

ENHANCING ENGINEERING EDUCATION THROUGH INTEGRATED PROJECTS AND PROJECT FAIR: A CDIO FRAMEWORK PERSPECTIVE

Manel Medhioub, Soumaya ARGOUBI, Lamjed Bettaieb

ESPRIT School of Engineering, Tunis. Tunisia

ABSTRACT

Engineering education is evolving to meet the demands of a dynamic professional landscape. At ESPRIT School of Engineering, we have embraced active learning methodologies, specifically problem-based learning, to cultivate a dynamic educational environment that effectively fosters the acquisition of practical skills among our engineering students. Our commitment to providing authentic learning experiences is exemplified through the integration of Integrated Projects into our curriculum. Aligned with the CDIO framework—Conceive, Design, Implement, Operate—these projects immerse students in real-life problem-solving scenarios. A unique facet of our curriculum is the introduction of the "Project Fair" experience, an event that combines project-based learning with sustainability inclusion and collaboration with industry partners. In essence, Project Fair is an extension of our commitment to the CDIO framework, providing students with a platform to showcase the results of their projects in a professional context. This event not only highlights the "Operate" phase but also actively involves stakeholders such as students, faculty members, administrative staff, and representatives from the industry. In this paper, we delve into the intricacies of the 10th edition of Project Fair, offering a detailed examination of how it aligns with CDIO standards. Our focus extends to the steps taken to involve businesses in the evaluation process, our emphasis on the United Nations' 17 Sustainable Development Goals (SDGs), and the active participation of alumni in enlivening the event. We outline meticulously planned steps crucial for the success of this event, involving the coaching process, a sophisticated evaluation method, and the efficiency of the organizing committee.

KEYWORDS

Project based learning, Active learning, Teamwork, Innovation, Sustainability, SDGs, Standards: 2, 5, 6, 7, 8, 11.

INTRODUCTION

Engineering students acquire skills that can be applied effectively in their professional careers. Active learning approaches, such as problem-based learning, create dynamic environments that stimulate authentic situations fostering skill acquisition. Numerous engineering education

Proceedings of the 20th International CDIO Conference, hosted by Ecole Supérieure Privée d'Ingénierie et de Technologies (ESPRIT) Tunis, Tunisia, June 10 – June 13, 2024

studies provide insights into the best practices associated with implementing Project Based Learning (PBL). This pedagogical approach serves as a learning framework that mirrors the challenges and complexities encountered in professional engineering practice. Moreover, the CDIO Syllabus (Crawley et al., 2014) emphasizes the integration of project-based learning experiences to enhance student learning outcomes. Furthermore, PBL stands out as a pedagogical approach especially beneficial within the context of CDIO design-implement courses (Edström & Kolmos, 2012). PBL and CDIO can play compatible and mutually reinforcing roles, and thus can be fruitfully combined to reform engineering education (Edström & Kolmos, 2014). This paper aims to introduce the implementation of PBL at ESPRIT, present the Project Fair as an authentic learning experience, and highlight the quantifiable achievements of the 2023 edition of the event. Indeed, the Project Fair is a key event to celebrate and exchange ideas on the issues and challenges of future and emerging technologies which are the crucial parameters of any digital makeover. Its ability to mirror real-world scenarios needs engagement with stakeholders, and the event serves as a conduit for networking opportunities. In addition, we have strategically incorporated the SDGs into the evaluation process, emphasizing the awareness of sustainability issues related to the 21st century. Our commitment to sustainability extends beyond the event, with alumni actively contributing to its success and bringing attention to the importance of sustainability in engineering education. Furthermore, the event fosters a competitive environment among projects, with exceptional ones receiving well-deserved recognition and prizes. This paper is structured as follows. Section 2 exposes the project-based learning approach of ESPRIT. Section 3 presents the Project Fair event and the schedule followed to ensure effective organization. Section 4 offers insights into the 10th edition. In Section 5, we elucidate our adherence to CDIO standards. Section 6 highlights the impact of this event on students and faculty members. The last section is devoted to providing a conclusion that encapsulates the details outlined in the paper.

