De Kolòn au Digital Making : Une plateforme collaborative pour soutenir l'innovation et la co-conception dans les communautés de pratique

From Kolòn to Digital Making: A Collaborative Platform to support Innovation and co-designing in communities of practice

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RÉSUMÉ. Cette recherche présente une plateforme numérique innovante qui combine le modèle haïtien du kolòn avec la théorie des communautés de pratique pour soutenir la co-conception de projets et l'apprentissage collaboratif dans les espaces de fabrication. Basée sur une étude impliquant 57 participants et cinq communautés internationales de makers, cette plateforme a été conçue pour faciliter l'apprentissage par les pairs et le développement des compétences grâce à un système de mentorat distribué. Nos résultats montrent des améliorations significatives des capacités de collaboration et des taux de réussite des projets. Ils mettent en évidence le processus de co-création d'une solution technologique centrée sur une approche communautaire, collaborative et inclusive. Ce travail contribue à faire progresser l'innovation et le développement des compétences dans le domaine de la fabrication numérique en fournissant un cadre pour « apprendre en fabriquant ensemble » qui fait le lien entre les espaces de fabrication virtuels et physiques.

ABSTRACT. This research presents an innovative digital platform that combines the Haitian kolòn model with communities of practice theory to support projects' co-design and collaborative learning in maker spaces. Build on a study involving 57 participants and five international maker communities, this platform has been designed to facilitate peer learning and skills development through a distributed mentoring system. Our results show significant improvements in collaborative capabilities and project success rates. The results highlight the co-creation process of a technological solution centered on a community-based, collaborative and inclusive approach. This work contributes to advancing Innovation and skills development in the field of digital fabrication by providing a framework for 'learning by making together' that bridges virtual and physical maker spaces.

MOTS-CLÉS. Communautés de pratique, modèle Kolòn, apprentissage collaboratif, fabrication numérique, communauté des makers.

KEYWORDS. Communities of Practice, Kolòn Model, Collaborative Learning, Digital Fabrication, Maker Community

1. INTRODUCTION

Today, digital technologies and artificial intelligence are present in almost all sectors of human activity, creating a landscape that is not only complex and interconnected but also evolving and unpredictable [STA 21], [TRE 07]. However, the effective adoption and use of these technologies requires the ability to mobilize technical skills to interact with these systems and to combine strategies used to adapt, collaborate, manage disruptions, and reposition oneself in terms of

claimed/expected/developing competencies [PER 16]. In this context of digital transformation, numerous studies highlight the formative role of communities of practice [LAV 91], [WEN 09] in developing these latter skills, commonly referred to as non-technical skills [BOU 20], [FLI 10], [JES 17], or also called collaborative and transversal skills [SAN 18], [TAR 13] in the ecosystem of digital technologies and Artificial Intelligence (AI) [PSY 24].

Lave and Wenger use the concept of communities of practice (CoP) to describe how individuals participate and engage in the activities of their organization, improve their skills, build norms, rules, new practices, and an identity in relation to it [WEN 98]. Psyché and Tremblay further argue that the construction of practices within a community represents a process through which individuals break professional isolation: each member benefits from the group's knowledge, with which they can reflect, collaborate, share, and build new knowledge [PSY 11]. The construction of these practices' accounts for the identity and life dynamics within the organization. They are collaboratively built through exchanges, interactions, knowledge sharing based on voluntary participation and community management of resources [PAS 23]; [WEN 09]. Communities of practice are therefore important contexts for human learning and skills development [PAY 22]. Much more than just a situation for knowledge acquisition, Lave [LAV 91] also advances the idea that the experiences conducted within communities of practice, the structure of the environment, the organization, and the acquisition of knowledge mutually generate each other. This theoretical foundation is highly valued today within organizations, groups, or associations seeking to enhance their collective effectiveness, expand their network, and foster creativity and innovation [MAV 21]; [PAT 17]. As Wenger (2005) [WEN 05] emphasizes, communities of practice provide a conceptual framework for enabling organizations to target the knowledge circulating: CoPs increasingly 'attract the interest of organizations striving to manage knowledge as a strategic asset' [LAN 05]. Companies, organizations, associations, or communities base the value of their success on knowledge development and sharing to make the most of it, develop the best product or service, expand their network, and improve their social impact.

The implementation of CoPs involves an understanding of the processes and issues of building, developing, and maintaining these communities, as well as the mobilization of knowledge that contributes to the enrichment of the collective [LAN 05]; [PAT 17]. The scientific literature provides us with a good understanding of the value and characteristics of CoPs, but their intentional implementation and management within organizations present specific challenges. Among these, those related to the intentional creation and maintenance of CoPs, and the availability of a digital tool capable of facilitating exchanges enabling knowledge sharing and providing guidance on collaborative work within CoPs [LAN 05].

