



ICERI **2023**

16TH INTERNATIONAL CONFERENCE OF
EDUCATION,
RESEARCH AND
INNOVATION



CONFERENCE PROCEEDINGS

13-15 NOVEMBER 2023
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Preface

The ICERI2023 Conference Proceedings contain the papers presented at the 16th annual International Conference of Education, Research and Innovation, which took place in Seville from the 13th to 15th of November 2023.

ICERI is an annual event whose aim is to provide a platform for lecturers and to share valuable research and information about education, pedagogical technologies, and educational innovations. This year, participants from over 80 countries took part in networking activities, plenary sessions, parallel thematic sessions and workshops. Keynote speeches were delivered by global educational experts. You can see their talks at IATED Talks (iated.org/talks/).

ICERI2023's focus included the following topics: Pedagogical Methods and Innovations, Technology in Teaching and Learning, Inclusive Learning, Special Education, Emerging Technologies in Education, International Cooperation, Teacher Training and Educational Management, Curriculum Design, Accreditation and Quality in Education, University-Industry Cooperation and Open Educational Resources.

The ICERI2023 International Program Committee is composed of lecturers and researchers from all around the world. A blind peer review process was followed to guarantee the quality of the final publication. During this process, the following points were evaluated: the content, relevance to the field, general structure, clarity of contents, originality, relation to the conference topics and disciplines.

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Lastly, we wish to extend our most sincere thanks and best wishes to all members and delegates who have contributed to the ICERI2023 Proceedings.

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ICERI2023 Keynote Speakers

Cristobal Cobo – Senior Education Specialist (Chile)



Keynote speech:

Unlocking the Potential: How Can Higher Education Lead the Way in a Changing World?

In the post-pandemic world, higher education institutions have a new, crucial role to play in addressing the global "poly-crisis," which includes climate change, demographic transformations, and the automation and datification of education, among other challenges. These challenges raise important questions about the future of higher education. During this presentation, we will explore a series of institutional and interpersonal capacities that need to be developed and consolidated in the context of higher education. These capacities include:

- a) Addressing sustainability and climate change literacies as cross-cutting and multidisciplinary capacities embedded in the institutional agenda and future professional development.
- b) Reinventing andragogy and hybrid learning for lifelong learners, creating opportunities for individuals of any age or background in a world of increased mobility and expanding life expectancy.
- c) Addressing the datification of education and cognitive automation by developing "algorithmic awareness" to navigate a world increasingly filled with smart technologies, which brings both opportunities and challenges.

Thriving in future-proof higher education institutions will be the result of proactively responding to the global poly-crisis and facing major disruptions. Universities are more crucial than ever, and reflecting on these challenges will be instrumental in shaping their future.

Biography:

Cristobal Cobo (PhD) is a Senior Education Specialist (Technology). He served as the founding Director of the Center for Research - Ceibal Foundation in Uruguay from 2014 to 2019. He is also an associated researcher at the Oxford Internet Institute, University of Oxford, from 2009 to 2019. Cobo works at the intersection of the future of learning, a culture of innovation, and human-centered technologies. Cristobal has been distinguished by the British Council of Economic and Social Research (ESRC) and is an associate research fellow at the Centre on Skills, Knowledge, and Organizational Performance, University of Oxford. He was a professor and director of Communication and New Technologies at the Latin American Faculty of Social Sciences, Mexico.

He has served as an external evaluator for the Inter-American Development Bank, the National Science Foundation, and MIT Press (US), the International Labour Organization (UN), and the International Development Research Centre (Canada). He holds a PhD in Communication Sciences from Universitat Autònoma de Barcelona, awarded "cum laude". His latest book, edited with Axel Rivas, is "The New Digital Education Policy Landscape: From Education Systems to Platforms" (Routledge, 2023). Previously, he wrote "I accept the terms and conditions: Uses and abuses of digital technologies" (in Spanish, Portuguese, and English) published by Santillana in 2019, "Innovación Pendiente" (Penguin Random House, 2016), and "Invisible Learning" with John Moravec (Universitat de Barcelona, 2011). He has been a speaker in more than 30 countries, including 4 TEDx events.