ESPRIT CASE OF STUDY

Active learning approach promotes original learning situations and better support for engineering students. ESPRIT school of Engineering emphasizes the development of durable skills for its students through specialized course offerings, projects, career fairs, and internship opportunities. ESPRIT on the other hand, adopts active learning, particularly problem-based learning (PBL) through integrated projects. These projects are effectively achieved in alignment with the CDIO principles (Conceive-Design-Implement-Operate) providing learners with real-life scenarios and fostering original learning situations for better support. The intensive utilization of project-based learning is one of the main provisions of the CDIO initiative (Crawley et al., 2014). This approach not only emphasizes theoretical knowledge but also hones the practical skills essential for success in their future professional endeavors. Obviously, faculty members establish clear guidelines and expectations for industry involvement to ensure that students' learning outcomes are met. Hence, students not only deepen their theoretical knowledge but also develop practical skills necessary for their professional growth. Students must work in teams and apply these various skills and knowledge areas. But how is it possible to give our students the opportunity to have feedback on their work from industry and encourage collaboration between our faculty members and experts who can offer real problem situations. Indeed, (Carlson, 2017) discussed these potential challenges specific to engineering education and considered that instructors must stay up to date with industry developments to design appropriate problems. This underscores the importance of creating opportunities for students to interact with industrial companies to contribute to the development of their competences, as highlighted by (Mazini et al., 2018).

Another challenge lies in ensuring sufficient resources and support for faculty members to effectively facilitate PBL. Additionally, fostering a culture of awareness about sustainability and integrating it into engineering education is another significant challenge. At ESPRIT, we are committed to refining our implemented PBL approaches continually. Our aim is to ensure that engineering students are not just academically proficient but also well-prepared for the multifaceted demands of the professional engineering landscape.

PROJECT FAIR PRESENTATION

Project-based learning has been a subject of exploration for numerous researchers, to engage students in authentic, real-world tasks to enhance learning. Obviously (Kokotsaki et al., 2016) offers an in-depth review of existing research on this pedagogical method. Examining previous studies, the authors explore the effectiveness of project-based learning and its potential benefits and challenges. This survey provides a solid foundation for understanding key trends and findings in the field, which is essential for guiding future research and informing pedagogical practice. Within engineering, (Zhou & Valero, 2016) have drawn attention to the promotion of creativity in students' projects. (Mozgavela et al, 2014) explore the gamification experience of students' project activity, shedding light on innovative approaches to project-based learning. In this section, we present the ESPRIT Project Fair as an authentic learning experience, outlining the goal, audience, and organization. Project Fair is a prominent end-of-year celebration which takes place annually at the end of the academic year at ESPRIT. It is considered as the school's flagship event during which ESPRIT students (from the 1st to the 4th year, all majors and specialties combined) showcase the projects they work on during the year with a lot of creativity and professionalism. In addition to integrated projects, ESPRIT offers this experience to combine project-based learning, sustainability inclusion and collaboration with industry. In line with our commitment to CDIO standards, this experience distinguishes itself from common authentic learning situations. It scales to larger classes and multiple sections and maintains the benefits of PBL while managing larger groups of students. Each year this event highlights our best practices about the inclusion of active teaching methods in our learning environment. Our goal is to create a setting that promotes collaboration and empowers students to take responsibility for their learning. Consequently, the Project Fair helps in the popularization of project-based learning, puts learners in a competitive environment which boosts innovation. To encourage engineering trainees, the standout projects realized by our students are exposed to emphasize their technical, communication and teamwork skills. Moreover, this event is a fully-fledged quality culture in which all stakeholders including students, faculty members administrative staff, and companies are involved. Hence, hundreds of visitors; families, instructors, partners; professionals, and business owners attend this event to discover the expertise and diligence of our students in coming up with brilliant solutions to real-life issues. As a result, Project Fair provides an exceptional platform for students to showcase their work through the organization of exhibition spaces, interact with a diverse audience, and receive feedback in a professional context. Over an academic semester, assiduous and meticulous work is undertaken within the various modules, which emphasize a project-based learning approach. Each of these modules rigorously implements the first three phases of the CDIO framework: "conceive", "design" and "implement". The project fair takes on particular importance in highlighting the "operate" phase, offering students an unprecedented opportunity to present the concrete results of their projects to a wide and diverse audience. To highlight the achievements presented by our engineering students at this event, we generate a catalog highlighting the most outstanding projects from each edition. This catalog will be shared with a wider audience later. Elsewhere, to reach a diverse audience mirroring real-world scenarios, students must effectively communicate and