The project Platform: enhancing performances within communities of practices was conducted to address these key challenges and propose an open-source digital platform capable of supporting and assisting the development of collaborative projects within communities of practice. Indeed, the results of Tremblay's research into the potential of virtual communities of practice, show the advantages of these communities for strengthening digital learning . While representing the basic characteristics of CoPs, these communities emerge as innovative digital ecosystems, characterized by spatial-temporal participatory, flexibility and enhanced accessibility. In this way, organizations can put in place more inclusive participation tools that encourage better access to and use of delocalized resources, "as well as the creation of a collective memory" [TRE 03]. Their effectiveness hinges on strategic parameters: dynamic mediation, institutional support, and inclusive technologies [TRE 03]. Building on these elements, Platform goals are to propose a collaborative environment conducive to innovation.

1.1 THE CONTEXT OF THE DESIGN PROCESS

In the field of design and technologies, mainly in educational technologies, Macgilchrist et al. 2024, propose to broaden design beyond a simple engineering approach focused on finding quick solutions [MAC 24]. Indeed, the authors point out that a design approach cannot be reduced to technical

innovation, but must involve rethinking the aims, actors and values at stake in any design process. Part of this approach is to define the context in which the innovation is to take place, mainly in terms of who it is intended to serve [MAC 24]. In the context of this project, the design of the digital platform starts from a point of view situated in a particular traditional and community-based organization, which we will describe in the following lines.

Indeed, much more than a digital collaboration space, the platform draws inspiration from the theoretical framework of CoPs and a particular community-based working model called kolòn. This term used in Haitian Creole refers to work organization modes based on community action and the sharing economy [CAS 13]; [VAN 09]. Rooted in this traditional work practice, the term Kolòn embodies a work philosophy based on the sharing economy, mutual aid, collaboration, mutual commitment, coaching, mentoring and reciprocity. This particular way of working was observed during an ethnographic study on learning processes and skills development within informal digital technologies repair and selling communities in Haiti [PAY 22]. These communities are primarily characterized by self-organization and self-management [RAM 14] made up of independent men and women working outside manufactured or industrialized spaces [PAY 23]. Their sustainability relies on a particular networking operational mode called kolòn. This functioning mode defines the integration and participation modalities of a group of professional actors in their community life as well as the process of network construction and operation [PAY 22]. The term kolòn designates both the group structure and the trusted collaborator with whom one works: when a technician integrates a newcomer into the market, they play the role of mediator and take responsibility for familiarizing them with the community's culture. The community building process is therefore based on this mediation process that involves each actor integrating and getting involved in the community via a trusted collaborator who will in turn become a mentor. Although mentoring is not a linear process, but rather a flexible one in which each person can in turn become a mentor or apprentice [PAY 22]. This community building process establishes a network based on trust, as each knows who the other's collaborator is.

In this work context, the activities involved in repairing and manufacturing technologies are perceived as more than just production, but rather as a way of life: a form of weaving the world with others through shared construction activities. The skills needed to carry out activities are certainly guided by the technological artefact, but are equally influenced by established environmental practices, rules and conventions [PAY 19]. The kolòn community work organization share similarity with the three dimensions of Lave and Wenger theoretical approaches to communities of practice. Indeed, the work organization is characterized by communication, collaboration and knowledge sharing, mutual aid and community-oriented resource management to build and maintain a system of trust and dynamic community [LAV 91]; [WEN 98]; [WEN 09].

Therefore, the digital platform relies on an integrated knowledge model that mobilizes both the theory of CoPs and the operational mode Kolòn.On the other hand, the design of this platform was carried out with maker spaces communities. The goal was to design and provide a co-design and innovation tool based on the principles of CoPs and the kolòn model, as well as an environment for acquiring non-technical skills in the maker spaces field [BOU 20]; [FLI 10]. These communities are generally workspaces or associations resulting from local entrepreneurial initiatives among groups of individuals sharing common interests [MOR 21]. They are valued for their ability to create human interactions and foster a community dynamic where participants exchange tacit knowledge and make it explicit through shared projects [PAY 20]; [PAY 22]. These spaces are also called third places [OLD 82]. They are generally defined as welcoming physical spaces, eager to bring together actors (researchers, designers, artists...). willing to work collectively on the realization of creative, innovative projects that meet local needs [ANT 15]. They refer to spaces structured around the ecological approach of "doing together" and heterogeneous places (hackerspaces, makerspaces, Fab Labs, production, and repair workshops, etc.) that evolve at the intersection of the worlds of hobbyists and artisans and those of engineers and computer scientists [ANT 15].

The practice of “doing things together” in the digital fabrication environment, embodies the view of fighting exclusion and promoting inclusion [BER 22]. Technologies and techniques used, the forms of relations, rules and relationships are all components of a group system. In these communities, actors are seen as producers engaged in the processes of technological innovation [NOV 20]. Here we find embodied the idea that “the shaping of the technical object involves a long process of simultaneous fabrication of technical and social elements that continues well beyond the boundaries of the laboratory or workshop. Instead of mute objects, we find ourselves faced with multiple movements and actors who ask themselves in practice [the question of what the thinking behind these technologies is] and “who experiment with solutions to resolve it” [AKR 10].

