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HOW DO WE ENCOURAGE THE LOWEST APPROPRIATE LEVEL OF TECHNOLOGY TO SOLVE HUMAN NEEDS IN OUR DESIGN SOLUTIONS

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ABSTRACT
As product design education evolves, the focus has shifted from creating objects to delivering product-service systems. This aligns with the New Circular Economy Action Plan and the European Green Deal objectives and strategies. Achieving a truly human-centred approach requires rethinking how we educate future designers. This paper examines a European Low-Tech Hackathon, where students developed solutions under human and technological constraints designed with a minimal technological footprint, aligning with sustainability principles and Low-Tech values.
Hackathon outputs were service-based product concepts featuring physical touchpoints tailored to local needs. Working as outsiders in multilingual, multidisciplinary teams, students engaged deeply with unfamiliar environments, questioning assumptions about resources and user needs. This participatory approach fostered inclusive design thinking, ensuring solutions were rooted in social, environmental, and human contexts.
Rather than defaulting to high-tech innovation, students critically assessed the appropriateness of technology, reinforcing the need for techno-diversity in design education.
This streamlined hackathon-based educational model empowers students to tackle real-world challenges without reliance on high technology. Prioritising context-appropriate, ecological, and human-centred solutions encourages a shift from techno-solutionism to sustainable, community-driven design. Embedding this model in design curricula fosters a more inclusive, transdisciplinary, and responsive approach to addressing global design challenges.

Keywords: Design education, product design, experiential learning, low-tech, hackathon

1 INTRODUCTION
Product Design, and thus, Product Design Education, has undergone somewhat of a paradigm shift in recent years, from being almost entirely object-oriented to designing for more and more integrated Product Service Systems [1]. Moreover, higher education is responsible for preparing engineers and designers to respond to future challenges. Moving from objects to services is a widely encouraged strategy, as mentioned in the Circular Economy Action Plan and the European Green Deal [2]. As educators have expanded their curricula to meet the requirements of these now ubiquitous design requirements, our understanding of object and material culture has also shifted to understand the human-centred requirements at the heart of a good Product Service System [3].
Again, as our discipline evolves and metamorphoses to reflect these changing competency requirements, our understanding of what is required to make a product genuinely human-centred must also evolve and change [4]. The increasing necessity to construct sustainable practice, not just within the realms of engineering efficiency [5] or ecology and conservation [6] but also within our evolving understanding of Strong Sustainability [7] therefore, we must necessitate a similar shift in understanding the object or a Product/Service/System's role within the territoire it inhabits.
The Circular Economy is often proposed as a development model that can be utilised to build sustainability-focused design curricula [7] and undoubtedly has benefits in terms of sustainability

compared to the traditional Linear Economy model. However, it often falls short of challenging the fundamental impulses that drive our consumption-driven culture [8].
One emerging model which appears to match many of the requirements of a strong sustainability Product Design programme is that of Low-Tech [9]. Low-Tech is a sustainability model that:

...prioritise simplicity, durability, repairability, and local production, offering a promising alternative to the current focus on efficiency, automation, and globalised supply chains.[10]

Low-Tech offers a model of material culture that can work alongside those important regenerative aspects of the circular economy model but one that embraces the strong sustainability requirements of understanding people and place within the product/system space.
For design and engineering programs to transition to a position of strong sustainability, we must understand the problem beyond incremental improvements and process optimisation. By implementing approaches that question the role of material culture within society, we can equip students with the tools required to assess and challenge the status quo.[11]
In this paper, we will examine an approach to implementing a method of experiential learning[12] that emphasises developing low technologically intense solutions within real-world constraints whilst providing students with valuable, practical insights to create inclusive, human-centred solutions.
Through the hackathon pedagogical framework, the students are asked to critically engage with and produce for communities whose needs remain unserved through current high-technology intense systems.
To do this, the paper explores the following key question:

How can low-tech, hackathon-based learning experiences be integrated into formal design curricula to promote sustainability, inclusivity and critical reflection?

