traditional teaching methods.

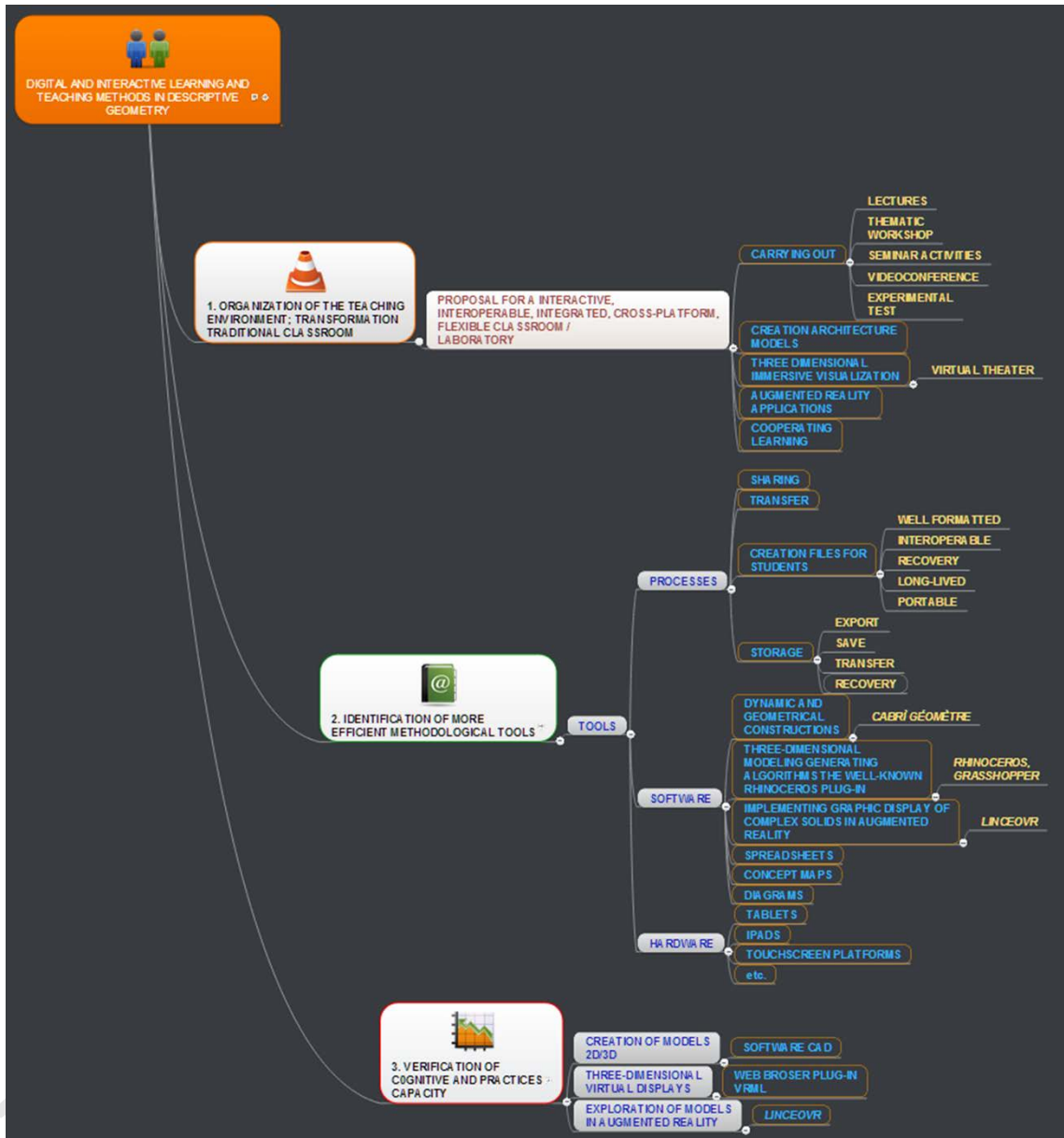


Fig. 1. Conceptual Map about digital and interactive Learning and Teaching methods in descriptive Geometry.

The classroom/laboratory, not yet existing at the University of Palermo, would create a structurally flexible environment, which facilitates the teaching/learning of interdisciplinary contents, and which is provided with hardware/software digital and interactive devices and equipment (Fig. 2 a,b).

In order to start and strengthen the teaching innovation process, it is necessary to change the traditional learning environments and to design new suitable educative spaces. The current spatial configuration of a traditional style classroom, structured in a random and undifferentiated way, should be more functionally redesigned for the logistical needs required by the technological – digital equipments.

In our investigation path, the multimedia digital classroom we propose is conceived as a laboratory becoming classroom, an original and versatile learning place where to develop interactive way of teaching, which allows the involvement of an even high number of students.

