Building a Constructionist Community

Expanding an Academic Learning Lab Beyond Institutional Boundaries

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While constructionism has proven to be a powerful educational approach—leveraging technology to enhance learning across diverse environments—its broader adoption is often limited by traditional school structures and the perceived radical nature of its principles. A key challenge for any constructionist research group is how to effectively promote these innovative practices to a wider audience and support their integration into mainstream education. To address this, our constructionist lab has developed an innovative collaboration model that connects academia with the regional educational ecosystem. Our goal is to cultivate a thriving constructionist community that extends beyond the boundaries of academic research, bringing together schools, educational organizations, and, most importantly, the educators who shape them. The model is built on partnerships with nonprofit organizations to amplify the university's impact beyond institutional confines. This collaboration draws on the strengths of each partner: the university contributes by developing innovative content, offering formal teacher training, and conducting rigorous evaluations of both short- and long-term impacts on students and educators. Nonprofits, on the other hand, offer the flexibility and reach to implement educational initiatives in local communities, including those in underserved areas. Their deep connection to local needs enables them to co-design initiatives from the ground up, ensuring contextual relevance and lasting impact. This study contributes insights into the replicability of our collaboration model, offering a framework that other institutions can adapt to advance constructionist methodologies in varied educational settings. By fostering collaboration among educators, researchers, and nonprofit organizations, the initiative provides a scalable approach to enabling meaningful and sustainable transformations in teaching and learning practices.

Keywords and Phrases: Community building, community outreach, nonprofits, informal learning

1 INTRODUCTION

In a previous paper (Montresor and Fiore, 2023), we reflected on the evolution of our university FabLab in advancing constructionist principles (Papert, 1991) across formal and informal education. What began as a university-based initiative has gradually expanded its reach, engaging schools and diverse learning environments beyond the academic walls.

Our central objective is to bring constructionist principles into formal education, creating the conditions for these ideas to take root and flourish within traditional systems. This involves not only integrating constructionist methodologies into everyday school practices but also cultivating a sustainable community of practice (Meyerhoff and Strycharz, 2013) to support their ongoing development. A core challenge underpins this effort: How can a constructionist learning lab effectively promote progressive education within institutional contexts that often resist change, given the radical nature of

the constructionist message and its challenge to conventional educational paradigms? This question remains central to our efforts as we strive to balance the freedom and creativity intrinsic to constructionism with the structured, often rigid, requirements of formal education.

Our previous work raised critical questions about the sustainability and replicability of our efforts and proposed expanding the alliance between the university, schools, and nonprofit educational entities. Since then, significant progress has been made. Our lab has strengthened its role as a regional educational hub, deepening connections between academia and the wider educational community. Meanwhile, the institutional landscape has shifted with the introduction of mandatory digital courses in pre-service teacher training and substantial funding for teacher professional development. These developments have reinforced the relevance of our approach and provided new opportunities to expand its impact.

As a contribution, this paper focuses on the elements that we believe are essential for the success of our efforts:

- Building a robust community of practice between formal and informal educators - We argue that a community of practice like this is not just beneficial but essential for sustaining and transmitting the constructionist message, as it provides the collaborative foundation necessary to navigate the challenges of aligning constructionist principles with traditional education systems.
- Embracing key constructionist values - Not only in how we engage students but also in how we cultivate our community of educators. Our approach is grounded in active participation, where both students and educators engage hands-on rather than passively absorbing knowledge; iterative collaboration, emphasizing cycles of creation, feedback, reflection, and refinement; shared ownership of learning, enabling students and educators to co-construct their experiences; and epistemological pluralism, fostering inclusivity by valuing diverse ways of knowing, thinking, and problem-solving.
- Leveraging nonprofits for reach and flexibility – Nonprofits identify and address local educational needs, extending constructionist initiatives beyond academia to underserved communities and adapting to diverse learning contexts.
- Engaging young educators across disciplines – We involve university students and recent graduates from various fields, equipping them with constructionist methodologies and immersing them in real teaching environments. This cross-disciplinary approach builds future advocates for progressive education.
- Bridging formal and informal learning – We merge university-led teacher training with a bottom-up movement driven by educators. This integration helps constructionist principles take root in schools while remaining adaptable to real-world classrooms.

