Educating the Future Digital Maturity Enablers. Learning from the Experience of the DC4DM LLabs

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Abstract. The ever-changing digitally enabled world we live in requires preparing young creatives and entrepreneurs with more suitable abilities and set of skills to face the challenges of ongoing digital transformations. The Erasmus + funded project DC4DM aims to implement a human-centered educational model to train Digital Maturity Enablers. This new type of professionals would be able to drive small and medium organizations towards their digital maturity: owning specific creative digital skills, they would be able to extract value from what the technological landscape offers and respond to the human needs through the principles of ethics and sustainability.

This paper aims to describe the DC4DM educational model and reflect on the experience of three testing sessions, called DM Learning Labs, 10-days design-led workshops involving a great diversity of university students, diverse for country of origin and study background, start-ups, and several local mentors and stakeholders to co-design compelling future tech-scenarios. The paper will present the results from a preliminary study which aims to understand how attending a DM Learning Lab has impacted on the participants. Particularly, to understand which Digital Creative Ability had developed thanks to the LLab experience and which learnings were consequently applied in new creative and co-design contexts. The paper tries to highlight how much the DC4DM methodology has the potential to change the way to educate future professionals through cross-disciplinary and collaborative learning opportunities.

Keywords: Digital Creativity · Digital Creative Abilities · Design Education

1 Preparing Future Professionals for the Complexity of Digital Transformation Era

The world is undergoing profound transformations in an era characterized by globalization and rapid technological advancements [1]. The pervasive influence of digital technologies has permeated every aspect of people's lives, from how they engage in sports and consume food to the way they conduct business and interact with others.

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These technologies have become integral to human beings' existence, necessitating a comprehensive understanding of their impact and the need for strategic guidance amidst this ongoing transformation.

It is crucial to recognize that emerging technologies have far-reaching effects, often exceeding the initial expectations. As the renowned quote by Amara [2] suggests, we tend to overestimate their short-term impact while underestimating their long-term consequences. It is precisely this recognition that drives our focus on digital maturity. The advent of new digital technologies carries the power to reshape behaviors, reinvent social relationships, and redefine the very fabric of humanity. Klaus Schwab [3] refers to it not only as the Fourth Industrial Revolution but also as a sweeping "transformation of humankind".

Amidst this dynamic and uncertain landscape, individuals must acquire new skills to navigate the ongoing digital transformation. They must embrace creativity and possess the ability to responsibly harness new technologies, contributing to the attainment of digital maturity within organizations. In this context the overarching objective of the Erasmus + funded project *Digital Creativity for Developing Digital Maturity Future Skills (DC4DM)*, is to implement, apply, and disseminate a human-centered educational model. This model aims to empower individuals with Digital Creative Abilities (DCAs), enabling them to navigate the future emergence of technologies. By equipping individuals with the necessary skills, the project seeks to drive progress, foster responsible use of new technologies, and propel organizations towards digital maturity.

The exponential growth of digital technologies is having remarkable impacts on manifold sectors and particularly disrupting the education system. As a matter of fact, the advent of groundbreaking technologies such as Artificial Intelligence, Machine Learning, Internet of Things, and Virtual Reality are opening countless possibilities to enhance learning and teaching experiences [4]. Indeed, as noted by the World Economic Forum's report on "Schools of the Future", traditional education systems urge for new educational models to be fully able to adapt and meet the ever-changing economic and social needs raised by globalization and rapid technological advancements [5]. Digital transformation is not only altering mindsets, behaviors, and social attitudes but also revolutionizing the processes of creation and innovation [6].

