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2025 EUCEET AWARD FOR EXCELLENCE IN TEACHING IN CIVIL ENGINEERING

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

ENGINEERING EDUCATION FOR A SUSTAINABLE FUTURE: CONFRONTING ENVIRONMENTAL CHALLENGES.

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2. SUMMARY

This teaching project integrates a variety of interdisciplinary initiatives conducted at the Universitat Politècnica de Catalunya (UPC), primarily within the Civil and Environmental Engineering Department. The main scope includes enhancing engineering education through the promotion of sustainability and critical thinking skills. Key activities include the implementation of **structured classroom debates**. These debates have been designed to simulate real-life environmental decision-making scenarios. Furthermore, the initiative includes the organization of the **interdisciplinary public conference** "Beyond Growth," which addressed themes related to ecological economics, energy transition, and sustainability. The project is rooted in active participation and experiential learning across several subjects, impacting hundreds of students and external participants.

Exportability: is easily adaptable to other institutions, educational levels, and national contexts. It has already shown effectiveness in Civil Engineering and can be transferred to other disciplines such as environmental science, economics, and even non-academic settings.

Interdisciplinarity: The project involves teachers from various subjects, departments, and areas of knowledge. It promotes collaboration between experts in engineering, environmental sciences, economics, social sciences, and more. This interdisciplinary approach enriches the learning experience and provides students with a holistic understanding of environmental challenges.

Impact on Learning: The initiatives have had a significant impact on learning by fostering critical thinking skills among students. Students have demonstrated improved understanding of environmental issues and enhanced ability to analyse and argue effectively. The use of debates and interdisciplinary conferences has proven to be an effective method for engaging students and promoting active learning.

Impact on Promotion of Civil Engineering Studies: The project has positively influenced the promotion of Civil Engineering studies by highlighting the importance of sustainability and innovative solutions in addressing environmental challenges. By integrating these themes into the curriculum, the project has attracted more students to the field and increased their awareness of the critical role engineers play in society.

Impact on Society: The initiatives have raised awareness about sustainability among the university community. They have also contributed to open discussions about growth and well-being for all. The project has fostered a sense of responsibility among students and encouraged them to become agents of change in their communities.

Collaboration with Industry: While the focus has been primarily academic and social, the methodology fosters dialogue with NGOs and potential future partnerships with industry. These connections support awareness and application of sustainable engineering practices aligned with industry needs.

Innovative methods in the teaching Project: The project's primary innovation lies in the integration of structured debates into civil engineering education —a rare practice in this field. Students take opposing sides on environmental issues to promote understanding and objectivity. They conduct scientific research, apply engineering knowledge, and present structured arguments and rebuttals. The methodology is based on cooperative learning, role-playing, and real-time feedback. This is complemented by the "Beyond Growth" conference, which employs multimedia content, interactive web tools (e.g., Slido), and cross-disciplinary speakers to create a dynamic and participative learning atmosphere.

Development of Teaching Material: Teaching materials associated with the project include educational videos, structured debate guidelines, conference presentations, and articles documenting the effectiveness of these methods. These materials are made available in open formats, promoting collaboration and knowledge dissemination.

Years Running / Number of Students Involved: The initiative has been running for multiple academic years, with active implementation since 2018. Over 150 students participated in structured debates, and 151 registered for the main conference, with 129 attending. In October of this year 2025, the **2nd edition** of this conference will take place.

Quantitative Appraisal of the Impact: The impact of the project has been quantitatively assessed through surveys and evaluations. Students have reported high levels of satisfaction and improved academic performance. The project has also led to increased awareness of sustainability issues and a greater commitment to addressing environmental challenges. The quantitative data collected supports the effectiveness of the project in achieving its goals.

Funding / Support Received: The project has received funding from various sources including university grants for educational innovation. Support has also been provided by social partners who have participated in conferences and debates. This funding has been crucial in developing and implementing the project.

SDG & Agenda 2030: The "Engineering Education for a Sustainable Future: Confronting Environmental Challenges" project is aligned with the Agenda 2030 and several Sustainable Development Goals (SDGs) 4. Quality Education, 7. Affordable and Clean Energy, 11. Sustainable Cities and Communities and 13. Climate Action, among others. This initiative emphasizes social and environmental responsibility through teaching methodologies, including structured debates and interdisciplinary conferences. Overall, this project demonstrates a high level of social and environmental engagement, aiming to create a generation of engineers who are equipped to drive sustainable development and address global challenges.

Awards Received: The project has been recognized with the following awards:

- **UPC Award for Quality in University Teaching:** This award acknowledges the excellence and innovation in teaching methodologies implemented in the project. More information about the award can be found at https://www.upc.edu/ca/sala-de-premsa/noticies/consell-social-reconeix-persones-comunitat-guardonades
- **Jaume Vicens Vives Distinction:** This distinction honours the significant contributions to the improvement of university teaching quality. More information about the award can be found at https://www.upc.edu/en/press-room/news/jaume-vicens-vives-distinction.
- Application for university grants IMPACTE: in March 2025 we have requested the **IMPACTE** grant from the "*Generalitat de Catalunya*" to continue implementing the methodology of class debate through a didactic guide and a series of conferences.

