Hackathon

Sonia Massari, Sara Roversi, Steven Finn, Chhavi Jatwani, Alessandro Fusco, Erika Solimeo, Alessio Cavicchi, and Matteo Vignoli

Definition

The word hackathon results from the combination of two words: the first one, *hack* or *hacking*, is a term that derives from the Old English verb *haccian* ("cut in pieces") and recently, especially in the technological age, is used in the (investigative) programming field to overcome obstacles to accessing technological systems and information. The word element *thon* is related to *marathon* and refers to the ancient Greek city *Μαραθών* (Marathon) from where, according to legend, the messenger Pheidippides departed to arrive at the Acropolis in Athens to announce the victory of the Greeks over the Persians in 490 BC. Today, the term refers to the long-distance running competition.

Being a relatively recent word, as it was first used in the late 1960s in programming activities in the United States (Yarmohammadian et al. 2021, 1), hackathon combines the creative process outside the established rules (hack) and recalls the endurance and high degree of effort that is at the core of marathons (Briscoe and Mulligan 2014, 2). The nature of a hackathon is that of a collective challenge, in which participants – divided into teams and within a narrow time frame – have to overcome obstacles to come up with something new through collaborative dynamics. In detail, hackathons start from the definition of the problem to be solved, pass through the information needed to tackle it (including searching for available resources and existing solutions), and apply learnings to solve it, which also include imagining new ways to activate them. This structure is due to specific phases that characterize the hackathon and ensure its success: collective elaboration of the idea (Damen et al. 2019, 4), the realization of the project (Prieto et al. 2019), creation of the prototype (Karlsen and Løvlie 2017), verification using a test of the prototype (Rey 2017), presentation of the final product to an audience of people interested in the theme and especially in the proposed solutions (Gama et al. 2018). These phases are similar to those of a design thinking innovation process (Liedtka 2014). Considering their systemic approach (Nechkoska et al. 2023, 311), hackathons are increasingly gaining traction at the global and local scale.

Historically, hackathons originated in a specific sector: in information technology, where programmers and designers would gather for hours at a time to co-create innovative new software. Since its initial use, the hackathon has been applied to a variety of fields as an innovative transdisciplinary method of engaging as many stakeholders as possible to develop collaborative projects that respond to shared problems. Hackathons thereby contribute to the plurality of knowledge resources and enlarge the circle of knowledge producers.

Current hackathons are defined as interactive and cross-discipline events lasting from four to 36 hours, in which participants come together, discuss, and inform themselves to respond to a problem that they perceive in their community (work, housing, political, etc.). Participants, guided by experts and in thematic working groups, leverage their experiences and skills by devising solutions. At the conclusion of the hackathon, these solutions are presented to a panel of experts and stakeholders who will judge them on their feasibility and then identify a winning team. Hackathons, actively used nowadays in the world of education and training at different levels from elementary to higher education, have become a space to express oneself, collaborate, and be an active part of changing mindset and way of teaching and learning in a transdisciplinary way. Hackathons stimulate the enthusiasm of the different participants, allowing them to intensify relationships, and to join an educational community characterized by a high diversity of societal roles and educational biographies.