In this scenario, human capital should be provided with opportunities to enrich their essential skillset – which includes, among others, complex problem solving, strategic and creative thinking, critical thinking, emotional intelligence, communication and negotiation, and relationship and network building abilities - with digital skills necessary to guide organizations and companies in their digital maturing path [7]. To allow such a skillset integration and empowerment and to guarantee a thriving transition towards maturity, people should undertake upskilling and reskilling processes that could be offered by innovative education models aimed at equipping the next generation of professionals with a mix of "hard" skills, such as technology design and data analysis, and "human-centric" skills, including cooperation, empathy, social awareness, and global citizenship, to empower learners to shape a future characterized by inclusivity and equality [8]. To remain competitive in the rapidly evolving technological landscape, Higher Education Institutions (HEIs) – the ones offering Engineering and Design curricula – should be prone to updating and rethinking their traditional educational models acknowledging

that digital technologies are becoming our next invisible and ubiquitous nature. Also, by observing the digitally enhanced generation, it appears clear that it exhibits distinct learning preferences, new skills, and novel social behaviors and work styles.

In this unfolding scenario, the ability to think creatively proves to be the crucial skill for navigating the digital transition. Creativity empowers individuals and organizations to achieve digital maturity, enabling them to adapt to the constantly changing digital landscape, collaborate with machines, and effectively lead technological advancements to drive innovation. This human ability enables people to manage and steer opportunities presented by technological evolution and encourages the development of a strategic approach in the adoption and application of such technologies. Being extremely impactful on humans' evolution, digital transformation is also affecting the creative abilities of the digitally enhanced generation.

Considering the main goal of developing, implementing, and disseminating an educational model to upskill individuals to guide digital transformation and achieve digital maturity, in the DC4DM project framework a design-oriented definition of digital creativity has been adopted. Thus, *digital creativity* can be defined as the human ability to create innovative and original digital outcomes leveraging the opportunities presented by digital technologies in a strategic and responsible way. This ability is enhanced by the interconnectedness of various human factors, which are shaped and influenced by the digital age and new technologies. Digital creativity is a multifaceted phenomenon that encompasses the cognitive, emotional, physical, and social dimensions of the human experience. All these dimensions are profoundly impacted by digital technologies which are calling for the redefinition of the essential skills, knowledge, and values required to activate and foster a creative process. When properly trained and empowered, these critical digital creativity factors - cognitive, attitudinal, emotional, and social factors inherent in human beings - can influence individual digital creativity and the outcomes of the creative process. These groups of factors, essential for digital creativity, are all necessary for individuals to generate a creative outcome.

Therefore, the DC4DM project is grounded on the belief that it is paramount to support individuals in the development and empowerment of their digital creativity skillset and prepare them to guide organizations in their path towards the achievement of digital maturity. This entails training individuals in both the *digital creativity factors* and the *creative design process*, equipping them with the ability to create innovative digital outcomes by strategically harnessing emerging digital technologies.

1.1 Digital Maturity Enablers and a New Educational Model

To foster growth and achieve digital maturity, organisations require the expertise of a digitally wise professional who can navigate the digital landscape, comprehend social, technological, economic, environmental, and political trends, and propose strategic pathways towards innovative and sustainable solutions.

Within the DC4DM project, this emerging professional role is referred to as the *Digital Maturity Enabler (DME).* The DME is an individual equipped with specific creative digital skills, enabling them to extract value from the offerings of the technological landscape creatively. Moreover, they respond to human needs while upholding principles of ethics and sustainability. The Digital Maturity Enabler is typically an individual

with a design, engineering, or management background. They must possess the following characteristics: (a) A conscious understanding and application of new technologies, accompanied by a thorough awareness of their potential impact from social, ethical, economic, and environmental perspectives; (b) An inclination to share ideas and specialised knowledge within cross-functional teams; (c) A strong future-oriented mindset, employing foresight methods to identify and illustrate original future scenarios.

In the continuously advancing digital landscape, the Digital Maturity Enabler demonstrates the necessary competencies to assist organizations in thriving and achieving maturity. These competencies include: (a) A comprehensive understanding of technology capabilities and the ability to design digital solutions using a human-centered design approach; (b) Proficiency in collaborating seamlessly within cross-functional teams, effectively communicating with individuals from diverse disciplinary backgrounds, and fostering a shared digitally minded culture; (c) The ability to navigate complexity and uncertainty, effectively addressing and overcoming challenges arising from intricate and unpredictable situations; (d) The capability to envision potential future scenarios and formulate long-term strategies by considering both opportunities and risks that may arise from digital technologies.