By adopting the guiding principles for the platform’s construction, the aim was to understand the challenges and opportunities associated with co-production and collaborative processes in this field. We also hoped to gather insights into how interventions can be carried out within this ecosystem to promote collaboration and knowledge sharing in in the making CoPs and according to the kolòn operational mode.

1.2 Research questions and objectives.

In the context of this project, the question arose as to how the kolòn model can, 1) help establish and maintain communities of practice in the digital environment? And 2) how can it support the development of both technical and non-technical skills (innovation, citizenship, collaboration, ecology, critical and creative thinking) within the maker spaces ecosystem?

The objective pursued is to support the actors and participants within the maker spaces ecosystem in acquiring and improving their skills in innovation and collaboration within communities of practice.

Specifically, the aim is to guide the users of the digital platform to:

- evaluate and improve their collaborative skills,
- acquire innovative fabrication practices within communities of practice,
- develop collective and networked working skills.

2. METHODOLOGICAL APPROACHES

As we announced in the theoretical framework, the design approach for this digital platform is rooted in a collaborative practice involving the participation of a multiplicity of actors. This fostered a process of co-evolution and co-construction of reality [MAC 24]. The design of the platform follows an iterative and collaborative approach linking technological design with academic research [HAT 09] and critical reflection on the process, also known as ”critical making” [RAT 11]. This design approach required a diverse team of practitioners, designers, and researchers to examine social issues, ethics, and responsibility in tool development. The aim in adopting this approach was to foster the development of a learning community around the design of the tool, where developers, participants, and researchers were able to develop their reflections, share their experiences, and bridge the gap between theory and practice. It also enables the proposal of an integrated theoretical value into the digital platform rather than the development of an isolated technology [RAT 11]. To achieve our goals, the research project involved:

- Interdisciplinary team review in management sciences, design, information technology and educational pedagogy: analyzed 35 texts on skills, collaborative spaces, mentorship, digital technologies, and practice communities.
- Data collection: surveyed makerspace ecosystem organization and practices.

- Conceptual development: Formalized the kolòn model through publication and concept extraction.

- Field engagement: conducted co-creation workshops with six makerspace types: incubators, FabLab, solidarity cooperatives. A follow-up 8 individual interviews and 3 focus group were conducted. The actors were from different regions (Haiti, Cameroon, Montreal, and Geneva).

- Prototype development: designed a technical platform integrating field and theoretical data with developers familiar with the kolòn concept.

This user-centered methodology ensured the platform's features evolved dynamically, aligning theoretical insights with real-world practices. Additionally, a dedicated wiki space was set up for the project to share the knowledge acquired in the design and implementation of the digital platform.

All the empirical data, including audio, text, and images collected was analyzed using the interpretative thematic analysis method [BRA 06]. First, a coding manual based on the theoretical framework and research objectives, referred to as 'theoretical thematic analysis' was developed to analyze the data [CLA 17]. Four main code categories were used (maker spaces communities; technical skills; non-technical skills; and collaborative work platforms) with a total of 35 codes. The data were carefully reviewed according to the coding manual to identify meaningful text units related to the research objective. The first descriptive analyzes of the material helped define new codes, bringing the list to 43 codes. The coherence and replicability of the themes were established by a second researcher who validated the codebook. The descriptive thematic analysis was conducted using the MAXQDA software, which facilitates the analysis of qualitative and mixed research data.

Second, the text units addressing the same question were grouped into analytical categories and received provisional definitions and explanations. Third, the data were systematically re-examined with the assistance of a personalized chatbot, AskyourPDF, to ensure that each category had a name, a definition, and a comprehensive set of data identified. This analysis ensured the exhaustiveness of the research and attributed all elements of the research material to at least one category. The interpretative thematic analysis resulted in 19 categories, grouped into 5 key themes: maker spaces communities; the mentoring system in the maker spaces ecosystem; collaborative work environments; technical skills; and non-technical skills.

The following sections present a concise summary of the research findings related to the design of the platform. They also show how these results relate to the kolòn model and how the overall contributions foster innovation.

3. APPLICATION OF THE RESULTS IN THE DESIGN OF THE DIGITAL PLATFORM

The results of the survey show a diversity of actors and types of communities involved in digital fabrication, ranging from academic institutions to artisans, hackerspaces, and technoshops. The following list presents the number of registered maker spaces communities, starting with those with the highest percentage of responses.