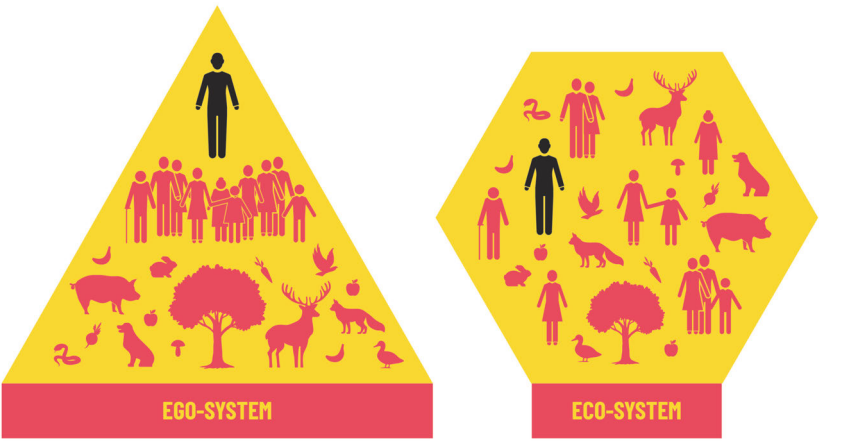
Background

Hackathons are the result of the capitalist market and were initially used as tools to foster digital innovation when digital technologies began to penetrate Western society (Uffreduzzi 2017; Yarmohammadian et al. 2021). After the rise of technologization exposed society to new challenges, hackathons began to be applied also in the business world: their approach, grounded in collaborative patterns, fostered the development of hackathons in research projects, design, and new solutions in the field of technology and digital innovation in the 1990s (Page et al. 2016, 246). During that period, when marketing strategies were focused exclusively on maximizing the needs of companies, hackathons boomed as tools to support companies in selling their products (Briscoe and Mulligan 2014).

In the early 2000s, when the markets in Europe and North America started to include the needs of the consumers, citizens, children, and families at the center of strategies (Richterich 2019), the hackathon started to play a role not only as a problem-solving tool but also for finding solutions closer to people's needs (human-value centered) through design thinking methods (Bell 2008). Hackathons were used as a fast problem-solving technique, drawing the attention of a trans-

disciplinary group of experts or novices to specific problems. The joint sleepless effort of this group created viable solutions for the given problem that could be implemented after a process of refinement. Scholars acknowledge that the hackathon approach has recently been hybridized with human-centered design to overcome the problem of obtaining technologically impressive solutions that lack a deep understanding of the problems from the users' point of view, always with an accelerated pace of implementation (Mincolelli et al. 2020). In the 2010s, several cases confirm that hackathons were also developed in non-Western countries, such as Asia and Africa (Chen 2018; Ghouila et al. 2018) as a tool to support farmers, to connect and empower citizens, and to expand scientific discoveries. More recently, civil society and leaders started to consider that the needs of humans pose the risk of ignoring systemic and complex problems such as climate change, biodiversity loss, or deforestation (Lodato and DiSalvo 2015). These challenges that global society has been facing have changed the scope and breadth of the problems that need to be hacked (Flores et al. 2018; Nechkoska et. al. 2023; Vignoli et al. 2021). New design methodologies were increasingly applied in hackathons to support the shift from ego-systems (characterized by a pyramidal approach where humans are at the peak) to eco-systems (Scharmer 2013), and embrace a more inclusive perspective.

Figure 1. Graphical representations of the Ego-system and Eco-system models. Source: Scharmer 2013.



One example is *prosperity thinking*, a design innovation methodology first developed in 2019 (Vignoli et al. 2021, 1801). Its aim is to reconnect and simultaneously consider both human and planetary needs in creative sessions. Prosperity thinking differs considerably from the prosperity thinking mindset as it emerged in

the late 1990s, which is grounded in the attitude towards "abundance, confidence, and gain" (Napolitano 1999, 3), and goes beyond the concept of prosperity thinking intended to achieve a prosperous life as proposed by Gallamore (Gallamore and Gallamore 2011, 78).

The Hackathon model and approach, when implemented with prosperity thinking design innovation methodology, is a rapid problem-solving tool that considers people's needs within the limits of the planet, therefore breaking down complex problems. The participants work in solution hunting, building artifacts to make ideas tangible (Dorst 2011), and in community co-design and testing. Most hackathons end up in project presentations that shed light on new ways of solving complex problems at local and more specific levels (macro, meso, micro) while generating multiple solution alternatives (Lewis et al. 2015; Soligno et al. 2015). For example, the hackathon virtually launched by AccelerateEstonia, Garage48, and Guaana (Global Hack) in 2020 with the goal of hacking health and wellness issues triggered by the global pandemic was a perfect example of how hackathons can become tools in support of complex and multidisciplinary issues (Flood 2020). This 48-hour online hackathon virtually gathered startups and tech teams, global leaders and industry experts, policymakers, media, and investors to turn ideas into rapidly implementable solutions on well-being, mental well-being, and relations, medicine, work and productivity, human resources, leadership, and environment (including climate actions, sustainability, and clean energy). These aspects are increasingly favoring the use of hackathons in schools and universities applied not to maximize their commercial application but to generate social and cultural impacts.