The Digital Maturity Enabler employs a set of essential skills to guide ongoing digital transformation. These skills, known as Digital Creative Abilities (DCAs), encompass 24 distinct abilities that are categorized into *cognitive, digital, cross-functional team,* and *strategic vision* dimensions. Collecting the essential DCAs, such dimensions represent the building blocks that support the entire process (Fig. 1). The DCAs encompass a wide range of personal skills that span cognitive, social, and emotional domains. They also involve various forms of disciplinary and procedural knowledge, in addition to specific attitudes and values that provide guidance on how to utilize knowledge and skills effectively in the face of specific challenges.

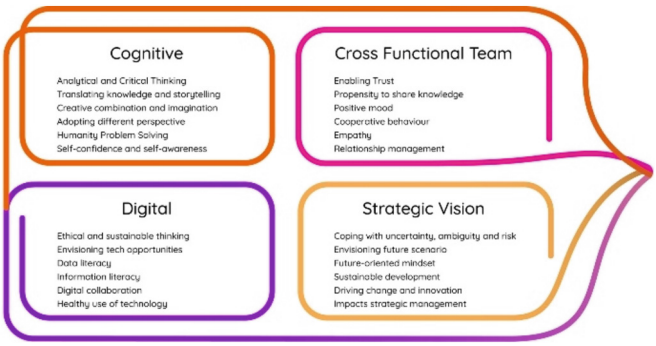

Fig. 1. The 24 Digital Creativity Abilities currently identified to prepare the next generation of DM Enablers.

The major ambition of the DC4DM project, indeed, is to provide an educational model to support people in training and gaining the necessary DCAs to become DMEs, new professional figures able to master digital technologies potential in a sustainable, ethical, and strategic way.

The DC4DM model (Fig. 2) proposes a holistic approach where each step in the process relies on specific DCAs to foster innovation and creativity within individuals and teams. The DC4DM model features a unique Design Futures process, which integrates both Futures Thinking (FT) and Design Thinking (DT) methods. Leveraging on the essential set of DCAs, the Design Futures process enables individuals to envision future scenarios and anticipate the potential applications of digital technologies. Moreover, it encourages to anticipate the implications these technologies may have on the societal, environmental, economic, and political spheres.

As shown in Fig. 2, the DC4DM model showcases a first exploration phase, called 'Explore' and represented by an elongated diamond overlapping the Voros' cone [9]. 'Explore' is the phase that aims to create practical perspectives on potential futures and opportunities. It involves analyzing social, technological, economic, and political indicators to shape and influence the future. This phase features two steps: *Horizon Scanning* and *Visioning*, which help identify emerging trends and construct possible scenarios to anticipate new design opportunities.

'Generate' phase aims to transform ideas into tangible solutions that align with the context and goals of the project. This phase involves generating innovative and technological ideas relevant to the envisioned future scenario. The 'Generate' phase includes two steps: *Ideating* and *Prototyping*.

Upon encountering a design challenge and applying the DCAs throughout the process, the subsequent iterative *Post-Process* focuses on the cultivation of shared knowledge structures. These structures encompass process and tools, goals, expertise and abilities, and encourage effective team interactions. By continually adding value to individuals, organizations, and the whole system, this *Post-Process* phase ensures ongoing growth and improvement.

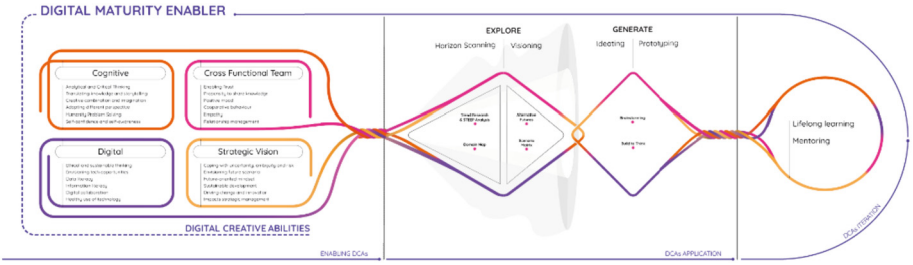

Fig. 2. Training of the Digital Maturity Enabler through the DC4DM model.