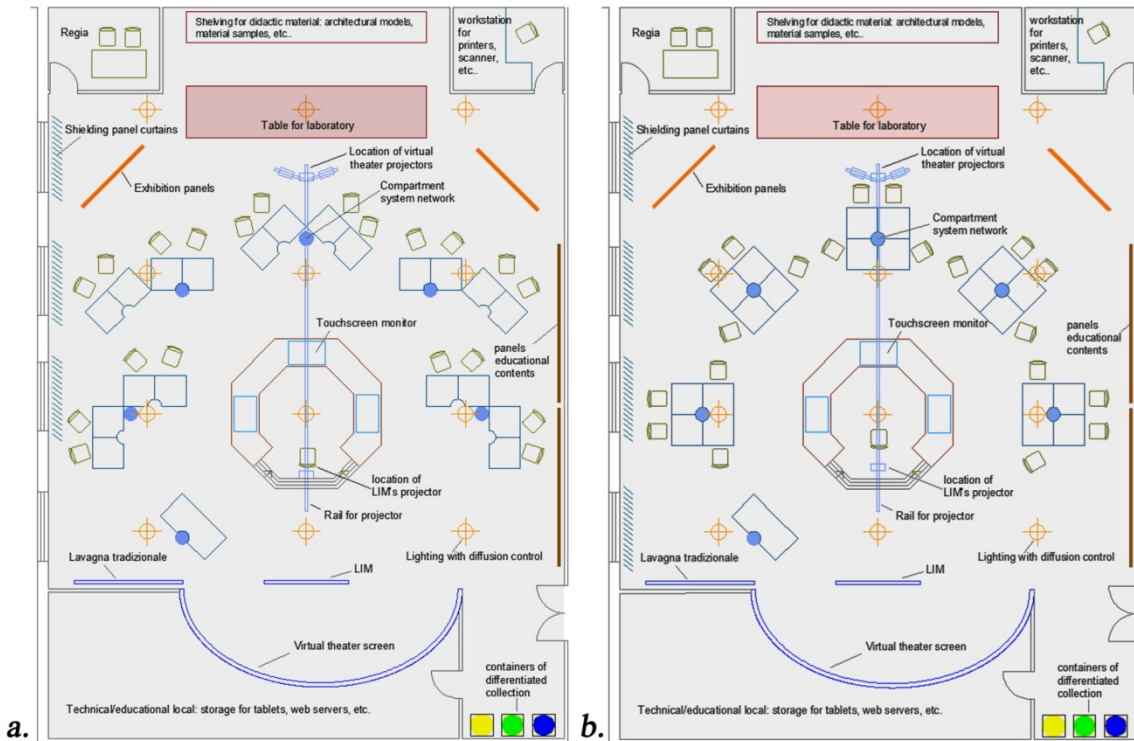


Fig. 2. A proposal of modular configuration for a university classroom/laboratory facilitating the integration of the digital and traditional teaching methods of descriptive Geometry.. a Configuration for laboratorial activities, videoconferences, thematic workshops, experimental tests; b. Configuration for interactive lessons, cooperative learning, seminars.

A classroom/laboratory with instrumental interoperable equipment, that can be integrated with already existing multiplatform devices, in which architectural models are created, virtual scenarios are opened, project experiences are shared with other universities. The proposed technological platform aims to create an environment in which technologies and services, useful for education and computer science culture and technological innovation diffusion, are integrated and available.

The teaching space is designed as an interactive environment, in which it is possible to experience also the immersive three-dimensional displaying techniques for the exploration of geometric models, through the installation of a “virtual theatre” properly set up (an virtual reality environment where, wearing special glasses, viewers can experience immersive environments, thanks to stereoscopic vision). In order to raise the quality of

learning/teaching, particular attention has been paid to the arrangement of the classroom layout, conceived as a highly flexible space, capable to rapidly adapt according to the purposes of the educational moment, to the different activities to be carried out (interactive lessons, cooperative learning, seminars, laboratorial activities, videoconferences, thematic workshops, experimental tests). The interactive lessons, created with open source applications, can be shared using tablets, iPads, touchscreen platforms related to 3D models and to the graphic constructions within the classroom.

3. INTERACTIVE DYNAMIC GEOMETRY APPLICATIONS AND GENERATIVE ALGORITHMS PROGRAMMING



The subject contents of the educational programme are presented to the class with the support of two well-known *dynamic geometry* software: *Cabri Géomètre* and *GeoGebra*. Particularly, the latter, developed in *JAVA* script (Hohenwarter et al., 2009), over the last few years has widely spread among the academic institutions, because it has some peculiarities which guarantee multiplatform operability and consultation through the most widespread browsers. In order to allow the students to consult and browse the geometric constructions made, an e-learning link with private access has been created on the web page of the Library of our Faculty of Engineering. On the course web page, in a dedicated section the html files of the graphic constructions are stored together with the synoptic tables about the handled themes, in order to facilitate the student to highlight and examine in depth some fundamental properties (Fig. 3).

In the explorative study of the geometric figures, the use of the above mentioned software proves to be a very useful exploratory investigation tool. The controls made available to the user allow to deepen the intrinsic relations among the geometric entities through the manipulation (repositioning, rotation, expansion) of control points in the created constructions (Fig. 4, 5, 6).