By documenting the methods and outcomes of a Low-Tech Hackathon, we offer a scalable and adaptable framework for design educators to embed Low-Tech principles within their programmes and develop experiential assessment modes to practice and prove those principles.

2 HACKATHON & PROJECT OVERVIEWS

A Low-Tech Hackathon is an intensive pedagogical method intended to provide a safe but challenging space for students to develop design solutions to problems experienced by the local communities whilst implementing the lowest appropriate level of technology. Traditionally, Hackathon frameworks have focused on digital innovation and high-tech solutions. In contrast, a Low-Tech hackathon focuses on providing contextually appropriate, resource-conscious approaches that align with local needs. Hackathons have evolved significantly since their origins in the late 1990s when they were primarily gatherings of programmers aiming to solve coding challenges [13]. Over time, they have expanded into structured, multidisciplinary, multi-day events utilised mainly by business and education [14]. The role of the Hackathon as a pedagogical method has become more widespread, especially with a shift toward more constructivist, active learning approaches[15]. Hackathons provide students with a temporally and spatially constrained environment to foster critical thinking and problem-solving, often within teams.
Traditional hackathons often promote a form of technological solutionism, assuming that high-tech and data-driven concepts are the best means of solving problems [16]. However, this often overlooks the importance of social, cultural and environmental contexts. Through this lens, the Low-Tech hackathon presents an alternative approach, encouraging students to engage locally and explore how simple and localised technologies can meet human needs with minimal resource consumption.
The hackathon formed part of an Erasmus+ KA220-funded project in which multinational; multidisciplinary teams developed solutions for a specific city. Participants of the Hackathon were given real-world problems revealed as part of the result of a social cartography performed before the event's commencement. This research allowed the team to understand the chosen city not just as a physical space but also from a social, economic and material perspective to provide a holistic understanding beyond physical geography[17]. This knowledge allowed briefs to be developed, which disrupted conventional design assumptions and allowed participants to question the local needs in developing appropriate solutions.
Student teams were built upon participants who had a variety of educational experiences, comprising members of undergraduate, master and PhD levels from a variety of disciplines. The teams were also

explicitly multicultural and formed of individuals from various linguistic and cultural backgrounds to enhance the diversity of thought[18] and approach while presenting challenges in communication, decision making and prioritisation.

All participants were outsiders to the community and, therefore, did not possess pre-conceived solutions (in traditional hackathons, participants will likely work on familiar problems within their own cultural or technological paradigm)[19]. This outsider status presented opportunities and complexities, notably encouraging a fresh perspective, allowing participants to more easily question assumptions on user needs, resources, etc., and the requirement to undertake a participatory approach to engage with the local community. This required students to have sensitivity to cultural nuance, a shift in mindset from interventionism to facilitation and a requirement to validate with local actors. To bridge this gap, each team was supported by two mentors – one with a design/education focus and one with a community focus.

Constraining students to focus on appropriate technology with the lowest possible level of intensity is a core requirement of the Low-Tech Hackathon and of primary importance to the Low-Tech philosophy through its understanding of sufficiency. Rather than restricting participants, it challenges them to explore sufficiency over efficiency, leading to a better understanding of resource use, especially within a given context[9]. Working within this deliberate technological constraint encourages participants to challenge their assumptions of technology and engage with the local requirements. This enables techno-diversity as design choices are based not on what is the most advanced or newest but what is most appropriate [16].

During the Hackathon, participants faced the limitations of the territoire. They were encouraged to avoid energy-intensive fabrication and long supply chains, instead relying on local knowledge and skills to realise their solutions. They engaged more deeply with the social and ecological landscape and understood that their concepts were embedded within local realities. While some participants initially struggled to reframe their approach to take into account this unfamiliar paradigm, ultimately, the experience fostered greater adaptability and reflection of the role of technology and techno-narratives within design, fostering competencies in resilient, human-centred solutions at a time of environmental and social uncertainty[20].