A hackathon is a transdisciplinary method of teaching and learning as it applies participatory and cooperative techniques (Hope et al. 2019). It proposes and invites rigorous, inclusive, and creative work and thereby takes from a high plurality of available knowledge resources. Recognizing the multiplicity and interconnectedness of the various dimensions of the real world, transdisciplinarity has the ambition to cross boundaries that separate paradigms, rigid institutional norms, and disciplinary labels.

Various diversities come together to face challenges during a hackathon: participants create groups of three to five people, and form personal relationships with each other due to the intensity of the project; it is an opportunity for enrichment, and participants are engaged by a facilitator and a team of tutors and judged by a panel of experts. Multidimensionality, inclusiveness, and creativity are the terms that denote the transdisciplinary approach of the hackathon. Today hackathons can involve increasingly large groups and, through the use of the internet, even those located in different geographic areas. In addition, there are several web platforms available for free, which can be used to share results and make communication during hackathons easy and effective.

This type of teaching methodology has a threefold goal: to strengthen the community involved, to attract and welcome diversity, and to provide an opportunity for all participants to learn. In the case of training, teachers are an integral part of this co-learning process. The transdisciplinary hackathon method is certainly not easy to pursue, but it is also the current bet for particular and broad areas of research (such as those on co-creation processes).

Debate and criticism

The addition of hackathons into the educational system is an added value, as hackathons are tools that emphasize teamwork and collaboration, ensure bi-directional exchanges, stimulate dialogue, questions, and critical thinking in students, and can support in-presence lessons to shape the professional figures of the future (Holley 2009; Huerta and Romaní 2022). In this sense, hackathons can guide students toward a holistic and ecosystemic overview of problems (and solutions), enhancing interconnection and transdisciplinarity (Massari 2021, 320). Though hackathons were not initially conceived as educational, didactic tools, increasing literature is proving their potential and increasing applicability as a teaching and learning tool in class (Wallwey et al. 2022).

Similarities and connections can be identified between the hackathon's three moments (involvement of people, search for solutions, and action for the realization of the solutions) and the process followed by teachers in designing lessons. Lessons, just like hackathons, are aimed at helping the students acquire knowledge. A hackathon can therefore be compared to a learning unit and indeed can be accurately defined as challenge-based learning (Leijon et al. 2021; Malmqvist et al. 2015; Nichols and Cator 2008). Significant differences between the challenge-based model and the traditional model subsist. In a traditional model, students expect first to receive the information they need to understand the learning content, then memorize that information, and finally apply it to a problem. In challenge-based learning, on the other hand, the problem to be solved is posed first, and only afterward are the students asked to figure out where to acquire the necessary information and how to apply it to solve the problem (Gallagher and Savage 2020; Leijon et al. 2021). Whereas in the first case, learning is based on solving the problem according to a functional approach, the second approach defines learning as challenge-based and follows a systemic perspective (Sternad 2015, 252).

A similar approach is project-based learning, a method of learning based on the realization of projects (Krajcik and Blumenfeld 2005). In this case, the differences between the two approaches are less pronounced but still significant. Project-based learning can be carried out individually or in groups, in which case it is the teacher who defines a problem and identifies steps to solve it. Challenge-based

learning, on the other hand, involves only group work. It is the students themselves who define the problem, identify the steps, and create the solution. Nonetheless, in both cases, real-world problems are tackled, students are at the center of the activity, and the teacher takes the roles of a guide and a learner at the same time. The ideal *forma mentis* of a teacher approaching such methodologies is openness to innovation.