During the construction process, it is possible to validate the initial hypothesis, speculate and verify the properties and the relations which remain unchanged or vary during the geometric transformations.

Compared with the traditional paper and CAD digital drawing, the students are allowed to change the position of the starting geometric entities, configuring, in this way, dynamic displays. For the understanding of the sequence of the graphic operations generating the geometric figure, important and effective interactive modalities are highlighted: the “step by step” reproduction of the graphic process; the display of the construction protocol with the list of the executed controls; the construction of “geometric places” of points, which satisfy certain conditions.

The use of these tools has allowed us to enhance the interaction between the theoretic – conceptual and the figurative component in the reasoning of descriptive Geometry, offering reflection occasions to sharpen the cultural and educational knowledge of the Science of Representation.

For example, a structured table is reported, which introduces the perspective reference system and the representation of the fundamental entities. The analysed figure shows the geometric layout of the perspective reference system simultaneously in 3D, according to a scheme in oblique axonometry at 45° (to the left) and, in 2D according to a two-dimensional scheme directly on the squared plane  to the right  Whilst remaining unchanged the construction process (executable “step by step”, operating with the buttons of the control bar at the bottom), the geometric entities can be manipulated modifying the visual perception of the entities image, on the squared plane and simultaneously in space (Fig. 7).

In the subject teaching planning, particular attention is paid to the study of surfaces (ruled quadric, developable quadric, of revolution, interpolation, helical, free forms) and of curves, generatrix and directrix, which compose them.

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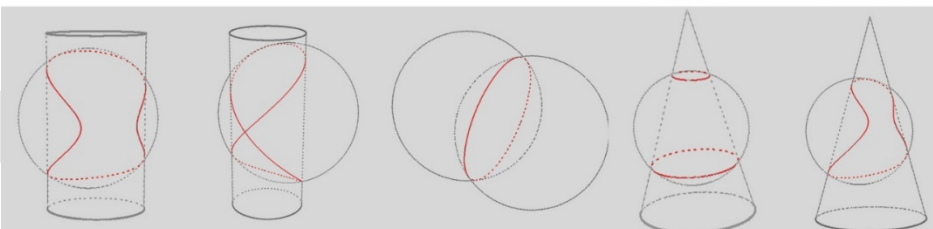
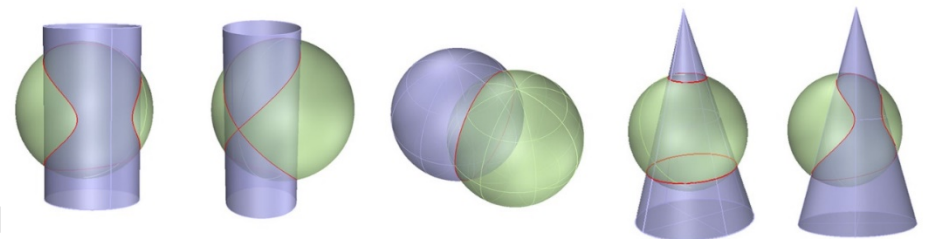
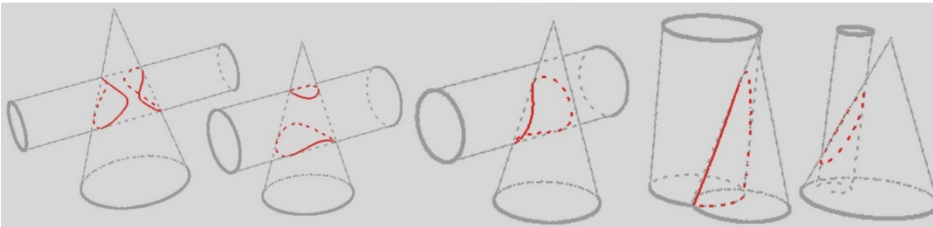
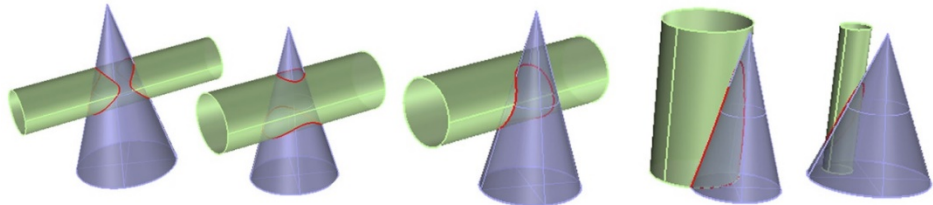
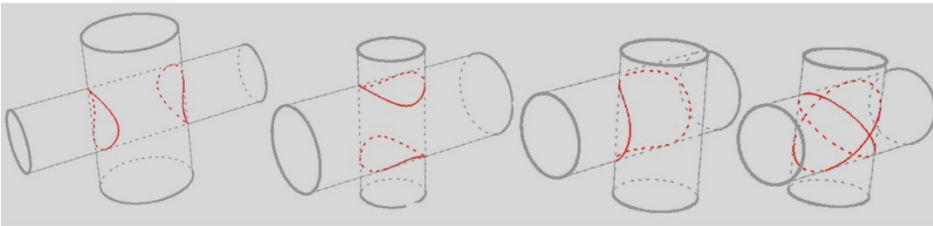
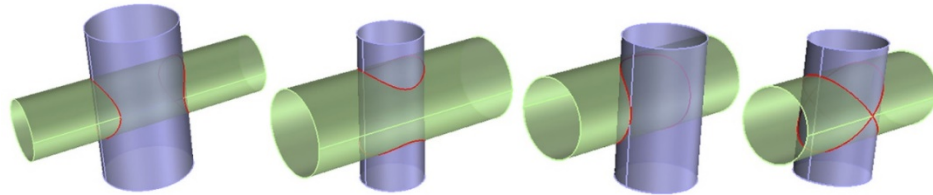
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The procedures adopted to construct them are structured parametrically controlled *Grasshopper*, generative architectonic modelling in of the well-known modelling software CAD *Rhinoceros*. use of generative algorithms for modelling of a geometric is an approach (Tedeschi, which has enabled us to: automate the procedures; generate parametric models that changes to the geometries; investigate on several spatial configurations intersection between different kind shapes (Fig.

