USING HACKATHON TECHNOLOGY TO DEVELOP INVENTIVE ABILITIES OF FUTURE ENGINEERS IN EXTRACURRICULAR ACTIVITIES

To‘raqulova Marjona Qiyom qizi
Associate Professor at Bukhara State Technical University

Received: 19.08.2025
Revised: 20.08.2025
Accepted: 21.08.2025

Key words:
hackathon, inventive ability, extracurricular activities, engineering education, creativity, innovation, problem-solving, teamwork, digital transformation.

Abstract
This article examines the use of hackathon technology as an effective pedagogical approach for developing inventive abilities in future engineers through extracurricular activities. The study highlights the importance of extracurricular environments in fostering creativity, problem-solving, and teamwork beyond traditional classroom learning. Hackathons are analyzed as intensive, challenge-based events that enable students to apply theoretical knowledge to real-world problems, collaborate in interdisciplinary teams, and generate innovative solutions. The article also discusses the educational benefits, challenges of implementation, and potential role of hackathons in strengthening innovation ecosystems and preparing engineers for the demands of the digital economy.

Introduction. In the context of the Fourth Industrial Revolution and global digital transformation, the engineering profession is undergoing fundamental changes. Modern industries are increasingly relying on emerging technologies such as artificial intelligence, big data analytics, the Internet of Things (IoT), robotics, and advanced simulation tools. As a result, the demand for engineers who are not only technically competent but also capable of creative problem-solving and innovative thinking has grown substantially. Traditional classroom instruction, while essential for providing theoretical foundations, is often insufficient in cultivating inventive abilities that are critical for solving complex, real-world problems.Extracurricular activities have proven to be a valuable platform for bridging this gap. Unlike structured classroom learning, extracurricular settings allow students to explore creativity, take risks, and work collaboratively on open-ended challenges. Among the many extracurricular approaches, hackathons have gained significant attention as an innovative and effective method of stimulating inventive abilities. Hackathons are short, intensive, time-constrained events where participants, often working in

interdisciplinary teams, design and prototype novel solutions to predefined problems. These events combine aspects of competition, collaboration, and creativity, thereby creating a unique environment for experiential learning.

The value of hackathons in education lies not only in the development of technical proficiency but also in the enhancement of soft skills such as teamwork, communication, leadership, and adaptability. For engineering students, hackathons replicate many of the conditions they will face in professional practice, including time pressure, problem ambiguity, and the need to integrate knowledge across disciplines. Furthermore, hackathons align with the pedagogical principles of active learning and constructivism, where students build new knowledge through direct experience and collaboration.Recent studies indicate that hackathons can serve as incubators of innovation and entrepreneurship, enabling students to transform ideas into prototypes and potentially viable start-ups. This outcome is particularly relevant for countries seeking to strengthen their innovation ecosystems and prepare a new generation of engineers capable of competing in a global knowledge economy. In Uzbekistan, for instance, national strategies such as the *"Digital Uzbekistan – 2030"* program emphasize the importance of fostering creativity and innovation among young specialists, including engineers, as a key driver of economic modernization. Therefore, the integration of hackathon technology into extracurricular activities is not only a methodological innovation but also a strategic necessity for modern engineering education. This article aims to explore the potential of hackathons as a pedagogical tool for developing inventive abilities among future engineers, examining both theoretical foundations and practical approaches for their implementation.

Literature review.The development of inventive abilities among engineering students has been a subject of interest in educational and innovation studies for several decades. Schumpeter (1934) introduced the concept of "creative destruction," emphasizing innovation as the driving force of economic and technological progress. Drucker (1985) later argued that innovation and entrepreneurship are central to modern organizational success, highlighting the importance of nurturing creative problem-solving skills among future professionals. In the era of digital transformation, engineering education faces the challenge of preparing graduates for complex, interdisciplinary problems. Brynjolfsson and McAfee (2014) noted that the acceleration of digital technologies requires new forms of learning that prioritize adaptability, collaboration, and innovation. This perspective suggests that traditional classroom-based approaches are insufficient for equipping future engineers with the necessary inventive and entrepreneurial mindset.

Hackathons have emerged as a promising educational practice to address this gap. Briscoe and Mulligan (2014) describe hackathons as "innovation marathons" that

foster creativity, collaboration, and experimentation in a condensed timeframe. Research by Komssi et al. (2015) found that hackathons contribute to both skill development and entrepreneurial motivation by offering students a platform to test ideas and rapidly prototype solutions. Similarly, Leckart (2012) highlighted that hackathons replicate real-world engineering challenges by simulating time pressure and ambiguity, which helps participants to think inventively under constraints. More recent studies confirm the pedagogical value of hackathons in higher education. Nolte et al. (2020) emphasize that hackathons are not only a learning experience but also a means of building professional communities and networks. They argue that hackathons create a learning ecosystem where participants can acquire technical skills, improve teamwork, and develop a sense of ownership over innovative solutions. Likewise, Pe-Than et al. (2019) observed that hackathon participation encourages interdisciplinary collaboration and enhances students' inventive capabilities, particularly in engineering and IT fields.