In this paper, we go beyond presenting our approach by critically examining which aspects are replicable and which are shaped by local context. While many constructionist studies highlight local successes, they often overlook discussions on scalability, adaptation, and long-term sustainability. This work aims to bridge that gap, offering insights that other research groups can leverage to adapt and extend constructionist practices in diverse educational settings. We begin by outlining the national context (Section 2), then introduce the Connecting Dots Learning Lab (Section 3), which links academia and nonprofits. We describe our implementation strategies (Section 4) and discuss the model's scalability. Finally, we present preliminary impact results (Section 5).

2 THE NATIONAL CONTEXT

Over the past decade, Italy has enacted several legislative measures to promote computational thinking and coding in schools, such as the National Plan for Digital Schools (Ministry of Education, 2013), the National Guidelines and New Scenarios (Ministry of Education, 2018), and more recently, the Guidelines for STEM Disciplines (Ministry of Education,

2023). However, these measures have had limited practical implementation: as discussed by Bocconi et al. (2022), there is no compulsory integration of computational thinking in primary schools; it is considered a cross-curricular topic in lower-secondary schools; and it is included only in specific programs in upper-secondary schools. Until recently, support was mostly limited to occasional funding for purchasing devices, and little effort had been made to equip teachers with the necessary competencies to apply these innovations effectively.

It was not until 2024 that Italy implemented substantial reforms in the training and recruitment of secondary school teachers, most notably introducing a 60-ECTS qualification degree program (European Credit Transfer and Accumulation System—60 credits being equivalent to a full year of study) as a mandatory qualification for aspiring educators, to be issued by universities. The program includes 24 credits in transdisciplinary courses, covering areas such as pedagogy and didactics, inclusive education, psychology, sociology, anthropology, school legislation, and digital competencies. Additionally, it offers 16 credits in subject-specific didactics, and 20 credits in supervised teaching practice. This reform marks a pivotal moment in the nation's teacher education framework. It not only finalizes a long-delayed restructuring process but also represents the first formal integration of digital competencies into pre-service teacher training programs across all disciplines. While previous initiatives were sporadic and fragmented, this program introduces up to 3 ECTS credits specifically dedicated to digital literacy. This inclusion gives future teachers a crucial opportunity to reflect on digital literacy's role in education and integrate it into broader discussions on pedagogy.

In parallel, significant efforts have been made to enhance STEM education for all students in Italy, alongside professional development (PD) courses for in-service teachers. Notably, Ministerial Decrees DM65 and DM66 of 2023 have played a crucial role in promoting STEM knowledge in schools. DM65 allocates 750 M€ to "New Competencies and New Languages" within the National Recovery and Resilience Plan and aims to integrate activities, methodologies, and content designed to develop STEM, digital, and innovative competencies within the curricula of all school cycles. DM66 allocates 800 M€ for the continuous PD of teachers, particularly in relation to the digital transition. This funding is part of a broader strategy to create a comprehensive system for ongoing training, ensuring educators are well-equipped to navigate and implement digital innovations in their teaching practices.

While these initiatives mark significant progress, they primarily focus on technical skills and digital integration rather than rethinking educational practices. This creates an urgent need and a unique opportunity to introduce constructionist approaches into Italian schools, to ensure that digital tools and STEM education do not reinforce traditional rote instruction and instead empower students as creators and problem-solvers (Montresor et al, 2025).

3 CONNECTING DOTS LEARNING LAB - FROM DOTS TO CONNECTIONS

The FabLab UniTrento was established in 2019 within the Department of Computer Science and Engineering at the University of Trento (Fiore, 2023; Montresor and Fiore, 2023). Initially focused on university-based initiatives, FabLab UniTrento has evolved into a regional educational hub, promoting constructionist principles among schools and teachers. It quickly became evident, however, that a university alone could not effectively reach every school and teacher. To extend its impact beyond institutional boundaries, partnerships with two nonprofit organizations have been established: Glow (https://glow.earth), a cultural association based in Trento specializing in educational outreach and innovation, and Verona Fablab (https://www.veronafablab.it), a social enterprise in Veneto with expertise in technological education and community engagement.