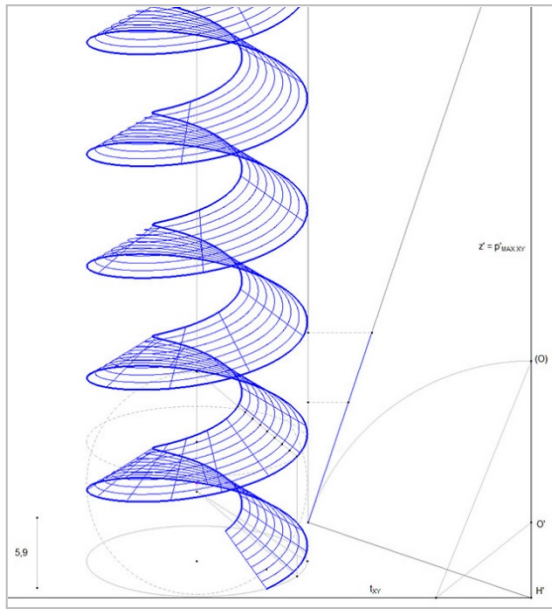


Fig. 3. Synoptic tables about the intersection of quadrics, in order to facilitate the student to highlight and examine in depth some fundamental properties.

Fig. 4. Direct orthogonal axonometry representation of a right helicoid ruled surface. The interactive dynamic construction was made with Cabri Géomètre. *Géomètre*.

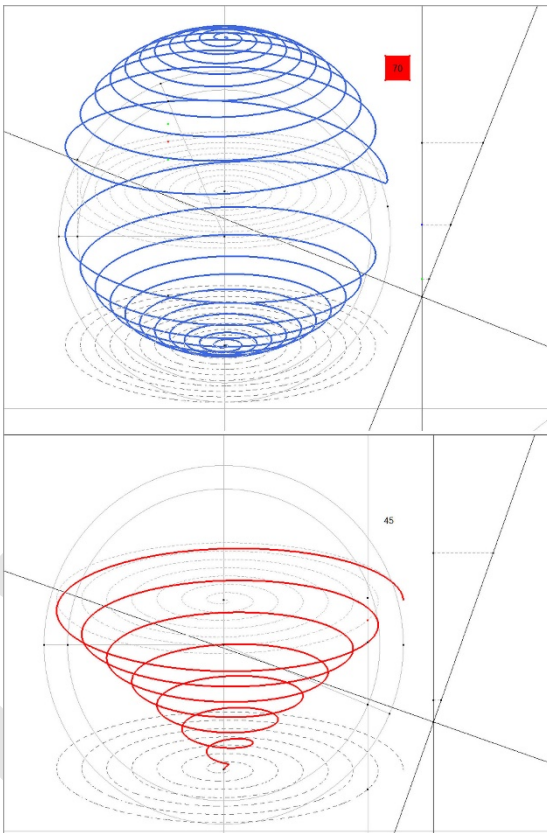


Fig. 5. Direct orthogonal axonometry representation of crooked spiral curves: at the top, a spherical spiral and, at the bottom, a conic spiral. The interactive dynamic constructions, made with *Cabri Géomètre*, allow to set the helixes pitch, coil changing the visual perception of their image.