2 Testing the DC4DM Educational Model Through Three LLabs

The DC4DM project also incorporates Learning Labs (LLabs), which are 10-days intensive design sessions tailored to provide participants with comprehensive training and mentoring towards the development of the key digital creativity competencies. LLabs offer a unique opportunity for students, SMEs, and startups to collaborate closely on

specific design challenges and envision preferable futures. These workshops gather participants with various levels of expertise proposing challenges concerning a selected theme. Within LLabs, participants have the chance to apply relevant DC4DM methods and tools, effectively harnessing their creativity and problem-solving skills and gain a future-oriented mindset.

Furthermore, LLabs serve as an invaluable platform for educators to acquire first-hand experience in applying the DC4DM model. As facilitators, they gain insights into effective teaching practices that promote *digital maturity*. These immersive experiences equip educators with the necessary knowledge and skills to guide their students and foster their growth in the digital landscape.

The DC4DM model has been developed between 2020 and 2023 through theoretical research and testing phases. To become a practical and usable learning methodology for educators, companies, and individuals who wish to become Digital Creativity Enablers, the DC4DM model and toolkit was tested three times through three LLabs.

The three LLabs had in common the following objectives: (a) to allow to learn about digital transformation; (b) to guide participants to create a working environment that enhances the value of individuals, increasing personal motivation and fostering integration with other members of the group; (c) to identify the main parts and procedures of a training format to be applied for the organisation of new LLabs. The three LLabs were organised and run differently because the goal was to understand how flexible and adaptable each part and phase of the model is; how to involve SMEs and Startups along the process to bridge their needs with the training objectives; and finally, how to engage students coming from different disciplinary backgrounds along the whole process.

LLab1: Feeding Madeira hosted by University of Madeira, in Funchal, Portugal, in July 2022. The emphasis was on designing regenerative and distributive food systems and the sustainable development of the island of Madeira thanks to the use and application of new digital technologies. Of the 10-days, the first three were dedicated to building the participants awareness on the local context and challenges related to sustainable development and food chain, and pre-process activities to start training the DCAs to apply through the Design Future Process. The remaining seven days was focused on co-designing future scenarios and possible creative digital tech-responses (Fig. 3). The participation of the startups along the co-design process at the beginning and end of the Design Future Process.

LLab2: Mobility hosted by Télécom Saint-Etienne, in Saint-Etienne, France, in November 2022. The emphasis was on reflecting on the mobility of the future in a broad sense. The LLab2 program was basically as the LLab1 one. The difference this time was on the effort to support better teambuilding and so allow a more efficient design process and methods application. As in the case of LLab1, startups and local organisations were called to interact only at the beginning and end of the process.

LLab3: Futuring Care hosted by Politecnico di Milano, in Milan, Italy, in February 2023. The main theme was divided into macro-themes and each one was associated to invited experts and mentors who had the role to guide the teams in understanding the challenges. The selected startups and small companies were invited to participate a co-design session so that the interaction between learners and real-world entrepreneurs would inform better the Design Future process. The program presented a new idea of

mixing the Pre-Process learning activities across Process steps so that training the DCAs was more integrated within process and teamwork (Fig. 4).