The independent nature of Glow and Verona Fablab provides several key advantages over the university:

- *Localized reach and adaptability* – Nonprofits serve as local connectors, strengthening ties with schools and enabling more responsive, context-specific initiatives, particularly in underserved areas.

- *Sustainability beyond the university* – Universities often operate within rigid structures, making long-term community involvement challenging. By embedding activities within nonprofits, constructionist practices remain accessible even as research priorities shift.
- *Participatory model* – Unlike top-down institutional initiatives, teachers and informal educators are empowered as active contributors, promoting shared ownership of learning and enabling a more collaborative, bottom-up approach to professional development.

These partnerships are more than logistical extensions of the FabLab's activities; they are transformative collaborations that have reshaped its identity and mission. Glow and Verona Fablab are not simply intermediaries between academia and schools but active cultural and educational actors, shaping constructionist learning through a deeply community-driven approach (Zeichner, 2009). Their work goes beyond implementing predefined programs—they actively shape the educational ecosystem, engaging in a *continuous*, *bidirectional* exchange with both academia and local communities.

Recognizing the potential of this multi-actor collaboration, the university, in partnership with Glow and Verona Fablab, established the Connecting Dots Learning Lab at the end of 2023. Connecting Dots emerged as a new collaborative entity, built on the foundation of the FabLab's expertise, the adaptability of nonprofit partners, and the active involvement of researchers, educators, teachers and students. Rather than operating as separate initiatives, these components came together to form a unified entity, connecting academic knowledge, teaching practices, and community engagement.

By integrating the academic expertise of the university with the operational flexibility of nonprofits, Connecting Dots creates a collaborative framework where each entity plays a distinct yet complementary role:

- The university provides formal training in STEAM education, pedagogical innovation, and constructionist methodologies for educators.
- Glow and Verona Fablab translate these methodologies into practical, community-driven programs, ensuring their adaptation to real-world educational needs.
- After implementation, the university research team conducts systematic evaluation and scientific validation, assessing the impact of these activities through questionnaires, interviews and observations.

This continuous feedback loop ensures measurable outcomes and ongoing refinement of educational strategies.

Connecting Dots operates under the principle that, much like a connect-the-dots drawing, individual entities—institutions, knowledge, practices—but more importantly, people—gain greater meaning and impact when interconnected. Its trainers, tutors and researchers represent the main "dots", linking their educational backgrounds and their competences to the needs of schools and communities. By bridging academic insights and practical applications, educators extend the reach of Connecting Dots (https://connectingdotslab.it), ensuring its presence and impact at a grassroots level. To visualize these connections, a sociogram has been developed (Figure 1), gathering information on the gender, age, initial training background, and courses delivered by trainers within the two nonprofit organizations across various schools. The sociogram also highlights those members of the community who are also part of the research team.

For the 2024-25 academic year, this collaboration has delivered over 8,000 hours of student activities and 2,500 hours of teacher training, focusing on STEAM education and technological innovation. Students participate in 10-hours of labs covering topics such as coding, educational robotics, prototyping and electronics, making, digital storytelling, podcasting, biology, mathematics, and science, while teachers engage in 15-hours of training sessions designed to integrate the constructionist methodology associated with these topics into their classrooms.

The initiative follows a community-driven approach, where Glow and Verona Fablab closely co-design students labs and PD courses, ensuring they align with the actual needs of students and teachers. This process guarantees that activities remain relevant, adaptable, and impactful across different educational settings.