convey their work in a manner accessible to non-experts. This platform facilitates a competitive comparison with other projects and the outstanding ones consistently receive recognition and prizes. Finally, this event comes as a coronation of all the efforts deployed by students and faculty members by setting up Project/Problem-Based Learning as a training approach and aiming to provide the job-market with readily employable 21st century engineers.

Agenda

Given that this event crowns the efforts of students and teachers throughout the academic year, its organization must be carefully planned. This will require a significant time investment to consider all details, ensuring the selection of the best projects and the recognition of the deployed efforts based on a clear and fair evaluation process using measurable criteria. Consequently, we have developed a schedule spread over the entire year, detailing the necessary steps for the success of our flagship event. The table below outlines this plan.

Table 1. Project Fair agenda

One Year Before the Event (Year N-1)	
When	What to do
June	Retrospectives <ul style="list-style-type: none"> - Production of the catalog showcasing the projects participating in the N-1 edition. - Collecting feedback from the N-1 edition
July	Collection of proposals for <ul style="list-style-type: none"> - Updating - Themes - Evaluation method
September	Initiation of event preparations <ul style="list-style-type: none"> - Introduction of the Fair Appointment of committee Finalization and announcement of <ul style="list-style-type: none"> - Evaluation criteria - Awards - Theme Solicitation of companies to offer specifications
October	<ul style="list-style-type: none"> - Preparation of the sponsorship file - Identification & Solicitation of sponsors
November	<ul style="list-style-type: none"> - Validation and announcement of the number of participating teams per level/specialization - Contact student clubs
December	<ul style="list-style-type: none"> - Pre-selection of participating teams for 1st semester projects
January - February	Launch of organization activities <ul style="list-style-type: none"> - Setting up tools & virtual or physical structures. - Definition of media and corporate communication strategies - Preparation of visuals, press releases, etc. - Re-establish contact with student clubs.
March	<ul style="list-style-type: none"> - Planning the sequence of events (running order, speakers, participants, evaluators, opening and closing remarks)

	<ul style="list-style-type: none"> - Development of the D-Day program - Drawing up animation program - Contacting the media
April	<ul style="list-style-type: none"> - Selection of participating projects & retrieval of student outputs for use in creating projects catalog (capsules, descriptions, posters, etc.) - Solicitation of companies to involve them in the evaluation process.
May	<p>Finalization of organizational activities</p> <ul style="list-style-type: none"> - Finalization of tools & virtual or physical structures - (D-15) Media coverage and solicitation of companies as guests - (D-7) Broadcast the event on social networks. - Raising awareness of the need for teachers & students to participate

10TH EDITION

This edition was distinguished by the diverse range of disciplines represented by the participating teams. There were participants from fields such as computer science, telecommunications, civil engineering, and electromechanics. As a result, there was a considerable breadth of topics covered. The table below offers a comprehensive overview of the showcased projects, exploring a diverse range of fields and topics they encompass, thus providing a multifaceted understanding of their content and themes.