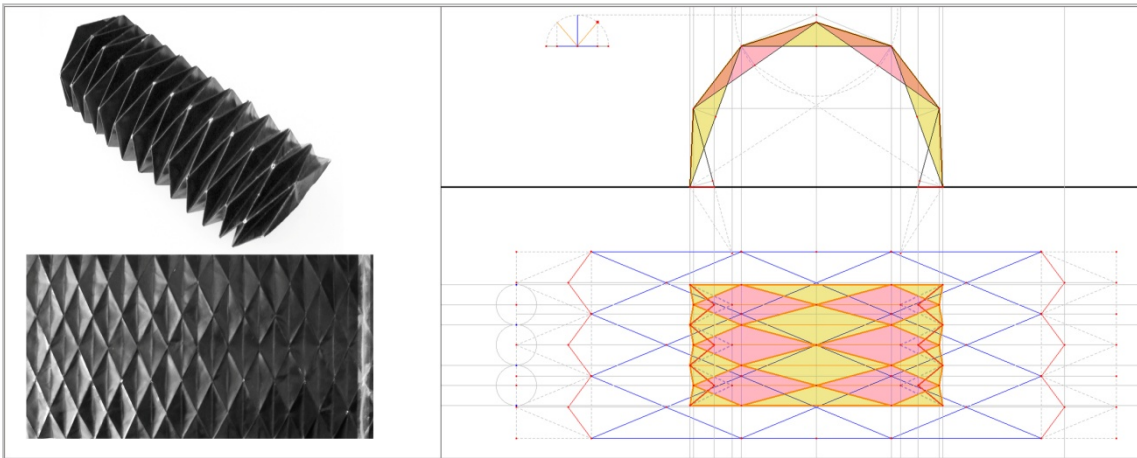
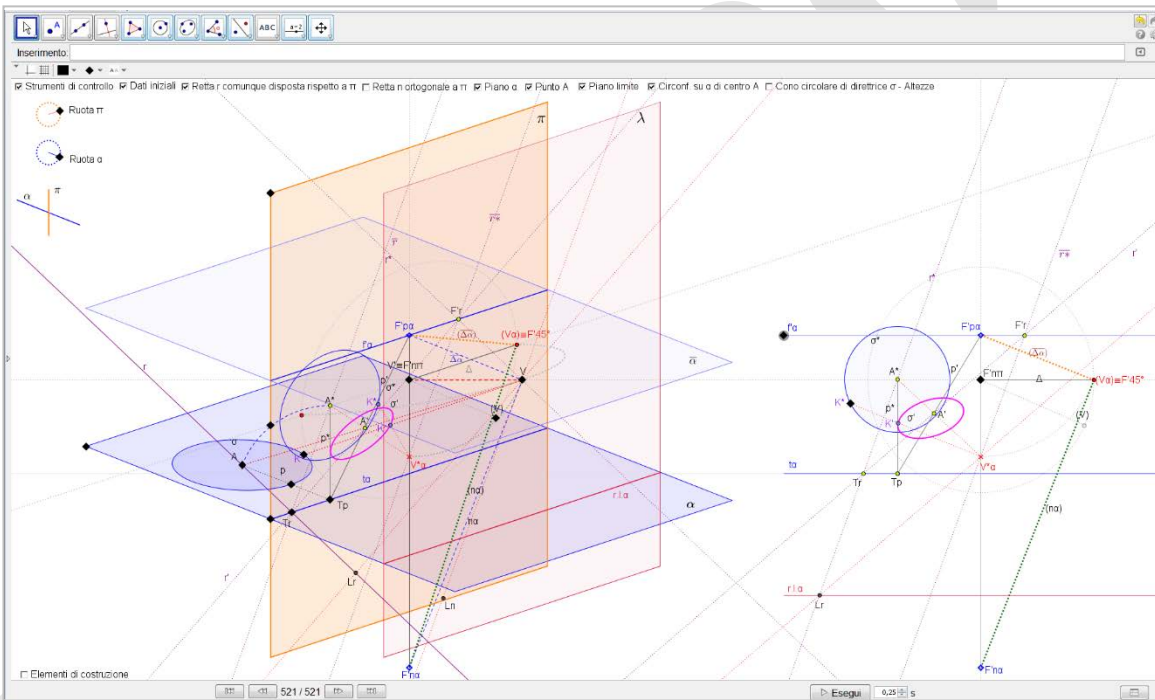


Fig. 6. Pleated prismatic surface resistant in form and its development on a reference plane; to the left, cardboard scale model and, to the right, interactive dynamic construction made with Cabri Géomètre.



4. INTERACTIVE DYNAMIC GEOMETRY APPLICATIONS AND GENERATIVE ALGORITHMS PROGRAMMING

During the exercises in class, the students study and represent significant examples of existent architectures, which present geometric-spatial complexities handled during the course.

Geometric and architectural models created in class are exported into VRML format (Virtual Reality Modeling Language) for the display in a common Web browser and made available for the whole class in a single multimedia storage.

To better understand form, geometry and structure of the realized architectural models, our course employs also the Augmented Reality (or AR) technology. The AR, the set of technologies which allow to “augment” a real scene (Primavera, 2010), is a young computer science discipline at experimental stage, pertaining to “computer graphics”, that deals with the overlay of digital contents to the observed real world. It integrates new ICT and communication forms, showing a representation of an augmented reality in which, to the normal display perceived through our senses, artificial/virtual sensorial information is added.

In our context the AR is an excellent teaching aid, as it allows the students, through marker identification tracking procedures, to display in real time the constructed three-dimensional models.

