

# Actionable Entrepreneurship Education in a “Teachers’ Community of Practice” across 17 European Research Universities

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**Abstract**—Digitalisation is bringing computing professionals to higher and higher position of responsibility. Universities, however, have not fully answered to the increased demand in skills that these professionals need to have. In this panel, we present the work of a Teachers’ Community of Practice that is trying to fill this gap by teaching Innovation and Entrepreneurship to computer science students from 17 European universities belonging to a consortium called EIT Digital. The panel will replicate the Community of Practice approach, creating a space to share experiences, encouraging participants to start their own Teachers’ Community of Practices, and transparently discussing points of success and failure alike.

**Index Terms**—Innovation and Entrepreneurship, teachers’ communities of practice, inter-university collaboration, teaching innovation

## I. INTRODUCTION

The digitalisation process is having profound implications on the skills professionals need to have. On the one side, there is an increasing demand for everyone to have computing skills; on the other side, there is also a high need for computing professionals, particularly those in leadership positions, to acquire strong non-technical skills. Indeed, computing professionals at all levels are now expected to be well-versed in so-called “general” or “soft” skills, such as critical thinking, creativity, communication, presentation, team work, (self-)management, etc [19].

Computer science education has notably reacted to this demand by integrating “Innovation and Entrepreneurship” (I&E) courses and minors in CS curricula. I&E education mixes established academic disciplines such as management, economics, social sciences and applied philosophy with actionable practices, i.e., practices, processes, methodologies and content that can be shared and re-used in similar contexts,

such as business modelling and market research. I&E therefore has a dual role: teaching students contextualising theories for impacts of computing in economic, social, and ethical terms together with methodological tools to perform customer/user research, idea validation, and team work.

The very nature of I&E creates a number of challenges, due to blurred disciplinary boundaries and accelerating practical needs. Furthermore, teaching I&E within computing curricula is a not-well-explored area, and this exploration has been further disrupted by the COVID pandemic. The ongoing accelerating evolution of teaching makes it even more crucial to understand what pedagogies are appropriate for the targeted learning outcomes.

In this panel, we present an approach to these challenges, namely the creation and management of a Teachers’ Community of Practice (TCoP). The featured TCoP was founded in 2014 within EIT Digital (EIT-D), an EU-wide network of academic, public sector, and industry organisations. This TCoP designed and implemented a 30 ECTS “I&E Minor” [13] that integrates within a two-year double-degree Master’s programme in computer science across some 17 European universities, and that has already benefited over 3000 students.

This TCoP approach has proven of high value in creating an exploration-first and actionable environment that allows teachers and participants to share ideas outside disciplinary silos, and build capabilities in their institutions. In this contribution, we will briefly contextualise I&E teaching as a way to build skills in computing students and the role of TCoPs (Section II); summarise the main results of the EIT Digital I&E Education TCoP (Section III); and provide some details on the session itself (Section IV). The panel (and this supporting document) should help showcasing how a TCoP approach may

help explore and filter research ideas, improving at the same time the breadth and depth of the participants' teaching.

## II. CONTEXT

1) *Soft skills — from digital to entrepreneurial competences*: As computing professionals increasingly take leadership positions in the industry, it is relevant to map the connection between digital and entrepreneurial competences. The Recommendation of the European Parliament and of the Council on key competences for lifelong learning [5] identified, already in 2006, digital competences as a way to “understand how ICT can support creativity and innovation”. More recent policy frameworks, such as DigComp and EntreComp [4] [2] further highlight this intersection, as both include skills such as creativity, innovation, and collaboration.

The practice of teaching to computing professionals, however, remains somewhat disconnected from this logic. Work such as Belski and colleagues' [3] [18] shows that while higher education has an effect in increasing students' soft skills, the effects and self-perceived efficacy benefits are somewhat marginal, even in the case of skills that would intuitively be core for engineers such as problem solving. As a way out of this gap, researchers and teachers are experimenting with changes in teaching methods. Though generalised, conclusive evidence for the effectiveness of these interventions is somewhat limited, an increasing number of studies suggest that innovating teaching is an important resource to build skills. Work such as Konings and Legg's [10], for example, gives a first quantification of how teaching through a family of methodologies called “Problem-Based Learning” may help students develop a number of soft skills. While gathering conclusive data is proving to be non-trivial, experiences and preliminary results on the rethinking of pedagogical methods are more and more frequent.