Table 2: Fields/Topics

Field	Topics	Number
Common core	Serious Game on sustainable development Municipal election management Smart Airport, Smart Radio, Smart Court, Smart travel Agency, Smart event planner, Smart coworking space, Smart RDI center, Smart Electric charging station, Smart Ambulance agency, Smart Technical Visit center, Smart ADHD center, Smart Share and Care center Barter / Catering / Automotive Transport, Freelance and employability, Art and culture, Environmental awareness and sustainability, Health and wellness, Finance/Insurance/Fintech, Sport/e-sport gaming	43
Computer Science	Health, E-learning, Art Employment/Recruitment/HR Real Estate, Home services MarketPlace/E-commerce Social network Monitoring Electronic Banking Bioinformatics Microinsurance/Microfinance Fintech E-sport	30

Telecommunications	Cybersecurity SOAR XDR SIEM SOC Mhealth, MEducation , Smart APP, AI, Blockchain, Internet of things, M2M Metaverse Serious games Addictive online multiplayer games User Experience in 5G Networks/ failure prediction in IP core networks	58
Civil Engineering	Urban planning and sustainable development Critical study of a work Sustainable construction and the environment Building physics Building structures Structures and structures	11
Electromechanics	Electromecanic systems Robotique et IA	18

In this section, we take a closer look at the unique experience of the 10th edition of this event, focusing on the CDIO standards covered. We highlight the quantifiable achievements of the 2023 Edition of the ESPRIT Project Fair as shown in Table 3, then we present committee information, evaluation process, and sustainability inclusion.

Table 3 Quantifiable Achievements of the 2023 Edition

Achievement	Number
Numbers of participating students	1000
Number of Stands	195
Number of participating companies	20
Number of participating faculty members	400
Number of winning teams	43
Number of prizes awarded by companies	5

Committee information

Setting up the organizing committee proved crucial. This committee was carefully put together, including six sub-committees, each responsible for a specific area of activity: sponsoring, communication, digitalization, evaluation, logistics, D-Day program, and logistics. This approach enabled us to ensure detailed management of every aspect of the event, while perfecting efficiency. We followed a series of well-planned steps which led to ensure the success of this event. The table below gives an overview of the different tasks carried out by each sub-committee.

Table 4. Sub-committee missions

Sub-committee	Missions
Sponsoring	<ul style="list-style-type: none"> - Budget estimate. - Draw up sponsorship file. - Identify & Solicit companies to sponsor the event and give prizes to the winners in recognition of their efforts.
Communication	<ul style="list-style-type: none"> - Create a press release for distribution to the media and public, to communicate concisely and informatively about the event. - Development of a complete communications and media strategy - Contact the media (TV, radio, digital magazines, etc.) to ensure good media coverage aiming to motivate students and raise the profile of their achievements among a wide target audience. - Design of visual communication media (roll-ups, stickers, logos) - Development of a catalogue showcasing the participating projects.
Digitalization	<ul style="list-style-type: none"> - Preparation of the resources of the virtual version of the Fair. - Posting promotional video clips for participating projects on our YouTube channels.
Logistics	<ul style="list-style-type: none"> - Drawing up a plan for stand layout. - Reservation of required equipment: data show, power strip, screen, table, chair, internet connection, etc. - Setting up tools & virtual or physical structures
Evaluation	<ul style="list-style-type: none"> - Definition of selection criteria for participating projects and development of criteria grids ... - Invite professionals to take part in the evaluation process. - Assigning evaluators - Prepare certificates of excellence for distribution on the D-Day
D-Day program	<ul style="list-style-type: none"> - D-Day program: speeches, stand visits, music, clubs, prize-giving, photo shoots. - Planning the flow of the event. - Prepare a parallel entertainment program involving student clubs.