With the simple movement of the selected marker it is possible to explore in all directions three-dimensional objects not actually existing (Fig. 10).

The technology using dedicated software (the one we used during the course is *LinceoVR*) is structured into three simple steps:

1. Object *identification* (the object usually consists of a printable marker, as link between the real and the virtual world) observable by means of a fixed or mobile viewer (video-camera, smartphone, tablet), with data processed by a computer.
2. Real time *tracking* in the space of the observed object.
3. *Mix* of the support (i.e. the 3D model) with the marker.

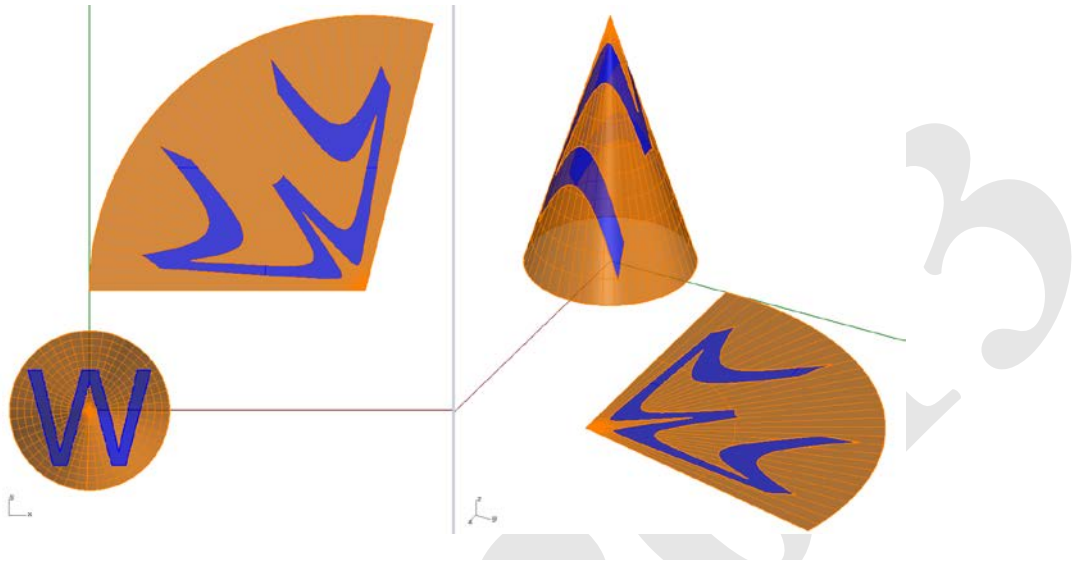


Fig. 8. Example of anamorphic projection of a plane figure (letter “W”) on a conic ruled surface and development of the system on a reference plane.

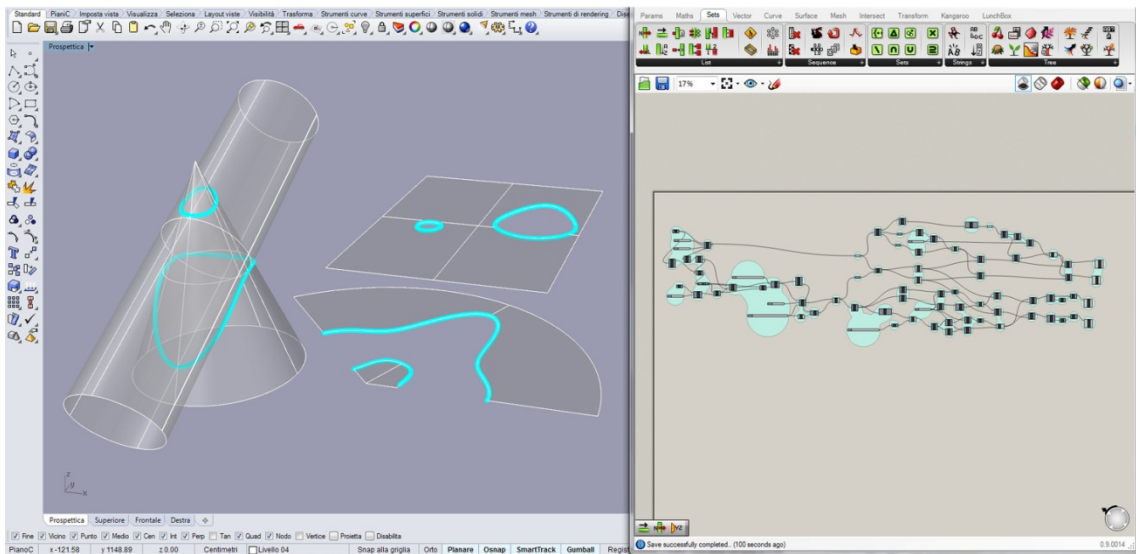
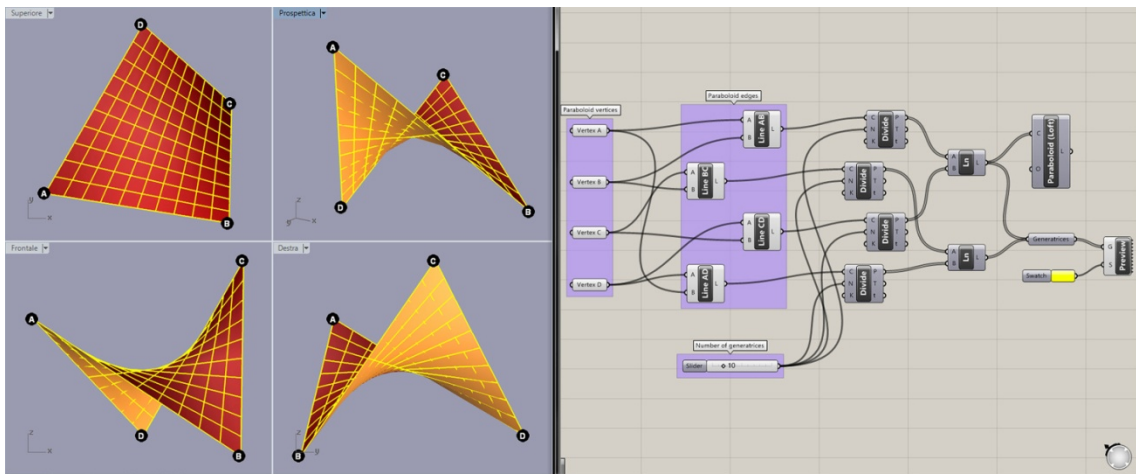