To measure the progress and development of the students during the Hackathon, students were asked to complete daily surveys and reflections on their interactions. The survey questions were designed to evaluate their perceptions of Low-Tech design before, during and after the event, their understanding of the role of efficiency vs sufficiency in developing design outputs, the effectiveness of the team-based interactions and the experiential learning environment. The learnings from this were presented as part of the Erasmus+ project's final deliverables [21].

3 KEY OUTCOMES FROM THE HACKATHON

The Low-Tech Hackathon successfully allowed the participants to explore their design practice within a scaffolded environment. That provided the opportunity to learn that design can be most effective when it is participatory, context-sensitive and accessibly oriented. The teams effectively completed work to develop interconnected, inclusive and adaptable concepts and gained a deeper appreciation of the Low-Tech as a viable design mindset, not just a theoretical methodology.

Table 1. Key Learning Metrics from Deliverable Report, Feedback Survey Analysis [21]

Survey Theme	Key Findings
Relevance of Low-Tech Principles	94.1% of students found Low-Tech design highly relevant for addressing local challenges.
Co-creation with Local Stakeholders	100% of students recognised the importance of community collaboration in design.
Shift in Mindset	The majority transitioned from efficiency-driven thinking to sufficiency-based design approaches.

3.1 Service-Based Product Concepts

One noticeable aspect of the Low-Tech hackathon outputs was the product/service/system-oriented nature of the design outputs. Rather than focusing on a particular technology type (typical for ordinary hackathons), teams developed integrated service-based solutions with tangible physical touchpoints. This aligns with the Low-Tech core values of appropriateness, accessibility and sufficiency.

More than this, each concept was rooted in the specific needs of the local needs, ensuring that the teams worked to solve real-world problems within their concepts. The projects highlighted the importance of an inclusive, people-centred approach to design and the value of fostering community engagement and active participation within the design process – especially when overcoming assumptions and biases.
One example of this was a product concept that recovered nutrients in the form of compost from the town's food waste stream to allow citizens to avail themselves of fresher and more extensive produce options (in a region of monocultures). Another example was a device that allowed for simple community composting. The team also considered integrating the system into wider society and looked at how implementing the composting scheme could be embedded within the local education curriculum and how a shared ownership model could allow for wider community engagement.

3.2 Inclusive Design Practices

The hackathon participants came from a broad cultural and interdisciplinary background. More than this, so did the coaches, facilitators and community stakeholders who interacted with the participants during their design challenge. This contributed to an expansive and genuinely transdisciplinary perspective being represented and included in the design process's problem-framing/problem-solving. In education, we often discuss the importance of this approach with our students, but how frequently we truly provide them with the opportunity to practice and work in this way is questionable. The format of the Low-Tech hackathon not only supported this approach but demanded it.

Co-constructing solutions with local actors was the most valuable part - it changed how I see the role of designers.

Student Quotation 1 - A student participant on design and Inclusivity during the Hackathon[21]

One concept that showed the importance of working in this manner focused on multi-modal transportation within the region. The design team worked with the local bus and scooter companies, businesses and citizens from within the community (including those who used and did not use the current systems) and asked, "What is the true role of the transport network here?" Their concept proposed an integrated system which challenged the current routes, infrastructure and rationale that had been implemented up until this point and proposed an entirely new system which could run more frequently, be more responsive to the needs of the territoire and support the growth of independent businesses. This concept looked to be wholeheartedly inclusive to all.

3.3 Questioning Assumptions

A final example to note is that as an outcome of the hackathon, participants were provided the space and opportunity to rethink and challenge their assumptions around the roles of technology, sustainability, and design in delivering social interventions. As the event asked students to work within strict resource constraints, they were forced to prioritise contextual adaptability over technological complexity.

Initially, I thought Low-Tech was just about 'less tech,' but now I see it as about making the most appropriate choices.

Student Quotation 2 - A student participant on the mental shift provided by the Hackathon experience[21]

One team presented a concept for a Low-Tech Community Hub, and in their design, they initially focused on providing energy-efficient kitchen solutions. However, this quickly evolved into a holistic community resource that combined shared gardening, Low-Tech food preservation methods, and cooperative cooking spaces, demonstrating that sustainability is more about social infrastructure than physical interventions.