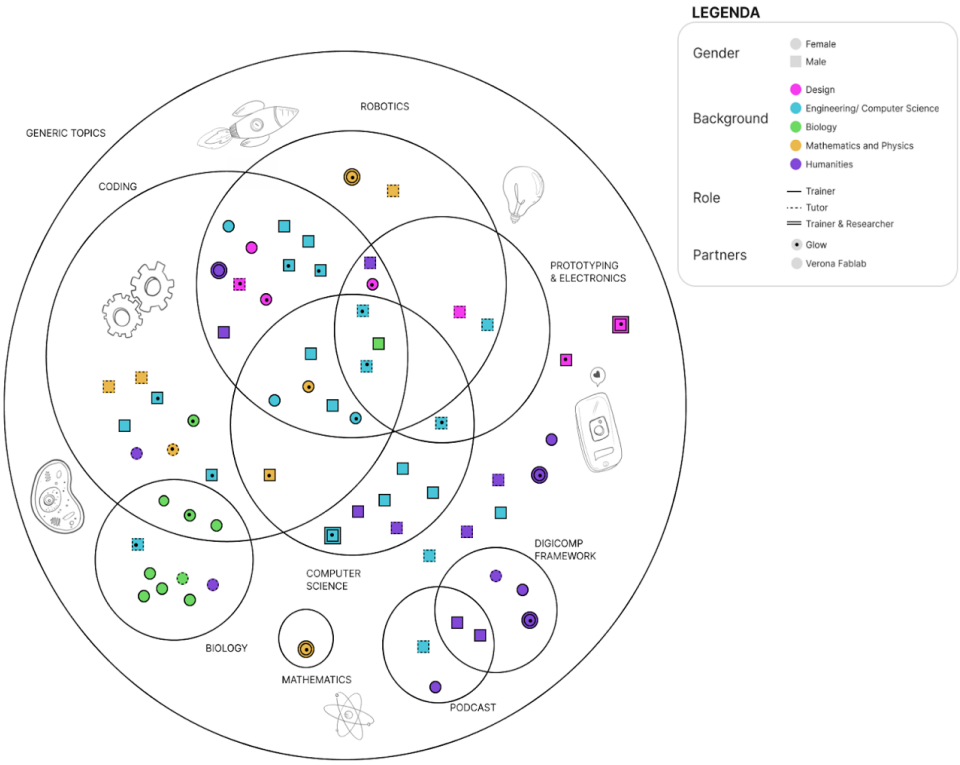

Figure 1: Connecting Dots sociogram including trainers and tutors from Glow (marked by a black dot) and Verona Fablab (without). some of whom also have an academic role as researchers. Some participants also hold academic roles as researchers. The visual representation distinguishes individuals by gender through shape, and by academic background using color: pink for design, blue for computer science and engineering, green for biology, yellow for mathematics and physics, and purple for humanities. Roles are represented through different line styles: tutors have dashed strokes, trainers have solid strokes, while those who are also involved in academia have a double line. All individuals are positioned in the diagram according to the thematic areas they contribute to, which include: general topics, coding, computer science, biology, podcasting, prototyping, electronics, and robotics.

4 IMPLEMENTING THE CONNECTING DOTS LEARNING LAB: FROM VISION TO PRACTICE

Connecting Dots, indeed, is driven by a dual objective: to generate an immediate impact on the educational landscape while fostering long-term systemic change. At the heart of our efforts lies a commitment to transforming the educational landscape by fostering a broader, interconnected learning community. Our approach is not limited to providing innovative teaching tools; rather, it is about shaping a mindset, co-constructing knowledge, and creating a shared vision for change.

We believe that education should not be static, isolated, or exclusive, but rather a dynamic and collaborative experience, where educators, students, and institutions interact in mutual exchange. To achieve this, we have developed a distributed, participatory model, uniting different actors in the learning ecosystem:

- Young educators and recent graduates trained in innovative methodologies.
- Teachers already embedded in schools, who engage with and enrich these approaches.
- Institutional structures, which provide a formal framework to scale up and sustain educational transformation.

This cross-pollination of experiences stimulates an expanding network, where ideas, practices, and pedagogical innovations flow between different levels of the system, reinforcing a culture of shared learning and continuous adaptation. However, achieving this vision requires not only engagement at the grassroots level but also structural changes at the institutional level. The pre-service teacher training course, for instance, represents a critical step in formalizing this movement, ensuring that the methodologies we promote are not merely optional pedagogical experiments but become embedded in ministerial requirements. By working within institutional frameworks while maintaining a constructionist spirit, we facilitate progress that is not only sustainable but also widely accessible.