Table 1 - Survey responses by type of maker spaces community

Type of maker spaces community	N	Response rate
Academic institutions or vocational training centers	9	15.79%.
Hackerspaces	7	12.28%.
Makerspaces	6	10.53%.
Open-source hardware communities	3	5.26%.
Artisans and art workshops	3	5.26%.
Technoshop citizen workshop networks	2	3.51%.
Hackers' schools and technical workshops	2	3.51%.
Fabcities and transition cities	1	1.75%.
Repair cafés	1	1.75%.

The comparative and interpretative analysis of the observed practices yielded a structured knowledge base of makerspace practices, categorized into six key areas within the digital platform. Each network provides a comprehensive definition, detailed activity types and comparative and interpretative analysis of observed practices. Users can explore these categories through an interactive, information-rich interface, enabling deeper understanding of diverse makerspace ecosystems.

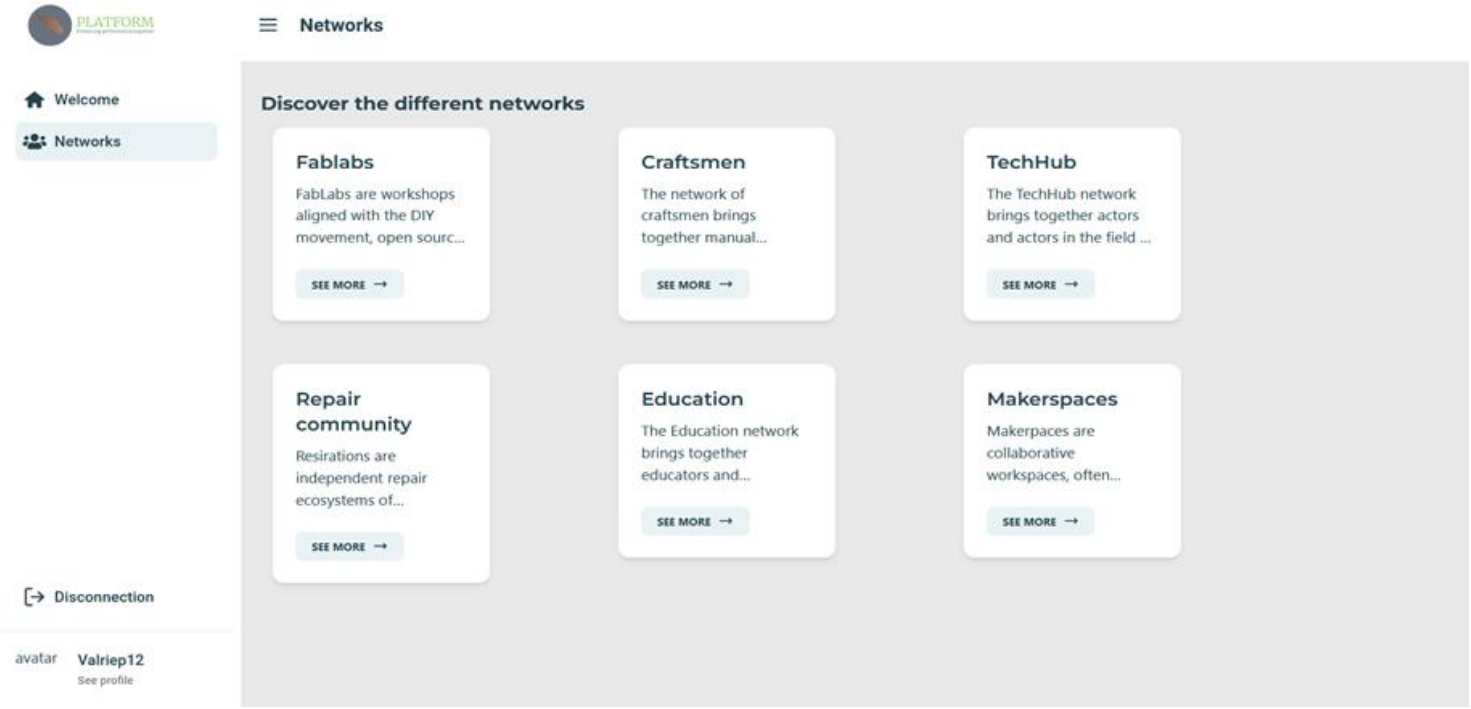

Figure 1 The repair communities' network in Platform

The integration into a network is preceded by a registration process and a request for access based on the user's choice. After which, a mentor is put in contact with the user to provide guidance and support for their integration into the network.

The registration process is important as it allows the users to provide information regarding their skills, profile, and the community they belong to, which will facilitate the mentoring process. This aspect was one of the key points of the research. Indeed, in the category “Maker spaces communities”, the term mentor is among the codes with the highest percentage (80%) after the milieu. Besides, the results of the interviews highlight the importance of a mentor, who plays the role of a guide, facilitator, or trusted collaborator, easing the integration process and ensuring success within the environment through the sharing of knowledge, tools, and resources, as well as fostering teamwork and innovation.