2) *Teachers' Communities of Practices (TCoPs)*: Using a sociological lens, one can look at the education profession as a practice that may create around it what Hordern has called a “generic discourse” [9]. In such fields, well-structured generalisable knowledge stemming from research intersects with ill-structured practitioners' insight and political agendas. In such varied context, it is not uncommon to find so-called Communities of Practice (CoPs). The connection between CoPs and learning is quite explicit, going as far back as Lave and Wenger's seminal work [11]. As such, it should be of no surprise that teaching and CoPs have also been explicitly linked as early as 1998 [17].

The digitalisation of education has also quite quickly had spillovers in the realm of TCoPs, with “online TCoPs” organised around forums reported as early as 2006 [8]. More recently, though, Mak and Pun [12] have advanced the idea that TCoPs may be instrumental in achieving “sustainable” professional development for teachers by facilitating practice sharing and providing support to participating teachers. To the best of our knowledge, however, experiences on creating TCoPs that are (1) long-lasting; (2) large (having more than a

few participants); (3) dedicated to teaching I&E to computing students; are extremely limited.

## III. THE EIT DIGITAL TEACHERS' COMMUNITY OF PRACTICE, ITS MAIN ACTIVITIES, AND PRELIMINARY RESULTS

The TCoP we present sees the participation of I&E teachers from all EIT Digital partner universities, plus an EIT Digital-appointed “I&E Coordinator” and several “I&E Education Officers”. The community jointly defines specifications for the courses that compose the EIT Digital Master School I&E minor, and works as a research and practice interest centre on the topic of I&E education for computer scientists. The TCoP holds periodic meetings (roughly four per year), called I&E Education Workshops, during which the community plans and tracks progress on various “activities” that are defined jointly on a yearly basis.

The panel will feature four such activities, presented by the respective activity leaders, that best represent in our view what the community has achieved during these years. These activities are of varying nature: some infrastructural (improvements activities, in Section III-A, and production activities, in III-B), and thus linked to the idea of TCoPs more in general, and some showcasing how the TCoP operates when working on teaching innovation (a course redesign, in Section III-C, and experiments on creating teams of students from multiple universities, in III-D).

For each of these activities, we outline the main added values, how they could be useful for other universities, and historical points of friction.

### A. I&E Education Improvements

The *I&E Education Improvements* activity is the TCoP's process of continuous monitoring and improvement. It includes tasks aimed at (1) harmonising the I&E education offering across EIT Digital universities by facilitating practice sharing and promoting the use of content produced by the TCoP (see Sec. III-B); and (2) increasing the offering's quality by jointly designing shared assessment frameworks for I&E education.

Because of the approach centered on teaching and learning experimentation that is at the core of the EIT Digital TCoP, the Improvements activity serves as an internal tool to ensure that successful experimentations are continued, and less successful experimentations are taken stock of, and eventually phased out. The Improvements activity encourages all partners to experiment on their teaching methods, self-assess their effectiveness, and document them so that they can be reused by other partner universities [1]. The activity also monitors what contents from the shared EIT Digital content library are used by the teachers, and to what degree of success.

As its main output, the Improvements activity produces guidelines that can be used by I&E teachers and mentors, co-developed by all participating universities. Guidelines might include course syllabi, design documents for teaching methodologies, formats for events (e.g., summer schools), or preliminary results on conducted teaching experiments. These

guidelines are made available internally to EIT Digital, and are particularly useful to build capacity when new universities join the consortium.

As in all organisations, internal monitoring and continuous improvements are not without challenges. The inter-institutional nature of the TCoP exacerbates issues that are logistical (e.g., alignment of internal calendars) or procedural (e.g., ensuring that the same broad methods would be compatible with multiple institutional settings) in nature. The scalability of this process is also an area of concern, as the relative large size of the consortium makes it harder to ensure every partner's voice is heard.