Currently, Cristóbal Cobo is a Senior Fellow for The Inter-American Dialogue. He has been featured in CNN, Deutsche Welle, El Pais, Le Monde Diplomatique, the Wall Street Journal, and the World Economic Forum.

Pooja K. Agarwal – Berklee College of Music in Boston, Massachusetts (USA)**Keynote speech:**

Teaching might be an art, but learning is a science!

Dr. Pooja K. Agarwal shares practical teaching strategies—based on 100 years of research—that dramatically improve student learning. Equipped with scientific knowledge and evidence-based tools, turn your teaching into POWERFUL teaching and unleash the science of learning in your classroom.

Biography:

Pooja K. Agarwal, Ph.D., is a cognitive scientist, conducting research on how students learn since 2005. She is the author of the book *Powerful Teaching: Unleash the Science of Learning* and an Assistant Professor of Psychology at the Berklee College of Music in Boston, teaching psychological science to exceptional undergraduate musicians. Dr. Agarwal is also the Founder of RetrievalPractice.org, a source of research-based teaching strategies for more than 15,000 teachers around the world.

Dr. Agarwal's research has been published in leading peer-reviewed academic journals; featured in *The New York Times*, NPR, *Scientific American*, and *Education Week*; recognized by the National Science Foundation; and highlighted in numerous books, podcasts, and videos.

Dr. Agarwal received her Ph.D. from Washington University in St. Louis. Her love of learning formed at the outset of her career as a 4th and 5th grade teacher in St. Louis, Missouri.

Website: retrievalpractice.org

Twitter: @RetrieveLearn

Conference Tracks & Sessions

The ICERI2023 conference program is available online at <https://iated.org/iceri2023>

ORAL SESSIONS MONDAY

Immersive Experiences
 Internships and Work-integrated Learning
 Curriculum Design Experiences
 Access (and Barriers) to Education
 Hybrid & Blended Learning
 Workplace & Vocational Training
 Student Engagement and Motivation
 Multilingualism and Language Learning
 Architecture and Design Education (1)
 Research on Virtual & Augmented Reality in Education
 Virtual & Augmented Reality in Vocational and Workplace Learning
 Pedagogical Innovation and Research
 Educating Individuals with Intellectual Disabilities
 Personalized Learning Environments
 Continuous & Life-Long Learning
 Student Support
 Language Learning Experiences
 Architecture and Design Education (2)
 Virtual & Augmented Reality Educational Best Practices
 University-Industry Cooperation
 Educational Leadership and Management
 Inclusion of Learners with Disabilities
 Learning Analytics
 Life-Long Learning
 Student Health and Wellbeing
 Education for Sustainability
 New Technologies in Architecture & Design Education
 Virtual & Augmented Reality in Health Sciences Education
 Game-Based Learning
 Professional Development of Teachers (1)
 Inclusive Education
 MOOCs & Open Educational Resources
 Lifelong Learning, Work-integrated Learning, and Higher Education in a Digital Era
 Students and Teachers Wellbeing
 English as a Foreign Language
 Arts & Humanities Education

POSTER SESSIONS MONDAY

Pedagogical Innovations and Trends in Education
 Emerging Technologies in Education

ORAL SESSIONS TUESDAY

AI in Education (1)
 Assessment and Evaluation Strategies (1)
 Quality in Education
 Diversity and Equity in Education
 Mobile and Multimedia Learning Experiences
 Gamification
 Service Learning

Robotics Education
 Computational Thinking & Coding Skills
 Generative AI Experiences in Education (1)
 Assessment and Evaluation Strategies (2)
 Professional Development of Teachers (2)
 Inclusion of Refugees and at-Risk Students
 Online Learning Experiences (1)
 Developing Soft Skills
 Project and Problem Based Learning
 Emerging Technologies in Engineering Education
 Programming in Higher Education
 AI in Education (2)
 e-Assessment
 Pre-service Teachers
 International Cooperation
 Digital Literacy
 Creativity & Design Thinking
 Active Learning in Engineering Education
 Mathematics Education
 Computer Science Education
 Generative AI Experiences in Education (2)
 Mentoring & Tutoring
 ICT Skills among Teachers
 Lessons learned from the COVID-19 pandemic
 Innovative Tools for Learning
 Pedagogical Innovations
 Active & Experiential Learning
 Teaching Mathematics
 Active Learning in STEM
 AI in Education (3)
 Student Selection and Admission
 Professional Development of Teachers (3)
 University and Society
 Online Learning Experiences (2)
 Exchange and Mobility Programmes
 Early Childhood Education
 Flipped Learning
 Teaching STEM