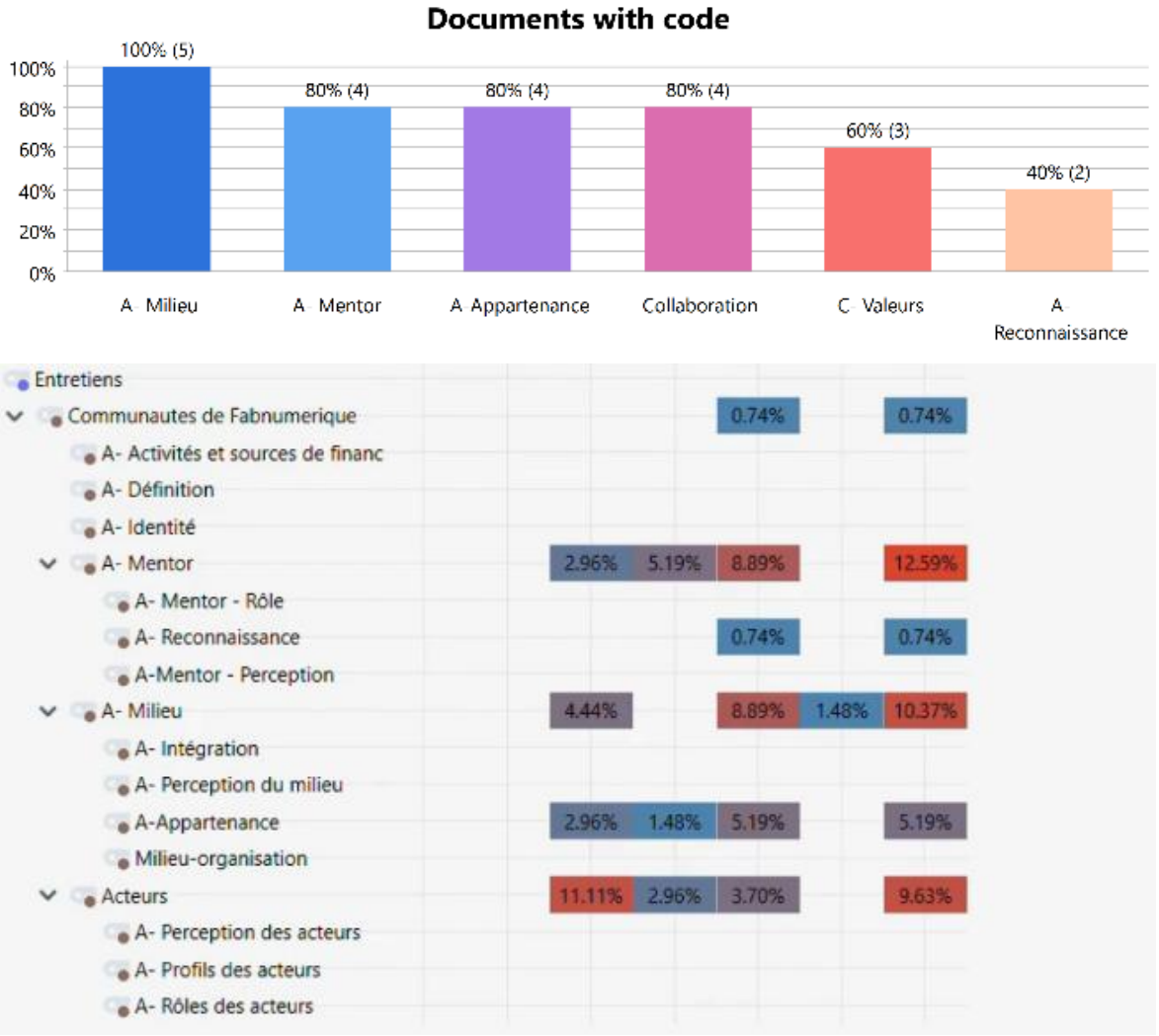

Figure 2 et 3 Representation of codes with the highest score in the first category

Although the term “mentor” is not frequently used in these environments, the sources identify roles played by actors across the field that capture the essence of mentoring in the observed contexts. These roles include the role of ensuring the transmission of knowledge; or the role of supporting, encouraging, guiding, valuing, and validating skills, or acting as a catalyst, integrator, and creator of social bonds. Profiles and roles vary depending on the communities and projects. What must be emphasized is that mentorship is situational and non-hierarchical, relying on the availability and specific skills of members at a given moment. As in the kolòn model, there is little hierarchical or linear relationship between mentor and mentored. In fact, in the maker space sector, there are several situations of “meetings and pretexts for the transfer of knowledge that ultimately stimulate projects and knowledge transfer relationships” (individual interview, 26-08-2024). This approach allows for the transmission of knowledge tailored to individual needs and fosters collaborative learning.