4.1 What We Do and Why We Do It

To bring this vision to life, we implement a series of interconnected initiatives, each designed to bridge the gap between research and practice, theory and experience, and individual action and systemic change.

a. Internal Professional Development and Community Building - A core aspect of Connecting Dots is fostering a collaborative culture among educators, researchers, and practitioners through periodic training sessions, workshops, and retreats. These activities serve as key moments for aligning perspectives, sharing methodologies, and reinforcing a collective vision for educational transformation. One example is a recurring informal event called "*Never Have I Ever*" allows educators to openly discuss their professional needs while engaging in critical self-reflection and collaborative problem-solving. This practice encourages trainers to confront uncertainties, share insights, and iteratively refine their methods alongside peers in a trustful, collaborative environment. In-person training sessions allow educators to engage with constructionist methodologies and hands-on, STEAM-based learning strategies. Additionally, dedicated residential retreat offers participants the opportunity for in-depth discussions and reflection, equipping them with technical knowledge and a shared pedagogical approach. These initiatives aim to cultivate a sense of community, where educators are not just passive recipients of training but co-creators of innovation.

b. Classroom Innovation and Teacher Training - Beyond internal training, Connecting Dots supports the integration of innovative pedagogies into school environments, proposing teacher trainings where school teachers and our trainers can work synergistically together. Teacher training programs such as those aligned with DM65 and DM66 emphasize hands-on, reflective learning experiences where theoretical insights can translate into meaningful classroom applications. A distinctive element of this approach is the teacher-as-a-multiplier model, where school teachers take on dual roles as both learners and trainers. Through dedicated training sessions led by expert educators, teachers first experience the methodologies as participants, gaining a deep, first-hand understanding of the approach, then share insights, materials, and best practices with colleagues. This contributes to an ongoing, community-driven process of educational innovation, where the impact of the training extends well beyond individual participants. This approach seeks to establish a sustainable and replicable framework for embedding constructionist and STEAM-based methodologies in everyday teaching.

c. Reflective Practice and Continuous Learning - A fundamental principle of Connecting Dots is the commitment to continuous reflection and improvement, where insights from both research and training are mutually reinforcing. This dynamic exchange allows methodologies developed in academia to be adapted for practical training events and vice versa.

On the research side, we introduced the "Thinking Cap" methodology, which provides a structured framework where educators and researchers openly discuss challenges encountered in their work, rather than focusing solely on successes. By embracing difficulties as learning opportunities, this reflective practice fosters resilience, adaptability, and continuous

methodological refinement. Bi-weekly research team meetings further support this process, offering a dedicated space for analyzing emerging challenges and refining pedagogical approaches. By ensuring that challenges and learnings from both research and training are systematically recontextualized across domains, Connecting Dots supports a holistic, evolving model of educational innovation that remains responsive to the needs of educators and learners alike.

d. Documentation and Dissemination - Ensuring the scalability and sustainability of educational innovation requires structured documentation and knowledge-sharing practices. Connecting Dots maintains detailed records of activities and best practices, consolidating insights into educational booklets and pedagogical guides. These resources serve as open-access tools for educators, enabling the adaptation and replication of effective methodologies across different educational settings. Moreover, systematic documentation allows for ongoing evaluation and refinement, making sure that lessons learned from implementation inform future iterations of training and classroom strategies. By formalizing these resources, Connecting Dots contributes to building a collective repository of educational knowledge, making innovation accessible, adaptable, and enduring.

e. Institutionalizing Change: The 60-ECTS Teacher Training Course - To reinforce the institutional impact of its methodologies, the Connecting Dots team has contributed to the design of a university-accredited, 60-ECTS teacher training program that integrates hands-on learning with theoretical foundations in STEAM and constructionist education. This initiative marks a critical step toward formalizing and scaling educational innovation, ensuring that progressive methodologies gain recognition within ministerial frameworks.

By embedding these approaches within institutional structures, the program lowers the entry barrier for educators who may not initially be drawn to innovative practices, while offering a structured and credible pathway for professional development. Aligning the course with national teacher training enables Connecting Dots to operate at both grassroots and systemic levels—bridging educational experimentation with formal policy change.