POSTER SESSIONS TUESDAY

Experiences in Education
 New Challenges in Education and Research

VIRTUAL SESSIONS

DIGITAL TRANSFORMATION OF EDUCATION

Data Science & AI in Education
 Learning Analytics & Educational Data Mining
 Digital Technologies and Resources for Learning under Lockdown
 Digital Transformation
 21st Century Skills
 Educational Programming & Robotics

DIGITAL & DISTANCE LEARNING

Distance Education in COVID-19 Times
 Blended & Mobile Learning
 e-Learning Experiences
 Learning Management Systems & Virtual Learning Environments
 Post-Pandemic Scenarios in Education

INNOVATIVE EDUCATIONAL TECHNOLOGIES

AI, Chatbots & Robots
Virtual & Augmented Reality
Social Media in Education
Technology Enhanced Learning

TEACHER TRAINING & ED. MANAGEMENT

ICT & Digital Skills
Pre-service Teachers
Professional Development of Teachers
Educational Management

ACTIVE & STUDENT-CENTERED LEARNING

Gamification & Game-based Learning
Problem & Project-Based Learning
Flipped Learning
Collaborative & Team-based Learning
Active & Experiential Learning
Pedagogical Innovations

QUALITY & IMPACT OF EDUCATION

Quality in Education
Experiences and Challenges in Curriculum Design
Sustainability & Environmental Awareness
University-Industry Collaboration
Social Impact of Education
Education and Research

EDUCATIONAL STAGES & LIFE-LONG LEARNING

From Pre-school to Secondary Education
Transition to the Job Market
Developing Entrepreneurship in Education
Life-Long & Workplace Learning

MULTICULTURALITY & INCLUSION

Multicultural Education
Diversity Issues
Special Educational Needs
Inclusive Education

ASSESSMENT, MENTORING & STUDENT SUPPORT

Assessment & Evaluation
Mentoring & Tutoring
Developing Soft and Transversal Skills
Student Support & Motivation
Student Wellbeing

STEM EDUCATION

Mathematics & Statistics
Engineering Education
Computer Science Education
STEM Experiences

LANGUAGE LEARNING AND TEACHING

Foreign Languages
New Technologies in Language Learning
Language Learning & Translation Studies

DISCIPLINE-ORIENTED SESSIONS

Architecture & Interior Design
Health Sciences Education
Business and Marketing Education

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TEACHING DESIGN IN A FULLY REMOTE ENVIRONMENT: CHALLENGES AND CHANGES IN THE PEDAGOGICAL APPROACH DURING THE COVID-19 PANDEMIC

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Abstract

Over the past 20 years, there has been a great debate in the literature on how to teach design knowledge and how to enable learning of the key processes related to this discipline. In this landscape, project-based learning (PBL) has always appeared as one of the most effective ways to enable the transfer of design knowledge and test the benefits of this discipline in practice. This type of activity, however, is always carried out mainly Face-to-Face, with group activities (typical of the design realm) and discussions with lecturers. However, the advent of the COVID-19 pandemic has challenged these teaching methods. How does the process of teaching Design in the PBL format change with the speed of digital technology adoption (due to the COVID-19 Pandemic)? Which activities are more effective fully remote and digital, and which are more difficult? This research is based on an exploratory inquiry on 120 students enrolled in bachelor's and master's courses at the School of Design of the Politecnico di Milano. The study analyses in detail which phases and activities have changed in the new concept of online PBL produced as a result of the Pandemic. The study, therefore, gives the possibility to reflect on the main activities that require implementation and how to develop design projects in a fully remote mode.