It is precisely in the common area between these two approaches that the main characteristics of the hackathon are identified. The hackathon is configured as a strategy for inclusive and collaborative teaching (Flus and Hurst 2021) that has many entry points (to the problem) and many solutions, allowing it to focus on global problems and develop local solutions (Decker et al. 2015, 4). In addition, it allows connection with multiple disciplines (Yarmohammadian et al. 2021) and represents an opportunity to develop competencies and useful skills (Cwickel and Simhi 2021), including soft skills (Decker et al. 2015, 3) as well as targeted use of the internet and digital tools for organization, collaboration, and sharing (Wallwey et al. 2022). Applied to education, hackathons could therefore represent a key tool to offer students the chance to foster active learning (learning by doing rather than learning by listening), become responsible for their own learning (a process that can trigger a sense of agency as responsible citizens), and learn to face collective and transdisciplinary challenges.

Although a hackathon as a methodology is usually associated with the challenge-based approach, typically applied in entrepreneurial environments (Gregg 2015), challenge-based learning can be used in class settings and has a high impact on the learning process, fosters collaborative creativity and provides benefits to the class (Hope et al. 2019, Lodato and DiSalvo 2015). In addition, challenge-based learning has added to new ways of teaching and experiential learning in class and has influenced (both tangible and intangible) teaching methods and the role of the teacher, which can now be considered not just as coordinators of activities but as real facilitators of interactions among students and between students and societal actors (mentors, stakeholders, and other collaborators).

Current forms of implementation in higher education

The aforementioned potential of hackathons applied in education has also been supported by concrete examples. Applied at the local and global levels, hackathons are already being used as examples to teach and learn in virtual, hybrid, and in-presence formats while being applied to many different critical topics.

The role of hackathons in supporting and widening civic engagement in schools is exemplified by the hackathon on civic education, which was co-organized by the Association Amore per il Sapere (Apis) and the Future Food Institute

in April 2021. This virtual hackathon was able to connect students of different ages and teachers around Italy. The challenges that students needed to hack were culture, wood, education, water, social innovation, food waste, companies, and territory. For each challenge, students could rely on the support of teachers, who were properly trained in advance to introduce the hackathon as an active teaching methodology, and of professionals working on the topic's relation to the challenge, to make their solutions viable.

The hackathon on community engagement, organized by the Paideia Campus in Pollica, Italy, in 2022, represents an example of a hackathon used for connecting formal educational environments to local community engagement. The main purpose was to find innovative solutions in the service of the cultural, social, and economic regeneration of the local territory, by gathering people from different sectors, ages, and experiences. Different community-based hackathons actively involved local citizens (outdoor lovers, community engagers, educators, and children) in designing new solutions to local problems. Local elementary schools and teachers were involved in all the intergenerational and transdisciplinary challenge-based dynamics.

Another application of a hackathon in higher education and geographically dislocated in different areas was the hackathon (called "Foodathon") organized both physically and virtually by the University of Wageningen (Netherlands) in 2018 grounded on the challenge of food security. As part of a conference on food and global hunger, the Foodathon was a special competition organized to engage students in achieving SDG 2 (Zero Hunger) and creating local solutions to the challenges of food systems. Geographically and culturally diverse participants had a 36-hour time frame to create intercultural and multidisciplinary teams and hack problems such as policy coherence for food production, food security and genetic diversity, sustainable dietary patterns, rural–urban linkages for food security, financing mechanisms to achieve SDG2, and circular food systems.

There have also been cases where hackathons have been applied by one single university but involved different departments and disciplines. The hackathon organized by the University of Pisa (Italy) and the Pisa Contamination Lab (CLab Pisa) in October 2022 started from the challenge of mobility and digital transformation fields and was aimed at fostering digital solutions in the agrifood and urban mobility sector for the creation of scalable and sustainable business models in compliance with the SDGs. Students, researchers, Ph.D. candidates, and professors from different departments of Pisa were asked to find a common language and a way to co-create digital and collaborative solutions for transparency and efficiency in food supply chains; city–country logistics and food and beverage delivery; food waste reduction and food recovery; healthier and more sustainable food regimes; and conscious, responsible and more sustainable better tourism in rural areas.

These examples are not exhaustive but are indicative of hackathons as a process and methodology that can promote and spread a culture of innovation and transdisciplinarity in schools at all levels, while also enabling participants to acquire tools and skills in planning, organization, communication, and soft skills. The examples aim to maximize the potential of hackathons as teaching tools and as a powerful example of a training scenario (for both students and teachers) for informal learning.