4.2 Building a Broader Educational Community

Beyond its structured activities, Connecting Dots is fundamentally about fostering a collaborative and inclusive educational ecosystem. Rather than simply training individuals, our goal is to build a self-sustaining network of educators, researchers, and students who learn from and support one another. By integrating young educators, experienced teachers, and institutional actors, we create a dynamic exchange of knowledge, where innovation emerges organically within the teaching community rather than being externally imposed. The co-presence of academic and community actors fosters what Zeichner (2009) calls a "third space"—a transformative arena where different forms of expertise merge to enrich teacher learning and pedagogical innovation. With the 60-ECTS teacher training course in place, the alignment between ministerial requirements and progressive pedagogical principles makes systemic educational transformation both desirable and structurally viable (Montresor et al., 2025).

5 PRELIMINARY RESULTS

The rapid and intensive implementation of our efforts, especially over the past year, has yielded promising and encouraging results on the feasibility, impact and effectivity of the presented approach. These results in fact appear to be valuable both at a systemic level and within the specific activities carried out. The monitoring, observation and mapping of these developments are presented in the following sections on two levels of analysis: the macro-systemic perspective (Section 5.1) and the micro-level insights using data collected from the activities (Section 5.2).

5.1 Within the Environment

Preliminary data suggest that the collaborative model effectively engages both students and educators, fostering a strong sense of belonging, motivation, and innovation in teaching practices. One of the key findings is that the individuals we train often do not require extensive technical or content-based instruction but instead benefit significantly from training focused on classroom methodologies and interaction strategies. This training equips them to better connect with students and deliver content in engaging, interactive ways. In turn, when these educators implement the practices in classrooms, they inspire teachers who are often amazed to see how familiar content can be delivered using new, technology-supported approaches. This transformation not only enhances classroom dynamics but also helps teachers better understand how to integrate technology meaningfully, making it less intimidating for both themselves and their students.

The collaboration between academia and the nonprofit sector creates a unique community that merges the rigor and credibility of academic expertise with practical, hands-on approaches. These practices, validated across a large and diverse sample of thousands of students and hundreds of teachers, demonstrate the scalability and adaptability of the model. Unlike traditional approaches, often constrained to small-scale validation, this model leverages the broad reach of partnerships to test and refine educational innovations on a much larger scale.

Initially, government funding for these initiatives was perceived as an imposition, with results seen as difficult to achieve. However, this model has shifted the focus toward creating tangible, impactful responses that address real needs. By fostering a shared vision for the future of education, particularly within schools, the initiative has laid the groundwork for new alliances and a common understanding of the importance of innovation in teaching.

The emphasis on "meaningful making" has been a cornerstone of this approach, encouraging participants to take ownership of their learning by creating projects that reflect their interests and experiences (Berland, 2006; Ryan et al., 2016). Anecdotal evidence from school workshops and community events underscores the enthusiasm of students and the renewed motivation of teachers adopting these methodologies. For instance, educators have reported increased student engagement and collaboration, while students have demonstrated enhanced critical thinking and problem-solving skills through STEAM activities (Stager, 2009).

One significant challenge has been ensuring the sustainability of these initiatives. The success of the model depends on ongoing support from both the university and its external partners. The involvement of Glow and Verona Fablab has been instrumental not only in navigating bureaucratic complexities, which might have otherwise hindered progress, but also in bringing freshness and widespread reach to the activities. The integration of play and experimentation into educational practices fosters a flexible, growth-oriented mindset among participants. Teachers highlight how this approach improves students' technical and STEAM-related skills and enhances their ability to think critically, collaborate effectively, and engage with learning in meaningful ways. By involving local organizations and creating strong community partnerships, Glow and Verona Fablab have further enriched the educational experience, helping to build a sense of shared purpose and collective growth (Aldrich and Herker, 1977; Tushman and Scanlan, 1981).

5.2 Within the Activities

To assess the impact of our proposal for constructionist-inspired activities, we conducted a mixed-methods study to observe how participants—primarily students and teachers—engaged in the activities and experienced learning outcomes aligned with constructionist principles.