#### *B. Production and maintenance of a shared repository of blended content on I&E*

The *Blended content production* activity engages the TCoP in creating and maintaining a shared repository of high-quality online content on I&E, creating shared “boundary objects” for the TCoP. The production involves partners in an exercise of change management towards the adoption of blended learning [6], promoting a form of inter-university exchange where universities include online material made by partners in their courses, thus strengthening the TCoP's cohesion [16]. As of the time of writing, 8 partner universities participated as content producers since the activity's beginning in 2014, creating more than 65 hours of high-quality video content, plus quizzes, text, and interactive mini-lectures.

The courses taught in the I&E Minor are implemented from a common syllabus: having shared online content helps defining a shared identity and creating economies of scale on the teaching of certain basic concepts. At the same time, partners are given complete freedom about how they integrate this content, letting them experiment with teaching methods.

Online content produced as part of this activity has been designed from the beginning to be reusable and modular so that, when syllabi are redefined by the TCoP, the community can jointly decide about what content they consider to be “core” to all I&E Minor courses (called within the EIT Digital “Red-Thread package”). When new universities join the consortium, the online content can also help them build capacity in delivering the I&E minor, and bootstrap their local implementations of the courses.

The main challenges on a day-to-day basis in this activity have mostly been related to ensuring that all producers timely delivered the content they were supposed to, and ensuring that the production quality was adequate and uniform. Beyond this, however, an open point of discussion relates to how the produced content could survive beyond EIT Digital, both in terms of infrastructure (i.e., where the video files are uploaded and hosted) and in terms of access (i.e., in terms of IP rights).

#### *C. Capstone I&E project redesign*

The *I&E Studies Redesign* activity involved all partner universities in re-imagining the capstone project course in the I&E Minor. The previous design foresaw that students would individually work with their local I&E teacher on the

writing of a “minor thesis” elaborating I&E topics connected to their final degree thesis. This, however, created a number of problems in scalability (the I&E teachers would need to individually supervise all second year students), relevance (some students' thesis might not have a strong I&E component), or redundancy (the students' thesis might already have an I&E component, and detaching it from the final deliverable would have created additional work). Teaching capacity and student distribution across EIT Digital universities is also not uniform, meaning that some universities had a teacher following five or six students, while some had up to 90.

The solution that has been implemented was to redesign the capstone project into a Challenge-Based Learning (CBL) course [7], where teams of students cooperatively work to solve a company's I&E challenge. In the final design, EIT Digital personnel would collect from partner companies, every year during the spring, a number of I&E challenges. During the summer, teachers bid on cases, contact the companies and discuss with them in more details the content of the cases, which are then assigned to student teams as projects for their final I&E course, held during fall/winter. This new course design created a safe space where students could experiment contact with companies in a group setting that requires lower commitment than the 1:1 engagement typical in industrial internships or theses.

CBL is by design an open-ended teaching methodology, aiming at promoting divergent exploration of the challenge space. As such, running the I&E Studies course comes with many challenges. The TCoP setting made it so that teachers could share practices, common problems, and how to streamline the process. As a result, the TCoP created a comprehensive set of internal guidelines, helping with activities such as case collection, definition of student deliverables, and possible grading rubrics.

The redesign process went through a gradual rollout, lasting three years: the activity was started in 2017, and was finally merged in regular monitoring (the “I&E Improvements” of Sec. III-A) in 2019. The process was slow, with the TCoP taking a prominent role in helping all teachers understand what CBL is, and how to integrate it in their offering. During these years, the course also accumulated elements of complexity, as the amount of guidelines increased. The currently-open challenge for the TCoP relates to how to refine this new model to make it easier to run and manage.

#### *D. Distributed Student Activities*

Started in 2018, the *Distributed Student Activities* (DSA) are one of the main experimental avenues for the TCoP. Their goal is to experiment with online I&E education, to create settings where students from multiple universities share educational experiences using digital tools. In practice, students might form remote teams to work on shared challenges (see also Sec. III-C), they might participate in hybrid lectures, or work on joint extracurricular activities [14]. The forced transition to online learning due to the COVID pandemic might make this

sound like a minor achievement, but the DSA have been, in retrospect, a great chance to build capacity in online education.