Finally, the cases demonstrate a hackathon as a method and approach able to engage an intergenerational, multidisciplinary, and multi-geographic group. The outcomes and impacts of a hackathon are both tangible (new and innovative final products, services, and systems) and intangible (new processes of learning, discussion, cross-cultural contaminations, new mindsets). On the one hand, a hackathon has a long-term impact as it supports teamwork and the value of diversity. The hackathon in education highlights how it is possible to co-create new physical and *phygital* (both digital and physical) spaces to reinvent the interaction between actors, schools, and local communities through experiences. As the cases presented here demonstrate, the most significant outcomes are often intangible and long-term: participants are "forced" to think with an ecosystemic perspective and propose solutions related to the entire value chain (production, distribution, marketing, consumption, post-consumption, and circularity to be related), embracing multi-level interaction to improve the ecosystem as a whole. The hackathon touches on diverse themes and issues as the cases present them: health and wellness, mental well-being and relationships, medicine, labor and productivity, human resources, leadership, environment (including climate action, sustainability, and clean energy), economics, banking, education, poverty, arts, and governance. The tangible short-term results of the hackathon are that it enables prototyping, testing, evaluating failures, and creating solutions that can generate change.

The aforementioned cases demonstrate not only the positive potential of the hackathon, but also the major difficulties: acquiring the methodologies of open innovation, working in teams, and facing multicultural and intergenerational difficulties. Through the hackathon, one can experience agility, learning to focus on the real needs to be met or the problems to be solved. A hackathon is therefore a strenuous but highly engaging and, at times, fun experience for all participants. It is no coincidence that global leaders, politicians, media, and investors today rely on the application of hackathon sessions to transform ideas into rapidly implementable solutions for positive impact on the community and for prototyping and implementation of solutions.

References

Bell, Steven. 2008. Design thinking. *American Libraries* 39 (1/2): 44–49.

Briscoe, Gerard, and Catherine Mulligan. 2014. *Digital innovation: The hackathon phenomenon*. Available from https://qmro.qmul.ac.uk/xmlui/bitstream/handle/123456789/11418/Briscoe%20Digital%20Innovation:%20The%20Hackathon%20Phenomenon%202014%20Published.pdf?sequence=2.

Chen, Liang-Chih. 2018. Developing technologies or learning institutions? Exploring the role of hackathons for developing innovation capability in emerging economies: The case of Taiwan. *Asian Journal of Technology Innovation* 26 (2): 202–21.

Cwikel, Julie, and Meital Simhi. 2021. Using the hackathon model in social work education. *International Journal of Social Work Education* 41(8): 1563-76.

Damen, Ida, Rens Brankaert, Mengru Xue, Xiaoyue Chen, Anne Grave, and Steven Vos. 2019. *Root: A multi-disciplinary approach to urban health challenges with HCI*. Available from https://dl.acm.org/doi/10.1145/3290607.3299051.

Decker, Adrienne, Kurt Eiselt, and Kimberly Voll. 2015. Understanding and improving the culture of hackathons: Think global hack local. *IEEE Frontiers in Education Conference* (FIE). Available from https://ieeexplore.ieee.org/document/7344211.

Dorst, Kees. 2011. The core of "design thinking" and its application. *Design Studies* 32 (6): 521–32.

Flood, Gary. 2020. *World's largest ever hackathon starts today to develop COVID-19 solutions*. Available from https://www.thinkdigitalpartners.com/news/2020/04/09/worlds-largest-ever-hackathon-starts-today-to-develop-covid-19-solutions/.

Flores, Myrna, Matic Golob, Doroteja Maklin, Martin Herrera, Christopher Tucci, Ahmed Al-Ashaab, Leon Williams, Adriana Encinas, Veronica Martinez, Mohamed Zaki, Lourdes Sosa, and Karina Flores Pineda. 2018. *How can hackathons accelerate corporate innovation?* Available from https://link.springer.com/content/pdf/10.1007/978-3-319-99704-9_21.pdf.