Once the request for network integration is validated by a mentor, the user can interact and design projects with a network of professionals and enhance both their technical and non-technical skills through exchanges. All networking and co-design activities within the network are supported by an

intelligent agent that houses the expert knowledge base on the functioning of maker spaces communities. The digital interface is also powered by a co-design model for project scenarios to guide users in their collaborative fabrication process. This model was developed based on observations made during workshops with participating communities. During these participatory observations, we focused particularly on shared processes of building and developing collaborative skills in the exercise of project design, creation, or tool fabrication. The engagement and involvement of actors in maker spaces communities in the actions implemented are generally linked to diverse conceptions of how each group of actors (fabmanager, facilitator, user, technicians, developers, programmers, researchers, trainers, volunteer users, etc.) solves problems These conceptions are referred to as "indigenous views of quality" [BON 00]. This means that they represent ways of doing things, prior experiences, ways of living, and work cultures. They may complement or act antagonistically toward each other. Thus, even when activities are organized around the creation of physical objects, these activities represent the values, expectations, and representations of a heterogeneous group of individuals who voluntarily come together to contribute—each according to their interests, roles, profiles, and skills—to the production of objects. The objects produced are thus seen more as an end and gain value through the shared act of construction, common conversations, and reflection [RAT 11].

The model developed therefore reflects the co-design processes in the maker spaces sector and is broken down into five (5) steps:

Step 1: Creating a community of practice: this step allows everyone joining a project to position themselves in relation to their skills and to inform the community of the reasons for their involvement and commitment to the project. This ensures the creation of a transparent community based on trust.

Step 2: Defining the project objectives: this step involves jointly conducting an analysis of internal and external perspectives and collectively defining values, expected outcomes, what is non-negotiable, what is achievable, and the technical specifics. The result should reflect the group's collective thinking

Step 3: Listing activities and actions to be undertaken: create a list of activities and actions needed to achieve the targeted objectives. When defining activities, consider a good balance between the group's needs, available resources, and the expertise of each member.

Step 4: Listing resources and collaborative environments: identify resources already available or those that can be recycled or reused. Also, identify local suppliers, networks, equipment libraries, and their locations. Identify environments that facilitate value creation, such as spaces for sharing information, documentation, and data archiving.

Step 5: Implementing the project: identify key actors for the implementation and sustainability of the project. These actors must be able to catalyze discussions, organize social meetings, connect with people, and strengthen connections or collaborations.

The use of this shared creation process in a common co-design space encourages the development of a collective framework while enabling actors to move from the individual approach of a project idea to a collective vision with value for the group. In other words, the goal is to know how to mobilize technical and collaborative skills in designing an activity to achieve collective performance. As participants move through the five-step process, they engage in abstract-to-concrete progression that aligns with constructionist principles of learning. Projects begin with tangible ideas and gradually evolve into sophisticated collaborative frameworks. The co-constructed project scenarios can be shared and downloaded through the network. All networking and collaborative project design activities within networks reflect the community life dynamics in kolòn, as analyzed in the repair communities and third spaces.

4. ALIGNMENT OF RESULTS WITH THE KOLÒN MODEL AND ITS CONTRIBUTION TO INNOVATION

The proposed co-design model for projects extends beyond a simple collaborative framework to embody core constructionist principles while facilitating skills development through a co-design process. This approach builds upon and enriches Papert's original vision of constructionism by integrating the social dynamics of the kolòn model with maker spaces practices [PAP 91]. The kolòn model's integration brings unique enhancements to traditional constructionist approaches. It introduces a system of distributed expertise where knowledge flows multi-directionally between peers, rather than following a traditional hierarchical structure. Moreover, the mentoring and accompaniment of newcomers to this system ensures a dynamic of trust and the participation of everyone in the community's expertise.

Indeed, just like it was observed within the repair communities functioning in kolòn, work, across the five other communities participating in this research, is organized in a mutual engagement format and shared governance. Importantly, these communities offer individuals the opportunity to experiment without pressure, providing almost free resources and tools. They propose a more inclusive and open approach to fabrication than traditional industrial models, as highlighted in the following quotation:

"What sets Fab Labs apart from other creative spaces is the emphasis on 'making' for fun, without distinguishing between personal and professional projects. The help and attention given to users are the same, regardless of the project... The focus is on 'practical implementation and creating things,' without distinguishing between significant projects and purely passion-driven ones" (individual interviews, 2024)

According to these interviewed communities, this collaborative approach is perceived to not only improve final outcomes, but also to contribute to broader social and economic transformations.

"These are people who have made the choice not to work in mainstream industry... These are people who have a real attraction for innovation in terms of tasks, ways of doing new things, a new approach to work" (individual interview, 2024).

Basically, the model enables participants to learn not just through individual creation, but through a process of collective meaning-making and shared construction of knowledge. It proposes to organize the distribution of expertise, without falling into a hierarchical system. The following sections examine the key aspects of these communities and how they have strengthened the kolòn model within the digital platform.