Keywords: Design teaching, design studio, remote teaching, project-based learning, remote environment.

1 INTRODUCTION AND THEORETICAL BACKGROUND

One of the most widely used approaches to enable experimentation and transfer of design concepts is Project-Based Learning (PBL). The literature has been discussing the effectiveness of this format for years, as it allows students to learn and absorb the main concepts of a discipline [1]. In fact, it is based on the constructivist finding that students understand concepts more easily and quickly when they work practically and experiment with their own ideas [2]. The concept originated more than 100 years ago from the work of John Dewey [3], who demonstrated in his research that students were actively engaged when encouraged to engage in activities that emulated what experts did in a real-world situation. A greater difficulty in learning associated with purely theoretical approaches can be attributed to the lack of opportunity for learners to develop their own understanding of the phenomenon [4].

Among the various definitions associated with PBL, Blumenfeld et al. [5] and Barron et al. [6] emphasised that students have the opportunity to be engaged in solving new and original problems by experiencing them first-hand. The proactivity it requires has often been described as an enabler of meaningful experiences [7].

It has been observed over the years how the PBL approach gives the possibility to improve people's creative attitudes, and project readiness, as well as to develop project management skills further [5] [1] [8].

This is possible because PBL is a student-centred form of instruction whose principles require the student to interact with other people, share his or her knowledge and understanding of the subject matter and be an active part of the learning process [9].

PBL has also been found to be useful for developing a central characteristic in design processes, namely that it has been observed to implement the ability to be better problem-solvers [10]. It also reflects another fundamental characteristic in the design realm, namely teamwork. It has been observed how through the collaborative approach that PBL requires, the classroom becomes a community of learners [11]

Although PBL was theorised with a hands-on, Face-to-Face approach, the evolution of technologies has also impacted this approach.

Patton [12] pointed out that the digitisation associated with PBL enabled students to be even more engaged in the process, as they could both exchange information and engage more easily in problem-solving. Indeed, the introduction of technology (such as cloud based collaboration software, digital workspaces, etc.) was seen as an enabler of new connections and networking possibilities for the

purposes of the project [13]. Furthermore, over the years, it has been observed how the introduction of technological means enabled faster and easier retrieval, visualisation and analysis of data needed for the project [14]. Various benefits were also seen for the creation of multimedia artefacts. In summary, the various benefits found demonstrate how the use of technological means in PBL can extend the number of actions that students can perform in the classroom and support teachers in speeding up student learning [2] [13]

Various experiments and observations have been made to try to understand the evolution of the approach with the support of technology. These early data, however, predicted a mixed approach, where the Face-to-Face component was an integral part.

In 2020, the advent of the COVID-19 pandemic has challenged the world, imposing new teaching modalities. The use of digital was no longer an opportunity to expand what was happening Face-to-Face but rather an integral part of teaching. The lockdown condition with which the world had to live required for several areas a complete translation of processes from full-physical or mixed physical-digital to full-digital. Design teaching and the conducting of design projects have been affected by this transfer process from offline to online. Digitalisation has changed the way design teaching is approached and how design projects are held. Teachers have had to develop new ways of teaching the discipline to students, while students have had to experiment with new ways of both learning and collaborating in project development.

Starting from this new condition, which began with lockdowns but then continued in the later blended teaching phases (a mix of Face-to-Face and remote modes), this study poses two research questions:

How does the process of teaching Design in the PBL format change with the speed of digital technology adoption (due to the COVID-19 Pandemic)? Which activities are more effective fully remote and digital, and which are more difficult?

2 METHODOLOGY

This paper bases its analysis on a survey distributed among students enrolled in bachelor and master's degree courses at the School of Design in Politecnico di Milano. The sample includes all students who followed at least one fully remote project study from the School of Design due to the COVID-19 Pandemic.

Design school project studios include at least one weekly lecture during the semester, where students work vertically on a specific project (and topic/challenge), applying the design process. During this period, students receive both theoretical knowledge preparatory to carrying out the project and have to solve the challenges associated with a project.