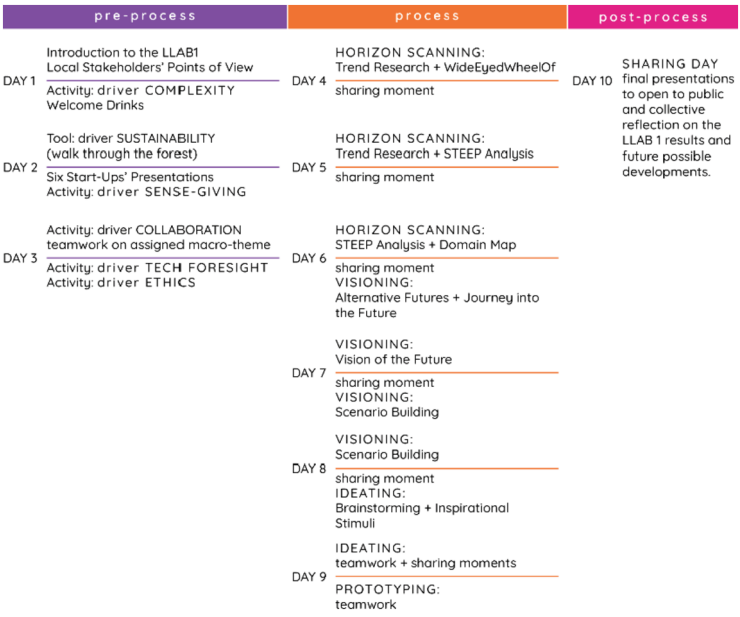

Fig. 3. The LLab1 "Feeding Madeira" program, which the LLab2 "Mobility" followed similarly.

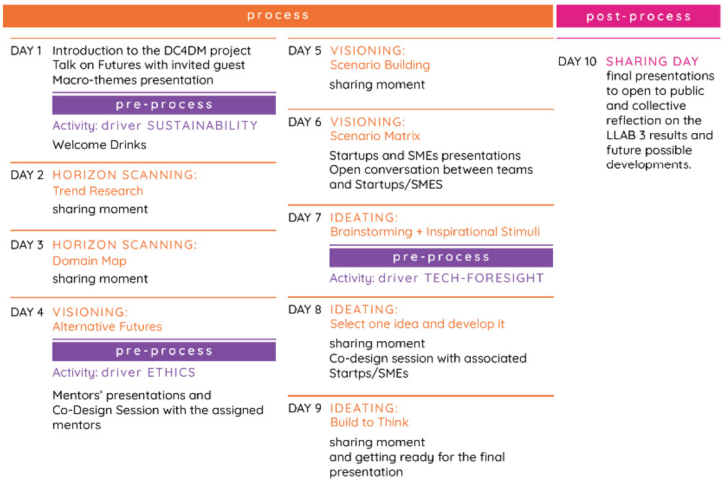

Fig. 4. The LLab3 "Futuring Care" program.

2.1 Feedback from the LLabs Participants

All LLabs participants were interviewed informally during and just after each workshop. These conversations allowed the consortium to understand what was going well and what was less clear or critical to the quality and functionality of both the DC4DM educational model and DM Learning Format. This paper demonstrates our intention in continuing the collection of feedback by presenting the results from a preliminary study which aims to understand how attending a DM Learning Lab has impacted on each learner. In particular, we want to understand which Digital Creative Ability had developed thanks to the LLab experience and which learnings have been consequently applied in new creative and co-design contexts.

An online questionnaire was sent to the whole group of LLabs participants. This paper focuses on the gathered answers from 16 students, of which 11 were from Design, 4 from Engineering, and 1 from Management. The following data regards some of the topics which we have tried to explore and are relevant to the aim of this paper.

We collected both qualitative and quantitative data to assess the respondents' perceptions of the LLab, utilizing a scale ranging from 0 to 5, where 5 indicates a highly positive response. Overall, the feedback received from all the respondents was very positive. 37,5% of the respondents rated the experience as four, representing a very positive perception. 31.3% of participants described having an overwhelming experience rating it as five. Another 31,3% of the participants rated the experience with a score of three, indicating a moderately positive response.

When asked why the overall experience was positive, 37,5% of the participants replied to getting to know new people. For example, participants claimed that they enjoyed "getting to know people from abroad" and to "create incredible friendships". Moreover, 31,3% reported enjoying the programmed LLab activities related to work and morning activities such as energizers and "morning walks". Another 18,8% reported to have enjoyed the "sharing moments" and "experiences" with the others. 12,5% of the participants enjoyed interacting with the invited startups and SMEs.