3. TEACHING INITIATIVES - OBJECTIVES AND METHODOLOGY

At the Universitat Politècnica de Catalunya, a methodology was carried out to promote critical thinking and sustainability through debate in the classroom. Several professors at the University have committed to implementing this methodology in their teaching. A video on social and environmental awareness was created, and a conference included professors, non-profit entities, students from various subjects, and the general public.

3.1 FOSTERING CRITICAL THINKING AND SUSTAINABILITY

We have implemented a pedagogical strategy that has proven effective over several years: the preparation and execution of debates. This methodology not only enriches the learning process but also empowers our students from an engineering perspective.

The structure followed in the course includes:

1. **Definition of Roles:**

   Students are divided into two groups, each representing opposing positions in the debate.

   Each group assumes a specific role defined by the teacher, regardless of student preferences. This ensures greater understanding, complexity, and objectivity in the debate preparation.

2. **Research and Analysis of Environmental Challenges:**

   Students investigate and analyse current environmental problems such as pollution, waste management, conservation of natural resources, and climate change from an engineering perspective.

   They deepen their understanding of these challenges, identifying their causes and consequences.

3. **Development of Engineering Solutions:**

   Students immerse themselves in creating engineering proposals to address identified challenges.

   They consider technical, economic, and social aspects to design viable and realistic solutions.

4. **Debate Preparation:**

   Each group meticulously prepares to defend their assigned position.

   They use scientific data, models, and concrete examples to support their arguments.

5. **The Debate in Action:**

   Moderated by the teaching team, the debate takes place. Each group presents their arguments and counterarguments.

   The implications are explored, and the advantages and disadvantages of each opposing position are debated.

6. **Comprehensive Evaluation:**

   The quality of presentations is assessed. The deep understanding of topics and students' ability to defend their positions are considered.

   Teamwork and students' ability to understand and defend opposing perspectives are also evaluated.

3.2 CONFERENCE 'BEYOND GROWTH'

In February 2024, we organized the conference titled **'Beyond Growth'**. This event, held at the auditorium of the School of Civil Engineering, focused on exploring alternative perspectives on development and economy. This year we will celebrate the 2nd edition of this conference.

Key actions taken to ensure the success of the conference include:

- **Production of Introductory Video:** To contextualize the topics addressed, we created and edited a video with the same title as the conference. This video is available on YouTube.
- **Website Design:** We created the website https://conferenciaupc.site/ to provide detailed information about the conference and speakers. The website also served as a platform for registrations and opened the debate using the 'Slido' tool.
- **Advertising and Visibility:** We designed and distributed advertising posters throughout the university. The poster can be viewed at this link. We contacted the Student Delegation of the School of Civil Engineering (DAEC) for their support and collaboration in promoting and developing the event.
- **Incentives for Attendance:** To encourage student attendance, the teaching team proposed activities that would count towards their course grades. The conference was included as part of the 'Universitari@s ODSesionad@s' initiative at the Universidad de Murcia, providing **0.5 ECTS** credits to attendees for attending the conference and three other workshops/conferences in the series.
- **Space for Debate and Reflection:** At the end of the conference, we opened an enriching space for debate between attendees and speakers using the 'Slido' tool.

4. QUANTITATIVE AND QUALITATIVE RESULTS

- **Scientific Article:** "Fostering Sustainability and Critical Thinking through Debate—A Case Study" evaluates the effectiveness of debate as a teaching method to foster sustainability and critical thinking skills in engineering students. The results indicate that debate is an efficient tool for acquiring knowledge and developing these competencies.
- **Attendance**: The conference attracted 129 attendees.
- **Participation**: Classroom debates involved all students and generated meaningful discussions that extended beyond the classroom and conference hall.
- **Video Views:** Today we have more than 1,300 views.
- **Presentation Downloads:** Presentations from the speakers were made available to attendees, with over 300 downloads recorded.

5. TRANSFORMATIVE CAPACITY

The initiatives aim to transform students' attitudes and prepare them for a future where engineering is fundamental. Evidence of improvement includes increased student satisfaction and

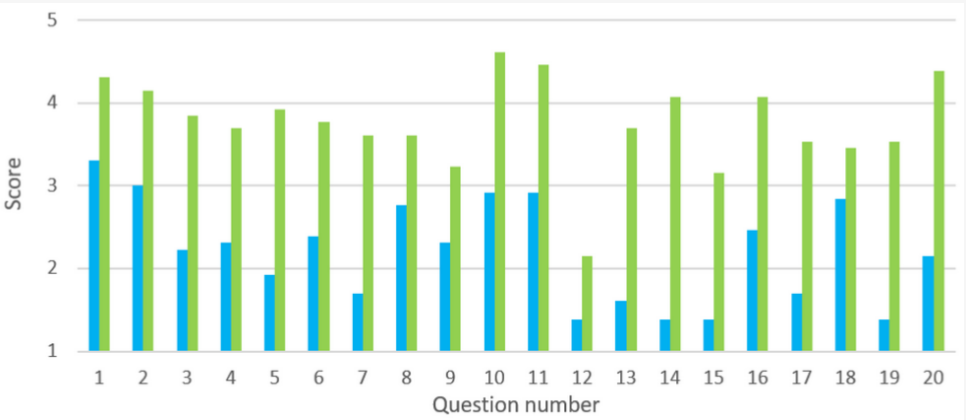
progress in their academic performance, demonstrating the effectiveness of the initiatives in student training.