The DSA represent an institutionally-recognised space to experiment with new teaching methods, and especially digitised learning. For students, both before and after the COVID pandemic, DSA have been a way to strengthen their connection with their peers from other universities, thus participating in a form of “virtual exchange”. The distributed setting also created a chance for students to face the many practical issues that emerge from working in distributed teams. Results from preliminary surveys conducted during these activities suggest that students feel like they did, indeed, develop their soft skills. While this would echo the results of similar studies [15] [20], the TCoP still needs to fully analyse and take stock of the data.

The main points of friction related to the DSA mostly have been about logistics. For as much as the consortium structure of EIT Digital gave the institutional space to run DSA, day-to-day challenges such as finding shared class slots (especially when more than two institutions were involved) and aligning agendas remained problematic.

#### *E. Towards a more “actionable” entrepreneurial education*

Entrepreneurship education benefits from being actionable, i.e., directly usable to take action. This should be true for students, needless to say, but entrepreneurship education needs to be actionable also for teachers. Indeed, a non-trivial issue in a content-producing TCoP is to ensure that produced pedagogical resources are actually used by teachers, and that teachers actually commit to making their pedagogical practices evolve.

When discussing teaching methods that prominently involve digital technologies, such as the ones discussed so far, it might seem that the highest integration barriers are infrastructural (i.e., ensuring the correct tools are in place). Quite differently, though, significant barriers to adoption are of pedagogical nature: when adopting and using other teachers’ pedagogical resources, teachers need to re-consider their teaching approach, and need to accept that integrating these resources might take several iterations to reach a good level of quality. A structural reason for this is that pedagogical situations are highly heterogeneous: with respect to the teachers’ pedagogical capabilities and/or styles; with respect to students and classrooms of students; with respect to how countries, educational systems, and even universities, differ. In this context, the cost for a teacher to adopt a resource produced elsewhere is not negligible, especially compared to the cost of following up on current approaches that have often been elaborated and used for years. As a consequence, the adoption costs of new teaching methods are structurally far higher than what a rapid evaluation would suggest. These adoption or switching costs need to be somehow mitigated if one wants to succeed in fostering lasting change in pedagogical practices. Making entrepreneurship education actionable for teachers, thus, means making pedagogical resources more than simply

“ready-to-use”, for “ready-to-use” resources might still not account for these structural points of friction.

It is through this lens, of making entrepreneurship education more actionable for teachers, that several key characteristics of the projects described in these pages can be understood and interpreted. We name here a few practical actions to increase teacher actionability that the TCoP implemented: (1) frequent physical meetings, to induce a considerable amount of practice sharing; (2) production of online pedagogical resources by members of the community, so that producers could ensure that their design was appropriate to the use context; (3) limited standardisation of resources, to accommodate various pedagogical practices within the TCoP; (4) production of resources that can be used both in-class and online in “Small Private Online Course”-like format, to create additional flexibility; (5) centralised hiring of programme officers, to build capacity and assist teachers. It is through these different strategies and means that the EIT Digital I&E TCoP tried to explicitly address the actionability issue, by recognizing it, and by jointly experimenting with various means to improve it.

### IV. PANEL DETAILS

The session is organised to be both a retrospective of the community’s long experience, and a chance to share the many lessons learned along the way, using the panel as a chance to welcome outside input. Speakers will give an “inside look” on the community’s successes, processes, and criticalities, and leave ample space to engage with the audience in a two-way exchange of practices.

Thus, speakers will not merely disseminate the TCoP’s work, but will share their experience, discuss it with the audience, and create a chance to exchange ideas and good practices. The hope is that the panel can provide all participants with relevant ideas to improve their TCoPs, or inspire them to start their own.

#### *A. Intended audience*

The primary audience of this session is composed of teachers and academic leadership (both inter- and intra-institutional) that participates in a TCoP, or that is contemplating forming a TCoP. These participants can benefit from the panel by getting an overview of the work of a long-standing and large community, and particularly by the transparent discussion of success stories and points of friction.