4.1 Creation of a Trust System Based on a Mentoring Process and Community Management Recognition

Mentoring support is highly valued alongside the benefits and opportunities associated with co-design, production, and responsible innovation with peers, "I've had mentors, and I know how important they are in my life." The role is perceived positively by the actors, who emphasize the importance of a mentor or catalyst to facilitate interactions and collaboration within a network, especially regarding the integration of new members: "The situated mentoring approach ensures that support is provided contextually as needed, while respecting and incorporating local knowledge and practices''. As one participant noted, "Through the platform's co-design process, participants don't just learn about making – they learn by making together. The collaborative aspect amplifies the constructionist principle of learning through creation" (individual interview, 2024).

4.2 Participation of Actors with Different Areas of Expertise in Maintaining the Community

Just as the kolòn model suggests, participation in the activities of the communities is based on an intercultural approach and involves everyone's motivation and willingness to articulate their

knowledge with others and contribute to the community's collaborative effectiveness [ABD 05]; [PER 14]. In general, the actors mention the importance of solidarity and trust in maintaining their community. But practices in these communities are represented through a differentiated relational ontology where each person acquires his or her unique professional expertise while contributing to and interacting with the whole [BOL 22]. Even when collaboration, mutual aid, and knowledge sharing are key values in Fab Labs, members are also encouraged to take the initiative, be autonomous, and be responsible for their projects. Trust is built on individual accountability as well as in a peer networking or mentoring system: "In a mutual learning context, you create a collective trust that you don't have in a more traditional [formal] environment. The focus is on digital, and the actors are driven by a desire to share their knowledge and help each other" (individual interview, 2024).

To reflect this aspect of sharing, the platform promoted exchange and interaction by making both participant profiles within the networks and the projects they carry visible to foster open innovation and crowdsourcing of ideas [TRE 17] Participants emphasized the importance of being able to view the profiles of members, discover their skills and achievements, and learn about ongoing projects to identify collaboration opportunities. As one research participant stated: "The communing we really want in these practice communities is built because, precisely, there is this fundamental interest in reconnecting."

4.3 Co-Design Model of Projects:

The proposed co-design model for projects was also highlighted for the ease with which it allows for the sharing and building of new skills with others through hands-on experience. The innovativeness of a flexible and organic approach to identifying skills and professional development, through a project co-design approach, allows for adaptation to the specific needs of projects and participants. The digital platform also includes an integrated knowledge model with which two intelligent agents interact to respond to user queries. In the forum areas, the intelligent agent interacts like a chatbot to which users can ask questions relating to operation, characteristic of digital manufacturing spaces. They can also ask about certain skills or user profiles for carrying out certain tasks. In the project co-design space, the intelligent agent retrieves all the information provided by users as a query for its database. The AI then retrieves the response from the database as input and constructs a text from it to send back to the group of users working on the project. Users can then modify or validate the proposed scenario.