To measure transformative capacity, we used student surveys. These surveys evaluate students' perceptions of various aspects related to the initiatives and provide deep insights into the implemented measures, helping us continue improving and innovating in education.

Motivation and Project Design: The initiatives were conceived upon recognizing the need to foster critical thinking and environmental awareness among students. The project design was based on evidence that debate, and the conference could be catalysts for change.

Evidence of Improvement:

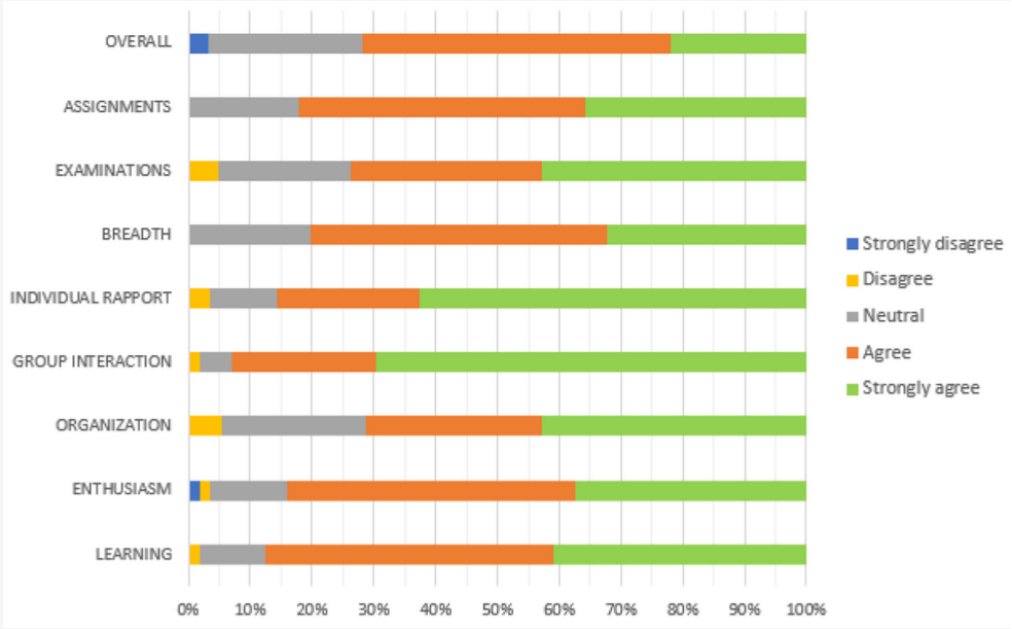
- Student Satisfaction: An increase in student satisfaction was observed when actively participating in the debate and attending the conference.
- Academic Results: Students demonstrated a better understanding of the topics covered and a greater ability to analyse and argue. Results were evaluated through pre- and post-debate tests, a specific debate survey, and student evaluations of teaching quality. All data are reported and analysed in the article "Fostering Sustainability and Critical Thinking through Debate—A Case Study" In summary, we can conclude:
    - **Pre- and Post-Debate Test Results:** The graph represents how students' knowledge changed after participating in the debate. The blue colour indicates pre-debate results, while green represents post-debate results. A significant improvement in students' knowledge is observed after the debate session.



    - **Debate Survey Results:** Shows the average academic evaluation scores of students by team. Each evaluation score of each team member is the average of the points received from other team members. This evaluation score constitutes a fixed part of the students' final grade (5-10%).

Team	Communication	Argument	Knowledge	Total
D team	79%	74%	83%	78%
SD team	93%	88%	88%	90%
Moderators	94%	91%	94%	93%
All	89%	85%	89%	88%

- **SEEQ Survey:** An anonymous tool that collects students' evaluations of university teaching quality, measuring nine different components of teaching effectiveness. Students completed it at the end of the semester, with the following results:



Using classroom debates and encouraging student participation in conferences within the university context provides a comprehensive and transformative educational experience that prepares students to effectively address 21st-century challenges.

Applicability within the Same Field of Knowledge (Environmental Engineering): The classroom debate initiative and sustainability conferences can be applied to other courses within the same discipline, such as civil engineering, life cycle analysis, natural resource management, among others. Additionally, debate is adaptable and advisable for other educational levels (Postgraduate, Master's...) and even at the high school level. It is also advisable to organize specific debates on topics such as climate change, biodiversity conservation, or renewable energies.

In the field of engineering, the debate methodology has proven effective in developing critical thinking and sustainability competencies among students. Through pre- and post-debate tests, it has been observed that students acquire knowledge and develop critical thinking skills efficiently.