Flus, Meagan, and Ada Hurst. 2021. Design at hackathons: New opportunities for design research. *Design Science* 7: E4.

Gallagher, S. Elena, and Timothy Savage. 2020. Challenge-based learning in higher education: an exploratory literature review. *Teaching in Higher Education* 1–23. Available from https://www.tandfonline.com/doi/abs/10.1080/13562517.2020.1863354?journalCode=cthe20.

Gallamore, Larry E., and Jan Burk Gallamore. 2011. *Prosperity thinking: Recession-proof thinking*. Bloomington, IN: Balboa Press.

Gama, Kiev, Breno Alencar, Filipe Calegario, and Andre Neves. 2018. A hackathon methodology for undergraduate course projects. *IEEE Frontiers in Education Conference* 1–9. 2018 IEEE Frontiers in Education Conference (FIE)Oct 2018, 1-9.

Ghouila, Amel, Geoffrey Henry Siwo, Jean-Baka Domelevo Entfellner, Sumir Panji, Katrina A. Button-Simons, Sage Zenon Davis, and Faisal M. Fadlelmola, The DREAM of Malaria Hackathon Participants, Michael T. Ferdig, and Nicola Mulder. 2018. Hackathons as a means of accelerating scientific discoveries and knowledge transfer. *Genome Research* 28: 759–65.

Gregg, Melissa. 2015. FCJ–186 Hack for good: Speculative labour, app development and the burden of austerity. *Fibreculture Journal* 25: 183–201.

Holley, Karry A. 2009. Understanding interdisciplinary challenges and opportunities in higher education. *ASHE Higher Education Report* 35, 1–131.

Hope, Alexis, Catherine D'Ignazio, Josephine Hoy, Rebecca Michelson, Jennifer Roberts, Kate Krontiris, and Ethan Zuckerman. 2019. *Hackathons as participatory design: Iterating feminist utopias*. Available from https://dl.acm.org/doi/pdf/10.1145/3290605.3300291.

Huerta, H. Gardó, and Riera J. Romaní. 2022. Marco de competencias para el análisis de hackatones cívicas de transformación educativa. *Edutec. Revista Electrónica de Tecnología Educativa* 82: 9–28.

Karlsen, Joakim, and Anders Sundnes Løvlie. 2017. "You can dance your prototype if you like": Independent filmmakers adapting the hackathon. *Digital Creativity* 28 (3): 224–39.

Krajcik, Joseph, S., and Phyllis C. Blumenfeld. 2005. Project-based learning. In *The Cambridge handbook of learning sciences*, ed. R. Keith Sawyer, 317–34. Cambridge, MA: Cambridge University Press.

Leijon, Marie, Petri Gudmundsson, Patricia Staaf, and Cecilia Christersson. 2021. Challenge based learning in higher education – A systematic literature review. *Innovations in Education and Teaching International* 59(5): 609–18.

Lewis, Bridget A., James Parker, Lara W. S. Cheng, and Marc Resnick. 2015. UX day design challenge: Hackathon to apply rapid design ideation to a practical user experience challenge. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 59(1): 304–6.

Liedtka, Jeanne. 2014. Perspective: Linking design thinking with innovation outcomes through cognitive bias reduction. *Journal of Product Innovation Management* 32 (6): 925–38.

Lodato, Thomas J., and Carl DiSalvo. 2015. Issue-oriented hackathons as material participation. *New Media and Society* 18 (4), 539–57.

Malmqvist, Johan, Kamilla Kohn Rådberg, and Ulrika Lundqvist. 2015. *Comparative analysis of challenge-based learning experiences*. Available from https://publications.lib.chalmers.se/records/fulltext/218615/local_218615.pdf

Massari, Sonia. 2021. Transforming research and innovation for sustainability: *Transdisciplinary design for future pathways in agri-food sector.* In Transdisciplinary case studies on design for food and sustainability, ed. Sonia Massari, 315–26. Cambridge: Woodhead.