Evaluation process

It all started with in-depth coaching of the students throughout the PBL sessions. Then, the creation of a sophisticated evaluation process was essential. We developed a suitable assessment method using detailed evaluation grids. These grids are based on specific criteria, taking into consideration a variety of skills and learning outcomes. This thorough evaluation ensured that every aspect of the event was aligned with our goals of quality and excellence. The evaluation process started with the selection of the participating teams among 8000 students. To do so we used different criteria which are:

- The mark awarded to the project, equivalent to the average of the assessments of the various team members, is set up by the tutors based on an assessment grid specifically designed for this project.
- In addition to this, we give 20% to assess the team's level of motivation and 20% to recognize the innovation of ideas.
- An evaluation of the advertising video designed by the team to promote their final deliverable.

The next stage involves selecting a winning team for each project, based on further evaluation criteria. Depending on the number of participating teams per project we may have a single round if the number is less than 7, otherwise, we'll opt for two rounds.

During the first stage of the two-round projects, the juries will be tutors with an in-depth understanding of the project details. They will be responsible for evaluating all teams to select the best five, from which a company expert will select the winning team.

For single-round projects, and in the second round for two-round projects, a guest expert from the professional community will carry out the evaluation to select the winning team for each project. This expert assessment aims to underscore the significant value added to the evaluation process, as their industry expertise and insights will contribute to selecting the winning team for each project. The appraisal criteria include competence in the use of technology, verbal, non-verbal and paraverbal communication skills, mastery of the language used to interact with the jury, quality of stand presentation, and consideration of sustainable development issues. In addition, visiting teachers who are not tutors will provide evaluations for each team, reflecting their appreciation of the project carried out. Furthermore, 10% of the score will be awarded according to the number of "likes" the video receives on YouTube. This edition involved businesses in the evaluation process, establishing contact between them and students. In addition, many alumni were committed to enlivening the event. The fair created a sense of pride and accomplishment not always present in everyday project-based learning.

Sustainability inclusion

The event put the spotlight on students' awareness of sustainability issues in the 21st century. Indeed, faculty members require support and training to effectively integrate the SDGs. This involves understanding the SDGs, designing appropriate problems, and assessing student learning. Therefore, we organized specific training sessions on the UN's 17 SDGs for our faculty members to ensure a comprehensive understanding of these global issues. To acknowledge the dedication of students who have considered the intricacies of sustainable development and proposed innovative solutions, our partners have generously provided three awards for the three best projects that offer sustainable solutions. A specialized jury, consisting of experienced educators in the field of sustainable development, played a pivotal role in selecting the winners. The selection process was meticulously guided by a criteria grid, focusing on the integration of SDGs within the projects and assessing the projects' overall impact on these globally recognized objectives. This initiative not only fosters a culture of sustainability but also encourages students to actively contribute to addressing the challenges outlined by the SDGs.

A CDIO FRAMEWORK PERSPECTIVE

The CDIO initiative as articulated in the work by Crawley et al. (2014), focuses on setting specific learning outcomes for engineering students. This emphasis ensures that they not only acquire the appropriate foundation in knowledge but also develop skills and attitudes essential for engineering practice. In this context, ESPRIT's focus on the student life cycle and its dedication to developing employability for graduates are in accordance with CDIO project's goals. The project fair is particularly in line with CDIO standards and practices, as it focuses on integrating curricula, learning experiences, and outcomes to ensure that students acquire the necessary knowledge, skills, and attitudes for their future careers. Here's how the fair experience aligns with these standards:

CDIO Standard 2: The project fair provides students with specific, learning outcomes for personal and interpersonal skills, as well as product skills.

CDIO Standard 5: The project fair offers students opportunities to apply their knowledge and skills in real-world engineering problems.

CDIO Standard 6: The project fair environment supports student learning and development, providing access to resources and facilities necessary for their engineering projects.

CDIO Standard 7: The project fair experience encourages teamwork and collaboration among students working together on complex engineering problems.

CDIO Standard 8: The project fair promotes innovative teaching and learning methods.