The questionnaire received 120 responses. The respondents were given a questionnaire divided into four sections. Each section corresponds to one of the four typical project phases (Discover, Define, Develop, Deliver), addressed during the design studio. The Discover phase corresponds to the identification and analysis of the problem; the Define phase deals with the identification of opportunities from the research carried out and the identification of promising design directions; the Develop phase refers to the development of the project idea in its various aspects; finally, the Deliver phase concerns the prototyping and testing of what has been produced to understand whether the result is consistent for the user and can go to market.

A Likert scale questionnaire was provided to measure how the different phases and related activities have changed in the shift from Face-to-Face activities to remote and digital ones. Each of the four sections was structured with two closed questions, for a total amount of eight questions. Closed questions were provided with multiple parameters to be analysed, ranging from 6 to 8 possible, depending on the investigated area. Each parameter needed to be evaluated on a likert scale from 1 to 5.

All the answers were collected in a .xls file to create a descriptive statistics graph for each area of inquiry [15].

The results were analysed using Excel and visualisations associated with the data obtained. The results were discussed by a team consisting of two professors and three researchers.

3 RESULTS

The survey was conducted with a likert scale questionnaire whose parameters ranged from 1 to 5. The parameters analysed the difficulty experienced by the students in carrying out the different subtasks associated with each macro-step of the process and undertaken in the fully digital version.

The lowest parameter (1) represented a lower difficulty in performing a given phase in the new fully digital PBL setting; the highest parameter (5) represented a high difficulty in approaching a given phase in the new fully digital setting.

The tables, except for the first one, express the percentage of answers obtained by the respondents concerning the degree of difficulty encountered. Only the results that were considered most interesting with respect to the scope of analysis are shown below.

The first result reflects the general difficulty encountered by the students with respect to the four phases. Table 1 shows the average score attributed to each phase by the respondents.

Table 1. Difficulties encountered by students in carrying out the different phases online.

<i>Phases</i>	<i>Grade of difficulty</i>
Discover	4,00
Define	4,60
Develop	1,80
Deliver	1,50

This initial finding shows that the first two phases, discover and define, were the most problematic for the students. Whereas the last two phases, develop and deliver, did not produce any particular problems in being tackled fully digitally. Thus, the analysis and conceptualisation phases of insights were more complicated to carry out online than the idea development and prototyping phases.

Table 2. Difficulties encountered by students during 'Discover' sub-phases.

	1	2	3	4	5
Find the right people to interview	0%	2%	8%	35%	55%
Create the right questions to interview people	0%	8%	15%	45%	32%
Identifying valuable situations to observe	0%	6%	12%	38%	44%
Identifying promising cases for the project	8%	12%	30%	32%	18%

Regarding the first area of analysis, concerning the 'Discover' phase, Table 2 shows that it is one of the areas where students experienced the most problems in the transition from Face-to-Face to Remote learning. Identifying the key people to interview and the key situations to observe seem to be those most impacted by the digital transition. The phase of identifying the right questions to ask during the interviews was less problematic, but still with difficulties. In contrast, the phase of identifying inspirational cases for the project was not particularly problematic.

Table 3. Difficulties encountered by students during 'Define' sub-phases.

	1	2	3	4	5
Selecting the most promising research data	0%	5%	10%	35%	50%
Going beyond the obvious user needs	0%	6%	9%	33%	52%
Clustering and making sense of the collected research data	0%	2%	8%	35%	55%
Being able to identify promising opportunities	0%	0%	5%	30%	65%

Regarding the second area of analysis, concerning the 'Define' phase, Table 3 shows that this too is one of those in which students experienced the most problems in the transition from Face-to-Face to Remote learning. Within this phase, all four proposed sub-activities were particularly difficult. The one that emerges as the most complicated is the action of identifying promising opportunities from the research carried out and the data obtained during the Discovery phase.

Table 4. Difficulties encountered by students during 'Develop' sub-phases.