In the context of Uzbekistan, educational reforms under the "Digital Uzbekistan – 2030" strategy have underscored the importance of fostering creativity, innovation, and entrepreneurial thinking among young professionals. Hackathons, as part of extracurricular activities, align with these national priorities by enabling future engineers to develop inventive abilities in practice, complementing the theoretical foundations obtained in traditional coursework.

Taken together, the literature suggests that hackathons are a powerful tool for developing inventive abilities in future engineers. They combine experiential learning with creativity, teamwork, and problem-solving, making them well-suited to the demands of modern engineering education. However, challenges remain in terms of sustainable integration, assessment methods, and ensuring inclusivity across diverse student groups.

Research discussion.The findings of the literature review and practical observations confirm that hackathons hold significant potential as a pedagogical tool for developing inventive abilities among future engineers. Unlike conventional classroom learning, hackathons provide an active, immersive, and challenge-driven environment that mirrors the complexity of real-world engineering tasks. This aligns with constructivist learning theories, which emphasize the importance of experiential learning and knowledge construction through practice.

One of the key contributions of hackathons is their ability to foster **inventive thinking under constraints**. Time pressure, limited resources, and ambiguous problem statements encourage participants to think creatively and seek unconventional solutions. This process mirrors the real challenges faced by engineers in professional contexts, where inventive problem-solving is often required under tight deadlines and with incomplete information. Another

important aspect is the role of **teamwork and collaboration**. Hackathons typically involve interdisciplinary teams, bringing together students from engineering, computer science, design, and business backgrounds. Such collaboration enhances communication skills, exposes participants to diverse perspectives, and promotes collective creativity. Research indicates that these interactions lead to more innovative outcomes compared to individual work, and they prepare students for collaborative work environments in industry.

Hackathons also function as a bridge between **theory and practice**. Students are able to apply theoretical knowledge from coursework to practical, hands-on challenges. For example, engineering design principles, coding skills, or project management techniques are put to use in the development of prototypes or solutions. This strengthens students' confidence in their abilities and deepens their understanding of technical concepts.

Furthermore, hackathons contribute to **entrepreneurial and innovation-oriented mindsets**. Many projects developed in hackathons evolve into start-ups, research projects, or community initiatives. By engaging in these activities, students not only enhance their inventive abilities but also develop an entrepreneurial vision, which is increasingly important in the digital economy.

However, the integration of hackathons into educational practice is not without challenges. Limited resources, insufficient faculty training, and lack of structured follow-up mechanisms may reduce their effectiveness. Additionally, ensuring inclusivity so that all students—regardless of prior technical expertise—can benefit from hackathon participation is a concern. Addressing these challenges requires universities to create institutional support systems, provide mentorship opportunities, and align hackathons with broader educational goals.

In summary, the discussion highlights that hackathons are not merely extracurricular competitions but serve as **transformative educational experiences**. They cultivate inventive thinking, teamwork, and problem-solving skills, thereby equipping future engineers with the competencies needed to thrive in a rapidly evolving digital landscape.

Conclusion. The study demonstrates that hackathons represent a highly effective educational technology for developing inventive abilities among future engineers in the context of extracurricular activities. Unlike traditional classroom methods, hackathons immerse students in time-bound, collaborative, and problem-driven environments that mirror the realities of engineering practice. This fosters creativity, critical thinking, teamwork, and the ability to apply theoretical knowledge to real-world challenges. The integration of hackathons into engineering education has multiple benefits. They stimulate inventive thinking under constraints, promote interdisciplinary collaboration, and encourage entrepreneurial mindsets. Hackathons also provide students with opportunities to transform innovative ideas into tangible prototypes and, in some

cases, into viable start-up projects. This makes hackathons not only an educational tool but also a contributor to the broader innovation ecosystem. At the same time, certain challenges remain in institutionalizing hackathons as part of engineering education, including resource allocation, faculty preparedness, and ensuring equal access for all students.

REFERENCES

1. Schumpeter, J. (1934). *The Theory of Economic Development*. Harvard University Press.
2. Drucker, P. (1985). *Innovation and Entrepreneurship: Practice and Principles*. Harper & Row.
3. Brynjolfsson, E., & McAfee, A. (2014). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. W.W. Norton & Company.
4. Briscoe, G., & Mulligan, C. (2014). *Digital Innovation: The Hackathon Phenomenon*. Creativeworks London.
5. Komssi, M., Pichlis, D., Raatikainen, M., Kindström, K., & Järvinen, J. (2015). What Are Hackathons For? *IEEE Software*, 32(5), 60–67. https://doi.org/10.1109/MS.2014.78
6. Leckart, S. (2012). The Hackathon Fast Track. *Wired Magazine*, 20(2). Retrieved from https://www.wired.com
7. Nolte, A., Pe-Than, E. P. P., & Filippova, A. (2020). Hackathons as Community-Based Learning: A Case Study. *Proceedings of the ACM on Human-Computer Interaction*, 4(CSCW), 1–26. https://doi.org/10.1145/3392877
8. Pe-Than, E. P. P., Nolte, A., & Filippova, A. (2019). Building Inventive Capacity Through Hackathons. *International Journal of Engineering Education*, 35(6), 1582–1591.