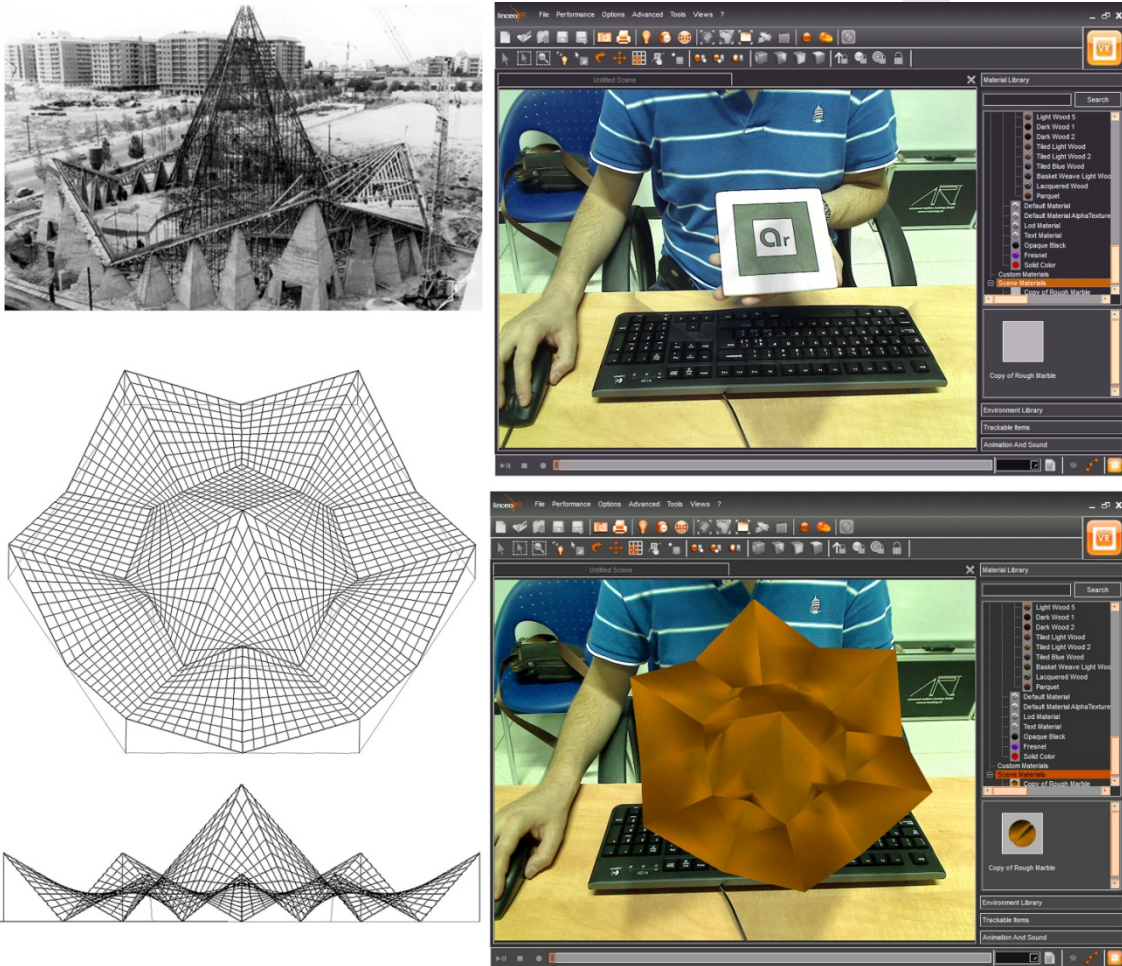
Fig. 9. Two examples of generative algorithms for the modelling of structured surfaces parametrically controlled within *Grasshopper*, a plug-in of the well-known CAD software *Rhinoceros*. At the top, a crooked rectangle with a portion of hyperbolic paraboloid subtended to it; at the bottom, intersection of a cone and a cylinder anyhow organized between them, and development of the surfaces.