	1	2	3	4	5
Visually representing meaningful project's concepts	2%	16%	31%	36%	15%
Presenting the concept for an intermediate review	1%	18%	26%	40%	16%
Finding a shared view with my teammates to define the concept	7%	19%	27%	33%	14%
Finding the correct digital software to share/visualize ideas	24%	27%	27%	19%	4%

Regarding the third area of analysis, concerning the 'Develop' phase, Table 4 shows that this phase was found to be less problematic for the students who found themselves performing it in the transition from Face-to-Face to Remote learning. Although by a small difference in scores, among the activities proposed, the one that proved to be most problematic was the discussion during the review moments. Following that, the activities of concept visualisation and of finding a shared view in the group presented some minor problems. By contrast, the phase of choosing software to visualise and share ideas was not problematic at all.

Table 5. Difficulties encountered by students during 'Deliver' sub-phases.

	1	2	3	4	5
Finding the right way to involve users in the test	4%	19%	36%	34%	8%
Understanding the level of details that should be given to let the user understand the project	3%	16%	41%	32%	9%
Prototype building	2%	16%	31%	36%	15%
Understanding how to synthesize the obtained feedback	1%	18%	26%	40%	16%

Regarding the fourth area of analysis, concerning the 'Deliver' phase, Table 5 shows that this phase proved to be the least problematic for the students in the transition from Face-to-Face to Remote learning among all four phases under analysis. Of the four sub-activities investigated, the one that caused the most problems always had to do with summarising the results. Indeed, the one with the highest percentage of difficulty turned out to be the action of understanding the feedback obtained during the tests. The other three stages have very similar levels of difficulty.

4 CONCLUSIONS

The study investigated how the transition from Face-to-Face to fully remote due to the COVID-19 pandemic has changed the way design is taught and developed in the discipline of Design. The study analyses in detail which phases and activities have changed in the new concept of online PBL produced because of the Pandemic. The study, therefore, gives the possibility to reflect on the main activities that require implementation and how to develop projects in a fully remote mode.

The results from the 120 students who answered the Likert scale questionnaire showed that this digital transition particularly impacted the analysis and synthesis phases. In contrast, the idea development and prototyping/testing phases were less problematic to be carried out online. This result is to be associated with the lack of direct support that often existed during the face-to-face phases. As mentioned, in fact, project studios take place within the School of Design of the Politecnico di Milano on at least a weekly basis. During these face-to-face moments, the teaching staff supported the students in the various phases. Discussion was therefore a key asset in relationship management. The analysis and research phase has always been problematic in the design world. Legrenzi [16] paraphrasing Oscar Wilde said that "Genius is not in knowing the answers, but in posing the right questions". In online design teaching processes, it is, therefore, necessary to consider that specific moments of discussion with students should be planned to continue to support them in the research and analysis process actively. As mentioned above, PBL and related design teaching form of instruction require the student to interact with other people, share his or her knowledge and understanding of the subject matter and be actively involved in the learning process; the remote-based interaction impact on the quality of communication and content sharing among students, and between teachers and students. The data analysis and

moreover the related synthesis in a design project requires an intense and continuous discussion to train the typical design attitude [17]; the fully remote context can smooth over the interaction causing difficulties in project development, and flattening the creative approach.

Possible digital intervention actions could be handouts or MOOCs that support the students in the design research and synthesis phases so that they are also guided in the processes that generally in Face-to-Face didactics saw the presence of the teachers and that in the remote phases instead made the students manage these phases more autonomously. The lower difficulty level in the last two phases is due to the higher and longer involvement of digital activities, tools and media in developing and executing design projects. The students were already more familiar with some digital tools that were used to support them in the restitution of the idea and the creation of the tests, which often already took place digitally. In addition, the last phases of the design process can be more easily assigned and divided among the students, easing the process of cooperation and reducing the collaboration and discussion activities.

Therefore, possible support actions to the design teaching are to be concentrated mainly within the first two steps, which were conducted more traditionally and with more human contact. The aim is to stimulate reflections to deliver new formats for online PBL in the Design field that overcome the difficulties identified by the students, making remote teaching as effective as possible.

It is necessary to consider that the questionnaire, made up of closed-answer questions, could be affected by a bias of students, who filter the multiple answers uncontrolled. Further research with semi-structured interviews could therefore be added in future research to investigate the reasons behind the difficulties encountered by the students. Moreover, the sample should also be scaled to obtain a more precise result than the answers obtained.

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