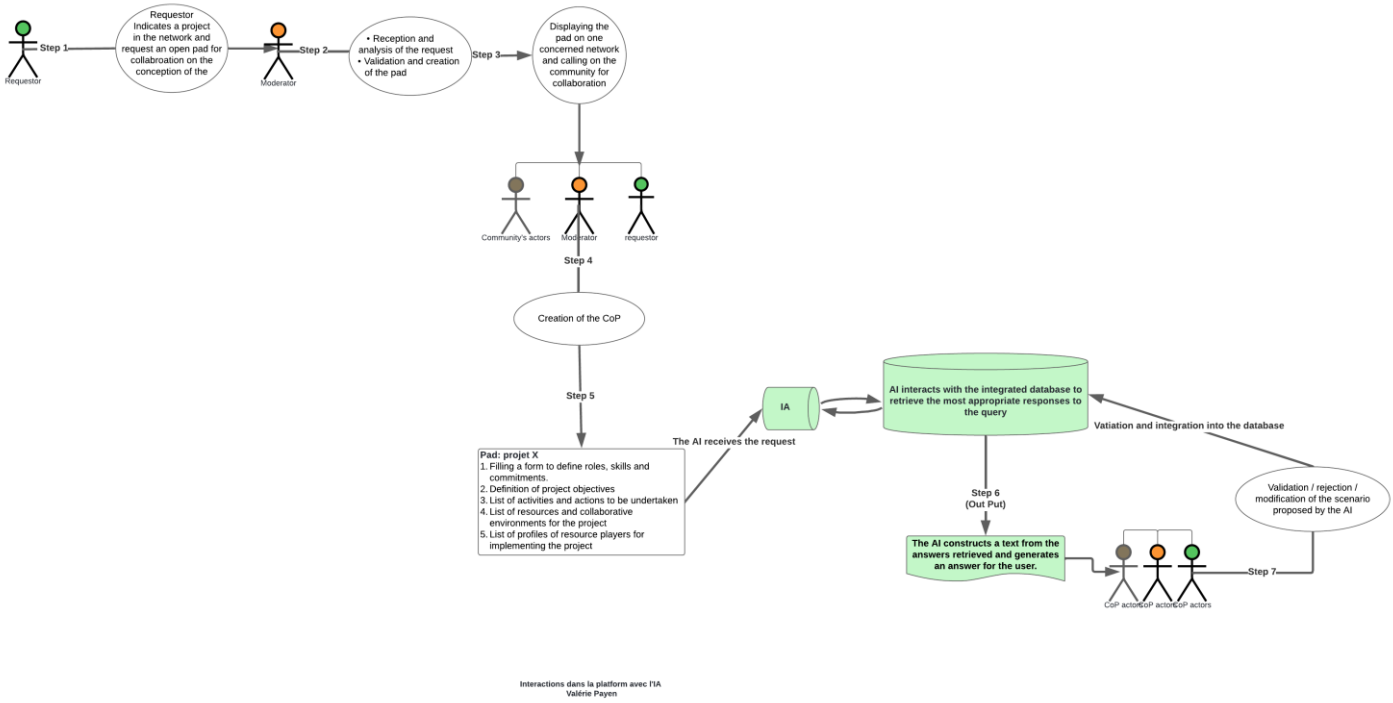

Figure 4 AI-assisted co-design of projects in communities of practice in Platform

The integration of Artificial Intelligence also represents valuable support, according to the participants. They emphasized the importance of this tool in supporting co-construction processes for projects on the platform, so long as its use complements human expertise and engagement.

4.4 Documentation and Knowledge Management

Finally, in most of the communities, participants expressed the need to better document projects and master tools for capitalizing on knowledge and facilitating skills transfer. “In these environments, communication is essential to express ideas, share constructive feedback, and explain complex technical concepts. This skill is essential for the success of digital projects, fostering a good understanding among team members. Therefore, saving projects on the platform provides the advantage of having a project data repository that can be revisited and benefit from collective knowledge.” The existence of tools and environments that promote and support collaboration, participation, and sharing knowledge in maker spaces communities was also highlighted. However, the observations underscored the importance of personalized support to ensure successful adoption. They emphasize the need for personalized guidance and gradual integration, without losing sight of the principles promoted by/embodied in the digital environment.

5. LIMITATIONS AND PERSPECTIVES

When asked what should be improved for the platform to better meet their needs, users emphasize the importance of bridging the virtual and local worlds. Local engagement is central to the actors’ vision, and the platform should facilitate connections or meetings between local actors working nearby, fostering interactions and collaborations within a geographically restricted community. Users could thus find individuals with specific skills, such as a skilled woodworker, or offer their own services for projects requiring a particular expertise. These exchanges with experts, artisans, and mentors in various contexts play a crucial role in maintaining the ecological culture of “doing together” that is inherent in these collaborative spaces.

Indeed, the response below to the question: if you must work with a team on a digital manufacturing project (prototyping a new product, developing a digital interface), what is the working environment you would prefer? Although 63.79% of the respondents did not complete the answer, we note that those who did answer 20.69 % highlighted their preference for a hybrid workspace that facilitates interconnections between virtual and physical environments. The two other categories were physical work environment (10.34%); one or more digital environments that support collaborative working (10.34%).

Blended work environments offer more flexibility and allow the team access to resources, tools, and information from anywhere and reducing barriers. Some programming environments (ex., Laravel: a PHP Framework) allow collaboration, but in person discussions are sometimes needed.

Based on these results, the platform should then facilitate collaborations between different environments (physical and virtual). Moreover, the design of the platform focused on developing an environment capable of supporting and assisting the co-design of projects within Communities of Practice (CoP) and according to the kolòn model, involving multiple actors with varying profiles and levels of expertise. This aimed to facilitate the sharing of knowledge and experiences. However, one of the main objectives of this research—enabling these actors to measure and assess the skills they have acquired—was not achieved. This functionality should be developed in the future, as it would allow novices to acquire new skills from more experienced individuals, as well as evaluate, update, and represent these skills within their networks.

6. CONCLUSION

Our observations reveal the effectiveness of this enhanced collaborative mode of organization approach in maker spaces communities. Importantly, the kolòn model has fostered stronger community bonds through shared creation, demonstrating how constructionist principles can be successfully scaled to community-level learning experiences.

The success of this model in practice has validated throughout theoretical integration of community of practice with the kolòn approach for constructing and maintaining communities. Participants consistently report deeper learning experiences when engaged in collective creation, supporting our hypothesis that both technical and non-technical skills can be developed and enriched through structured collaborative frameworks. This suggests a promising direction for the evolution of constructionist learning through communities of practice in the digital age, where individual and collective work and learning can be seamlessly integrated through thoughtfully designed technological supports.

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