5. CONCLUSIONS

On the basis of our teaching experience, structured and shared with the students through the introduction of technological solutions for communication, management and access to the discipline contents, we strongly believe that teaching cannot overlook the smart integration between ICT and knowledge anymore.

Innovation implies the acquisition of digital skills by the professors and their training to be in step with the new media languages, in order to effectively and consciously integrate them in the teaching of their discipline.

Pier Cesare Rivoltella, professor of Teaching and Learning Technologies at the Università Cattolica of Milan, well summarizes the necessary change of the teaching approach. In a recent speech given at the Pontificia



Università Lateranense, he says: *We live in a circumstance in which didactics seems not to be a professional skill for the professors anymore. This is proved by the fact that the new recruiting procedures will evaluate only their research activity. At the same time, didactics is nevertheless one of the main requirements to work in a context in which practices and behaviours of young people are increasingly marked by the presence of the new languages and meaning construction forms and more and more distant from the traditional lecture model.*

Fig. 10. To the left, orthogonal projections drawings of a composition of hyperbolic paraboloid surfaces (Iglesia Nuestra Señora de Guadalupe, Madrid, architect Felix Candela). To the right, two freeze-frames of a real time display of the three-dimensional model in augmented reality within the software LinceoVR, which show the three steps of the procedure: identification, tracking and mix.

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Appendix

Some references of sitography are reported, which are significant but not exhaustive, regarding the couple education/technology in learning/teaching processes.

<http://www.cremit.it/>

(Centro di Ricerca sull'Educazione ai Media all'Informazione e alla Tecnologia. Il CREMIT nasce nel novembre del 2006 come centro di ricerca che affianca le scuole, a livello di formazione degli insegnanti e di intervento nelle classi, sui problemi dell'educazione mediale e dell'ICT).

http://www.istruzione.it/innovazione_scuola/default.htm

<http://www.scuola-digitale.it/classi2.0>

(MIUR, progetto Cl@ssi 2.0)

<http://www.sero.co.uk/capital.html>

(progetto "Capital").

<http://www.ite.educacion.es>

(progetto "Escuela 2.0").

<http://www.scuola-digitale.it/editoria-digitale/il-progetto/editoria-digitale-scolastica>

(MIUR, azione "Editoria Digitale Scolastica", strumento di supporto per docenti e studenti nel processo di innovazione degli ambienti di apprendimento).

<http://www.igi-global.com/chapter/ict-classroom-new-learning-environment/72056>

<http://www.igi-global.com/chapter/geogebra-institute-torino-italy/72094>

<http://www.learningforall.it>

(L4ALL è un progetto triennale di ricerca FIRB (Fondi di Investimento per la Ricerca di Base) 2007 finanziato dal Ministero dell'Istruzione, dell'Università e della Ricerca (MIUR). Il progetto mira a indagare come un utilizzo consapevole delle tecnologie possa contribuire ad innalzare la qualità della didattica, in specifico per gli allievi con necessità particolari. Il risultato concreto del progetto sarà un Repository online in cui verrà raccolto un ampio numero di buone esperienze didattiche basate su tecnologie.

<http://www.lacasadegliinsegnanti.it/PORTALE>

<http://ec.europa.eu/digital-agenda>

(The Digital Agenda is the EU's strategy to help digital technologies).

<http://dera.ioe.ac.uk/6347>

(2020 vision: report of the Teaching and Learning in 2020 Review Group)

<http://www.indire.it>

(Sito dell'Istituto Nazionale di Documentazione per l'Innovazione e la Ricerca Educativa)

<http://www.scuolab.it>

(servizio del Politecnico di Milano, nel quale sono raccolti numerosi progetti di didattica multimediale).

<http://www.aace.org/pubs/default.htm>

(Association for the Advancement of Computing in Education).

<http://www.mediamente.rai.it/HOME/bibliote/biografi/m/maraglia.htm>

("La nuova didattica multimediale", intervista a Roberto Maragliano, docente di Tecnologia dell'Istruzione all'Università di Roma 3, presso il Dipartimento di Scienza dell'educazione).

www.triangle.co.uk/jit/index.htm

Sito della rivista internazionale Technology, Pedagogy and Education, dedicata agli educatori e tesa a supportarli nell'integrazione dell'Information Technology all'interno dei processi d'insegnamento e d'apprendimento. <http://www.aace.org/pubs/default.htm>

Sito dell' Association for the Advancement of Computing in Education, la quale patrocina diverse pubblicazioni sul rapporto tra tecnologie ed educazione.

INTE 2013