Mincolelli, Giuseppe, Nicolò Cocchi, Clio Dosi, and Matteo Vignoli. 2020. "OPER. TEN" transform emergency now! Facing Covid-19 with open innovation and human centered design. *Strategic Design Research Journal* 13(3): 658–68.

Napolitano, John P. 1999. American Institute of Certified Public Accountants *Planner: Ideas from leading experts in financial planning*. Available from https://egrove.olemiss.edu/cgi/viewcontent.cgi?article=3971&context=aicpa_news.

Nechkoska, Renata P., Antonia C. Gonzalez, Alberto Bertello, Simona Grande, Marc Schmüser, Nataliia Rzhevska, Yulia Matskevich, Milen Baltov, Urska Jez, Eugenio Clavijo, Ekaterina Tsaranok, Montserrat D. Marín, Raouf Hajji, Rui Couto, Karolina Bolesta, Sara Abou Ibrahim, Elena Poughia, Man Yang, Paola De Bernardi, Geert Poels, Gordon Müller-Seitz, and Marcel Bogers (2023). Multi-vortex tornado blueprint for disruptive global co-creation (inspired by EUvsVirus). In *Facilitation in complexity: Contributions to management science*, eds. Petrevska R. Nechkoska, Gjorgji Manceski, and Geert Poels, 307–62. Cham: Springer.

Nichols, Mark H., and Karen Cator. 2008. *Challenge based learning white paper.* Cupertino, CA: Apple.

Page, Finlay, Sylvester Sweeney, Fraser Bruce, and Seaton Baxter. 2016. *The use of the "hackathon" in design education: An opportunistic exploration*. Available from https://www.designsociety.org/publication/39074/.

Prieto, Marcello, Krishnan Unnikrishnan, Colin Keenan, Kaochoy Danny Saetern, and Wendy Wei. 2019. *Designing for collaborative play in new realities: A values-aligned approach*. Available from https://ieeexplore.ieee.org/document/8811545.

Rey, Stéphanie. 2017. Museomix: *Lessons learned from an open creative hackathon in museums*. Available from https://ceur-ws.org/Vol-1861/paper7.pdf.

Richterich, Annika. 2019. Hacking events: Project development practices and technology use at hackathons. *Convergence: The International Journal of Research into New MediaTechnologies* 25 (5–6): 1000–26.

Scharmer, Otto. 2013. *From ego-system to eco-system economies*. Open Democracy. Available from https://www.opendemocracy.net/en/transformation/from-ego-system-to-eco-system-economies.

Soligno, Roberta, Francesco Scorza, Federico Amato, Giuseppe Las Casas, and Beniamino Murgante. 2015. Citizens participation in improving rural communities quality of life. In *Computational science and its applications – ICCSA 2015* Vol 9156, eds. Osvaldo Gervasi, Beniamino Murgante, Sanjay Misra, Marina L. Gavrilova, Ana Maria Alves Coutinho Rocha, Carmelo Torre, David Taniar, Bernady O. Apduhan, 731–46. Cham: Springer.

Sternad, Dietmar. 2016. A challenge-feedback learning approach to teaching international business. *Journal of Teaching in International Business* 26(4): 241–57.

Uffreduzzi, Massimo. 2017. *Hackathon as emerging innovation practice: Exploring opportunities and challenges through 8 in-depth case studies*. Milano: Politecnico di Milano.

Vignoli, Matteo, Sara Roversi, Chhavi Jatwani, and Margherita Tiriduzzi. 2021. Human and planet centered approach: Prosperity thinking in action. *Proceedings of the Design Society* 1: 1797-1806

Wallwey, Cassie, Meris M. Longmeier, Donnelley Hayde, Julia Armstrong, Rachel Kajfez, and Renee Pelan. 2022. Consider "HACKS" when designing hackathon challenges: Hook, action, collaborative knowledge sharing. *Frontiers in Education*, 7 (95-104).

Yarmohammadian, Mohammad H., Monsef Sanaz, Shaghayegh Haghjooy Javanmard, Youseph Yazdi, and Mostafa Amini-Rarani. 2021. The role of hackathons in education: Can hackathon improve health and medical education? *Journal of Educational Health Promotion* 10 (1): 334–39.