CDIO Standard 11: The assessment approach during the Project Fair allows students to prove their learning outcomes and receive feedback on their performance, supporting continuous improvement and personal development.

CDIO Standard 12: The project fair contributes to the overall evaluation of the engineering program, ensuring that it delivers a high-quality education to students.

IMPACT FOR STUDENTS AND FACULTY MEMBERS

The outcomes which indicate the success of this event are:

Stakeholders' satisfaction

Following the event, we launched a comprehensive survey form with a series of criteria for the various stakeholders. The aim was to gather detailed feedback on every aspect of the project fair. This initiative is part of our continuous improvement process, aimed at optimizing our processes and meeting the expectations of our community.

According to the results of a post-event survey, 74% of students and 90% of teachers expressed satisfaction with the organization and atmosphere. Communication during and after the event was appreciated by 76% of teachers and 80% of students. These results can be attributed to the fact that the quality of organization and communication has increased the visibility of our students' achievements, providing them with the opportunity to establish connections with professionals in the industry. As for the evaluation process, it met with the

approval of 84% of teachers and 55% of students. This has enabled us to assess the skills and technologies acquired by our students, along with identifying areas that could be enhanced.

Industry involvement

The Project Fair is structured to provide students with an exceptional opportunity to not only present their work through organized exhibition spaces but also to interact with a diverse audience, including industry professionals. The contribution of industry partners to the ESPRIT Project Fair plays a key role for both the school and the students. By involving them in the assessment process, we create a direct link between industry experts and our students, providing valuable insights into the skills demanded by the professional sphere. Students establish networking opportunities with potential employers, and faculty members foster meaningful connections with industry professionals.

Alumni Involvement

The active participation of alumni in the ESPRIT Project Fair holds significant importance, serving as mentors and animators. Their engagement contributes to the success of the event and plays a crucial role in the development of current students. Alumni bring invaluable insights into the industry and guide students offering practical advice and sharing their own career journeys. They provide a broader perspective on career paths and industry expectations. Connections with current students often extend beyond the event and lead to internships, job placements, and mentorship opportunities. In addition, alumni serve as animators during the 10th edition of ESPRIT Project Fair, and they energize the atmosphere. Overall, alumni participation enhances the impact of the Project Fair and contributes to the development of the students.

SDGs Cover

The incorporation of the United Nations' 17 Sustainable Development Goals helps translate 21st-century engineering skills into practical application. In the 10th edition of the project fair, the thematic focuses on " Integrating sustainable development issues into the training of engineers and managers " to highlights the crucial role of engineering in addressing global challenges and promoting sustainable development. By incorporating the SDGs in the Project Fair, students cultivate a sense of responsibility and awareness, essential for addressing the complex challenges of the modern world. Beyond immediate problem-solving, this approach encourages students to consider the long-term impact of engineering decisions on society, the environment, and the economy (United Nations, 2015).

CONCLUSION

In this paper we presented the "Project Fair", an authentic learning experience which is a distinctive feature of our curriculum. After discussing implementation of the project-based learning approach at ESPRIT, we presented a series of carefully planned steps crucial for the success of our event. We started by detailing the crucial steps required to ensure optimal organization of this major event, given its scope involving various players. Focusing then on the tenth edition, we explained how we created sub-committees to give equal importance to all organizational aspects. This was accompanied by a sophisticated evaluation process, based on measurable criteria established using criterion grids. In addition, we integrated sustainable development issues to value solutions aligned with the Sustainable Development

Goals. Particular attention was paid to aligning this authentic educational experience with CDIO standards. Finally, we undertook an in-depth study to assess the impact of the event on both our students and faculty. This holistic approach aimed to comprehensively analyze the positive spin-offs and lessons learned from the experience, thus consolidating our commitment to educational excellence and sustainable development. To perfect communication for future editions, we are planning to create web and mobile applications. These applications will provide access to information on participating teams, while simplifying the evaluation process. To enhance the virtual version of the Project Fair, we are working on a metaverse-based solution. This will make it possible to carry out virtual visits remotely, guaranteeing extended visibility.