3.4 Implementation Challenges

Although the hackathon was ultimately a successful experiential learning event, it did not run without challenges which needed to be overcome and could impact the future running of similar events. Feedback from the participants identified several areas where they may struggle, and proper scaffolding needs to be put in place to support better outcomes in the future.
These included cognitive overload – the event was highly intensive, leading to mental and physical fatigue. There were also evening community events to accompany the design events, which expanded the length of the day and forced interactions. Although enjoyed by most participants and added context, they were also found to be tiring and could be scaled back. There were issues with understanding the plan and process of the event. Sometimes, the programme must be flexible to allow students to be most

effective. However, schedule changes and communication with the participants could prove challenging with teams dispersed across the event space and broader region. This led to participants sometimes being unsure of what was being done or was happening next. Finally, a multi-national event provides an opportunity for cross-cultural collaboration, which can also bring challenges around language, understanding and cultural integration.

4 EDUCATIONAL IMPLICATIONS AND PEDAGOGICAL TOOLS

Hackathons, or design sprints, as pedagogical methods, provide a compelling approach to traditional course work or continuous assessment by immersing students in intense, unfamiliar and challenging situations which force experimental, creative and out-of-the-box thinking. Unlike traditional course work models, these approaches demand adaptability, rapid iteration and real-world validation. This experiential approach, especially when scaffolded with transdisciplinary voices of the wider problem space, allows students to engage more deeply with complex human-social and technical systems.

The hackathon model explored here shows an alternative approach to the conventional, technology-driven focus of design education and successfully demonstrates how a context-sensitive and experiential learning model can foster strong sustainability education and allow students to explore themes around inclusivity and sufficiency impactfully. Many participants of the Hackathon began the event with efficiency and technology-driven mindsets but, during the week, reconsidered their approach and believe that they have learned a new way to consider approaching design problems. Time will tell how well this lesson takes.

Although organisation of the Hackathon to this degree is not short of a complex operational administration, the simplified and focused approach that sprint like models provide allow students to truly engage with design challenges and, more importantly, work to address their understanding of the role of design, designers and technology in creating solutions that work for people and the communities they inhabit. By removing techno-solutionist thinking, students could design for sufficiency and purpose and, ultimately, for the end user.

The Low-Tech Hackathon framework provided by the project [10] provides a scalable and adaptable model to integrate experiential and sustainable focused learning into formal curricula. By linking and integrating the curricula of modules through combined and experiential events such as Hackathons, students can better understand and apply knowledge to enhance effectiveness. The hackathon outcomes demonstrate that when students are free to explore, collaborate, and question, they produce more thoughtful, resilient, and impactful solutions, a crucial shift toward a more sustainable and inclusive approach to design education.

5 CONCLUSIONS

The Erasmus+ project and the Low-Tech Hackathon specifically have demonstrated how changing the focus of design education from object-based design to socially oriented thinking can foster contextually appropriate, human-centred product innovation. Through working within real-world constraints, students were empowered to craft solutions that were embedded in broader social and environmental systems, reinforcing the importance of designing for sufficiency rather than efficiency. Through the events' design-sprint-like framework, participants were able to interact and engage deeply with the territorial challenges, co-create with local actors, and critically question their assumptions of technology and sustainability. The hackathon also demonstrated to participants that design solutions are most effective when considering the broader ecosystem rather than focusing solely on product innovation.

As we evolve design education, there is a growing need to embed Low-Tech, human-centred approaches into curricula, moving beyond high-tech solutionism toward place-based, inclusive, and sustainable design. Future teaching models should incorporate experiential, interdisciplinary learning frameworks like hackathons, which equip students with the skills to navigate complexity and engage meaningfully with local communities.

When considering the education of the next generation of designers, we must develop an approach responsive to global challenges, rooted in local knowledge, and adaptable to diverse socio-economic contexts. The Low-Tech Hackathon model provides a compelling template for this shift, demonstrating that when students are encouraged to explore, collaborate, and critically reflect, they develop more impactful, sustainable, and accessible solutions.

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