Nevertheless, we also asked the participants to share what is not that positive memory from the LLab. 38% of the respondents felt stressed or exhausted during the event. 31% reported issues such as the lack of time to complete activities and tasks properly and the language barrier that occurred during teamwork. Also, 13% reported that building teams to work with was an additional stress factor. Another 13% felt confused regarding the overall learning process.

We asked participants what they reckon to have learned from the attended LLab. From the answers that we gathered, we observed significant personal growth as they are of the opinion that they learned considerably about Future Design Thinking; they felt "to be open-minded about new things" and learned how to, for example, "use AI to present (…) futuristic idea(s)." In addition, participants highlighted the development of personal skills such as the art of communicating. Indeed, communication was one of the challenging skills to master during LLab. Nevertheless, many of the participants said to have learnt "to be comfortable in talking in public" and "how to express (themselves) better to other people".

We asked the participants to reflect on which Digital Creative Abilities (DCA) they could reckon improved thanks to the LLab. Their responses were categorized based on the DCA dimensions:

Cognition: Creative combination and imagination (62,5%), analytical and critical thinking (25%), translating knowledge and storytelling (50%), adopting different perspectives (75%), humanity problem solving (43,8%), and self-confidence and self-awareness (25%).

Digital Proficiency: Digital literacy (25%), information literacy (18,8%), envisioning tech opportunities (56,3%), ethical and sustainable thinking (31,3%), digital collaboration (37,5%), and healthy use of technology (18,8%).

Cross-Functional Teamwork: Enabling trust (37,5%), the propensity to share knowledge (31,3%), positive mood (50%), cooperative behaviour (50%), empathy (37,5%), and relationship management (37,5%).

Strategic Vision: Coping with uncertainty, ambiguity, and risk (50%), future-oriented mindset (62,5%), sustainable development (25%), driving change and innovation (31,3%), impact the strategic management (18,8%), and envisioning future scenario (68,8%).

We asked: *In your opinion, what else would have helped to boost your ability in future thinking?* Most participants (38%) highlighted that their ability to envision different possibilities would be greatly enhanced through exposure to an example of an alternative future; participants suggested to provide "a sample of an alternative future" and to experience "anything more tangible that made (them) feel the future". Also, 38% of the participants reported other strategies to improve their ability to envision the future. These strategies include "disconnecting a bit more from the logistics of available technologies", fostering better communication among group members, and other suggestions. On the other hand, 19% of the participants reported that giving them more time would have boosted their ability of future thinking; although "10 days is already a lot for a project" as commented by one of the participants, there was of general opinion that more time would be ideal.

Participants were asked about their ability to apply the skills acquired during the LLab in a real-world environment, following a few months after their participation. 94% of participants reported that they indeed used the skills learned in a real-world scenario, such as in academic environments (master-level thesis writing, design courses), entrepreneurship courses, artificial intelligence for ideations of novel ideas, and among other scenarios.

Lastly, participants were encouraged to reflect on the DCAs once again, but identifying those which they would feel to improve further to become a Digital Maturity Enabler. Following the same categorization as above:

Cognition: Creative combination and imagination (31,3%), analytical and critical thinking (43,8%), translating knowledge and storytelling (62,5%), adopting different perspectives (31,3%), humanity problem solving (25%), self-confidence and self-awareness (31,3%).

Digital Proficiency: Digital literacy (50%), information literacy (31,3%), envisioning tech opportunities (56,3%), ethical and sustainable thinking (31,3%), digital collaboration (37,5%), and healthy use of technology (43,8%).

Cross-Functional Teamwork: Enabling trust (12,5%), the propensity to share knowledge (25%), positive mood (31,3%), cooperative behavior (25%), empathy (18,8%), and relationship management (25%).

Strategic Vision: Coping with uncertainty, ambiguity, and risk (50%), future-oriented mindset (31,3%), sustainable development (37,5%), driving change and innovation (31,3%), impact the strategic management (25%), and envisioning future scenario (62,5%).

2.2 Reflecting on the Results of the Survey

The LLabs participants who participated in the survey enjoyed the overall experience. The experience allowed students to interact not only with their peers from different backgrounds, but also with a variety of experts, local stakeholders and entrepreneurs who shared and discussed valuable insights about tech-related real-world experiences. To ensure maximum comfort for all participants, we deliberately created an open work environment that encouraged communication not only within the teams, but also across the different ones.