FINANCIAL SUPPORT ACKNOWLEDGEMENTS

We express our heartfelt appreciation to our esteemed sponsors, whose generous contributions have played a vital role in bringing this endeavor to fruition. We extend special gratitude to ESPRIT, Attijari Bank, and Assurance Star for their dedication to fostering innovation and education. Their financial backing had a substantial impact on the success of our event.

REFERENCES

- Carlson, J. (2017). The impact of problem-based learning on student engagement and achievement. *Journal of University Teaching & Learning Practice*, 14(3), 1–15. <https://ro.uow.edu.au/jutlp/vol14/iss3/>.
- Crawley, E. F., Malmqvist, J., Östlund, S., Brodeur, D. R., & Edström, K. (2014). *Rethinking engineering education: The CDIO approach*. Springer.
- Edström, K., Kolmos, A., (2012) Comparing two approaches for Engineering Education Development: PBL and CDIO. *Proceedings of the 8th International CDIO Conference. Queensland University of Technology, Austria*.
- Edström, K., & Kolmos, A. (2014). PBL and CDIO: complementary models for engineering education development. *European Journal of Engineering Education*, 39(5), 539–555. <https://doi.org/10.1080/03043797.2014.895703>.
- Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). *Project-based learning: A review of the literature. Improving schools*, 19(3), 267-277.
- Mazini, S.R., Pontes, W., P. Rodrigues, P. & Scarpin, L. (2018). The improvement of faculty competence and collaboration between academia and industry: a case study in the engineering courses of a Brazilian university center. *Proceedings of the 14th International CDIO Conference. Japan*.
- Mozgaleva, Polina & Gulyaeva, Kseniya & Zamyatina, Oxana. (2014). The Project Fair: The gamification experience of students' project activity. *Proceedings of the European Conference on Games-based Learning. 1. 423-429*.
- United Nations. (2015). Transforming our world: *The 2030 Agenda for Sustainable Development*. <https://sustainabledevelopment.un.org/post2015/transformingourworld>.
- Zhou, C., & Valero, P. (2015). A Comparison of Creativity in Project Groups in Science and Engineering Education in Denmark and China. In G. E. Corazza, & S. Agnoli (Eds.), *Multidisciplinary Contributions to the Science of Creative Thinking* (Vol. II, pp. 133-151). Springer. https://doi.org/10.1007/978-981-287-618-8_9.

BIOGRAPHICAL INFORMATION

Manel MEDHIOUB is Faculty member and Chief Academic Officer at ESPRIT School of Engineering (TUNISIA). She holds a PhD degree and an Engineering degree in computer sciences. She teaches senior courses related to network services, cloud computing and security. She has published 7 scientific papers in international journals and conference proceedings.

Soumaya ARGOUBI is Faculty member and head of the algorithms and programming pedagogical unit at ESPRIT School of Engineering (TUNISIA). She holds a PhD, a Research Master's in Protocol, Networks, Images, and Multimedia Systems, and a National Engineer's Diploma in computer sciences. The research areas in which she is involved revolve around wireless networks, the incorporation of Sustainability in engineering education and the innovation in educational strategies. She teaches courses related to algorithms and C/C++ programming as well as networking. She has published 4 scientific papers in international conference proceedings.

Lamjed Bettaieb is the Deputy Director General at Esprit School of Engineering (TUNISIA). His interests include Active Pedagogy, Problem and Project-Based Learning, Accreditation and Positive Psychology. He is the co-chairholder of the UNESCO Chair hosted by Esprit and he is the chair of the International CDIO 2024 conference.

Corresponding author

Manel Medhioub
ESPRIT School of Engineering
1, 2 rue André Ampère - 2083 -
Technological Pole - El Ghazala
manel.madhioub@esprit.tn



This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/).