The session, however, can also benefit any computing teacher, both technical and non-technical. Technical teachers will have the opportunity to engage with practical experiences on building relevant non-technical computing education; non-technical teachers will have the opportunity to explore how they can leverage an interdisciplinary setting to tailor their content to computing students’ needs.

The panel format, with the variety of backgrounds of its members, should create a setting that welcomes questions of any nature, and that can facilitate a good discussion around content and process points alike.

## B. Session outline

The format of this session replicates the TCoP approach, discussing points transparently and with as little judgement as possible, within the conference's setting. The panel is thus designed to showcase, through its structure, how a TCoP normally operates, engaging the audience in a similar process.

The session will be divided in two parts.

In the first part, the panellists will discuss the EIT Digital I&E Education TCoP, and share its success stories and challenges. This part is foreseen to last 45 minutes, divided as follows:

- Introduction (10 minutes) — a presentation of the session's structure, of what a TCoP is, and of the EIT Digital I&E TCoP's structure and goals.
- "Lightning talks" on the main activities of the TCoP (5 minutes each) — short presentations summarising the results presented in Section III.
  - Continuous improvements and monitoring (see Sec. III-A).
  - Producing and maintaining a shared repository of blended learning content (see Sec. III-B).
  - Redesign of I&E capstone course (see Sec. III-C).
  - Creating cross-university student activities (see Sec. III-D).
- Rituals and challenges in the EIT Digital I&E TCoP (5 minutes) — how simple processes help creating a healthy community setting.
- Audience Q&A (10 minutes) — open discussion on what has been shared thus far.

The second part foresees a facilitated discussion on creating and maintaining TCoPs. The discussion will revolve around some key questions asked by the panel moderator. Each question will be briefly answered by a panel member, sharing the perspective of the EIT Digital I&E Education TCoP, then audience members will be invited to provide their input. This second phase is foreseen to last 30 minutes, and will tentatively include the following questions:

- Who are relevant actors that can participate in TCoPs?
- What is an appropriate frequency for community meetings?
- How much can a TCoP scale?
- How can leadership be effectively rotated within TCoPs?
- How can a TCoP ensure that participants are active within it?
- What funding sources can support the work of a TCoP?
- What can a TCoP do to ensure a lasting legacy?
- How can a TCoP maintain shared infrastructure?
- How can university consortia solve typical IP and access issues?

As a last point, the session will be ended with a 5 minutes wrap-up.

## C. Panel Members

The panel will feature five experts in the topic, junior and senior, from multiple academic disciplines and economic

sectors.

Maurizio Marchese is Associate Professor of Computer Science at the University of Trento, and Vice Rector for International Relationships. He coordinates many cooperation projects, including the local EIT-D I&E. In the panel, he will contribute to the computing and international cooperation dimension, and will present the continuous improvements activity.

Jean-Michel Dalle is the director of a highly successful incubator in Paris, and Professor of Economics and Management at Sorbonne University, with a focus on I&E. His dual experience led him to emphasise actionable education as a key factor for students and teachers alike. In the panel, he will bring a perspective rooted in economics and entrepreneurship, and will present the shared content repository.

Alvaro Piña Stranger is Associate Professor of University Rennes 1. His research is in technology transfer, venture financing strategies, and entrepreneurial finance. He also researches I&E education and blended learning, and coordinates I&E education in Rennes. He will bring a social sciences perspective to the panel and present the redesign of the I&E capstone course.

Javier Segovia is Professor at the Universidad Politécnica de Madrid, researching data-driven decision making, and with great experience in R&D and technology transfer. In I&E, he focuses on inducing an "entrepreneurial mindset" in engineers. In the panel, he will contribute to the computing angle, with a focus on entrepreneurial practice, and will present the Distributed Student Activities experience.

Lorenzo Angeli is a post-doctoral researcher in computer science at the University of Trento. His research explores the impacts of computing by combining computer science, sociology of technology and entrepreneurship, with a particular focus on how these impacts can be taught to computing students. He will serve as the moderator of the panel.

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