Although the concerned participants enjoyed the LLab experience, some participants reported stressful situations related to forming teams for different projects, time constrains and language barriers. This problem occurred more frequently during the LLab1. Yet, we addressed the problem of team forming for the LLab2 and LLab3.It is common to encounter such challenges during the initial phase as different members of each group familiarize themselves with one another. Thus, we implemented team bonding exercises in the morning to foster trust and establish relationships among groups. These exercises had a very positive impact on creating an environment for collaboration which enhanced the overall team dynamic.

When we asked if participants had the opportunity to apply the skills and knowledge acquired during the LLab in real-life scenarios, preliminary results indicate that most of the participants did, indeed, use the learned skills in practical situations. Such results suggest that the theoretical and practical exercises offered to the participants during the LLab have broad applicability in real-life contexts. For example, based on the participant's feedback, these skills appear to be relevant in designing artificial intelligence related project, academic environment (thesis writing, design courses), entrepreneurship courses, and among other settings.

We also asked the participants to reflect and share their thoughts on which DCAs they would like to improve to become Digital Maturity Enablers and the most prominent results of the questionnaire demonstrate a need in improving abilities such as "Translating knowledge and storytelling" (62,5%) and "Envisioning future scenarios" (62,5%). The preliminary results suggest that participants acknowledge that it is important to improve their communication abilities to effectively express complex information in a simplified manner; such improvements will allow participants to articulate ideas and narratives with their intended audience in a way that it is easily understood and relatable. Regarding the capacity to envision future scenarios, participants admitted having difficulties in visualizing, for example, alternative tech-related futures.

On the one hand, this could be attributed to the fact that we currently live in the digital age where we are constantly exposed to a set of novel and exciting tech-related

possibilities. Such saturation of novel ideas and information can make it challenging for the participants to imagine and create alternative futures. On the other hand, it is worth considering that the time constraints of the LLab may have hindered participants to envision the future. Such skill requires thoughtful reflection, research, and experimentation that necessitates a great amount of time and effort. Thus, participants may feel, as stated previously, that more time is required to mature and perfect their ability to create alternative futures.

Nevertheless, by acknowledging these challenges and providing additional opportunities to assist participants to enhance their future envisioning skills, we can promote growth, proficiency, and maturity of the DCAs.

3 Conclusion

Digital transformation is challenging the status quo and requiring existing systems, organizations, and people to become resilient and adaptable to proactively face the change. The deployment and uptake of emerging technologies are increasingly changing organizations and the whole society, enabling an unprecedented digital transition.

New innovative educational models must provide upcoming generations with radically new skillset to enhance their creative abilities, enabling them to spot and exploit the viable potentialities of emerging technologies and unleash their creative potential. The DC4DM educational model responds to this task and promotes a learning process that empowers both individuals and teams in thinking and communicating future scenarios and design responses. As tested through the above described LLabs, and successfully presented positive results, the DC4DM methodology encourages collaborative and open-minded dynamics among cross-functional teams.

The DC4DM project, which started in September 2020 and concluded in August 2023, has been the opportunity to develop a set of open-source learning materials gathered into the *EDU Box* virtual container [10], which can keep evolving according to ever changing digital scenarios and learning needs.

Finally, the DC4DM project goes beyond the mere transfer of Digital Maturity (DM) methods and tools; it fosters collaboration among a diverse range of entities within a European network of Higher Education Institutions (HEIs), Small and Medium Enterprises (SMEs), Startups, and Business Incubators. This collaborative effort encompasses various activities aimed at sharing knowledge and cultivating digital creativity competencies. The project involves the organization of Digital Maturity and DM Sharing Days, considered as informative events. These gatherings are meant to disseminate valuable information, insights, and best practices related to Digital Maturity among the participants. Through these events, individuals and organizations gain a deeper understanding of the concepts, methods, and tools associated with Digital Maturity.

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