Study Context and Methodology. The data collection involved 1,101 middle and high school students ($M = 14.2$ years, $SD = 2.08$) from the provinces of Verona and Trento, who participated in our programs. The study, approved by the Ethics Committee, included pre- and post-intervention surveys. The surveys included a quantitative tool developed by our

research team, the Activities' Learning Experience Scale which is currently being validated and aims to provide a structured representation of the learning process according to key dimensions that align with our approach and the principles of constructionism. The scale includes 18 items equally divided into six subscales: Reflective Learning, Transformative Learning, Meaningfulness, Self-Efficacy, Engagement, and Empowerment. It uses a 5-point Likert scale (1 for "completely disagree" and 5 for "completely agree"). Data collected so far from a sample of 1,275 respondents support the measure's reliability, with a Cronbach's alpha of 0.873 and an RMSEA value of 0.0510, indicating a good model fit and the ability of the scale to capture the intended constructs.

Results. Analyses involved paired samples t-tests and Wilcoxon signed-rank tests to assess significant changes ($p < 0.05$) while qualitative data were mapped using thematic analysis (Braun and Clarke, 2021).

Variability in pre-post intervention scores showed significant positive effects of the activities on the learning experience ($p < .001$). We observed significant effects on Transformative Learning and Reflective Learning suggesting that students reported a deeper reflection on what they were doing and envisioned future applications of what they just learned. Relevant effects were also observed for Engagement and Meaningfulness factors with increased attention, motivation and interest ($p < .001$). Furthermore, higher scores for Self-Efficacy support how the interventions can contribute to increasing the confidence in their ability to learn and master the subject matter ($p < .001$). Statistics are visually shown in Figure 2.

Findings support the idea that participants experience meaningful and transformative learning while reinforcing engagement, self-efficacy, and meaningfulness. Future analyses will focus on further exploring patterns and trends across different types of activities and participants' profiles.

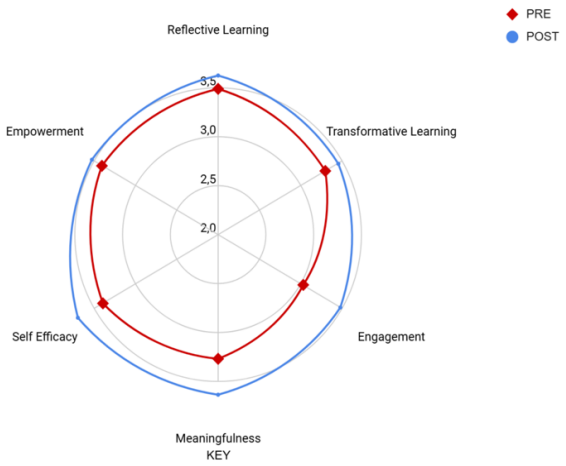

Figure 2: Pre-intervention (red) and post-intervention (blue) mean scores across six subscales. The radar chart highlights significant improvements after the intervention, with notable gains in areas related to reflective and transformative learning.

6 CONCLUSIONS

This model demonstrates that strategic partnerships between universities and cultural associations can significantly enhance educational outreach and sustainability. By embedding constructionist methodologies into both university-led and community-driven activities, Connecting Dots fosters an inclusive and participatory approach to education. The successful

integration of playful, hands-on learning underscores the university's expanded Community Outreach, transforming it from a one-way dissemination of knowledge into a collaborative, co-creative process.

As both a think tank and a community space, Connecting Dots facilitates the development of innovative educational models, bringing together students, educators, and professionals in a shared learning ecosystem. Technology plays a pivotal role, not only as a tool but as a central component in creating accessible, engaging, and interactive learning experiences. Through a collaborative model, the initiative integrates the academic expertise of the University of Trento with the operational capacity and outreach capabilities of Glow and Verona Fablab. While the university focuses on advanced training in STEAM methodologies and pedagogical innovation, its partners implement these practices in schools and communities, including underserved and remote areas. The university research team, in turn, systematically evaluates the impact of these activities through methods such as questionnaires and interviews, ensuring continuous improvement and measurable outcomes.

Future research will refine impact assessment tools, explore the replicability of the model in other academic contexts, and expand its scope to include more diverse community groups. This comprehensive approach aims to foster a robust, sustainable constructionist community that bridges academia and society, nurturing the next generation of learners and reaffirming the transformative potential of education when research, practice, and community engagement intersect.

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