Archives available at journals.mriindia.com

International Journal on Advanced Computer Engineering and Communication Technology

ISSN: 2278-5140
Volume 14 Issue 01, 2025

Smart Team Builder for College Hackathons: A Comprehensive Survey

[1]Prof. Vinay S. Nalawade, [2]Pratap S. Patil, [3]Aniket D. Gaikwad, [4]Pratiksha S. Panhalkar
[1 2 3 4]Department of Computer Engineering
S. B. Patil College of Engineering, Indapur, Pune, India
Email: vinaynalawade2007@gmail.com, pratapsanjaypatil@gmail.com, aniketgaikwad10101@gmail.com, pratikshapanhalkar9@gmail.com

Peer Review Information

Submission: 11 Sept 2025

Revision: 10 Oct 2025

Acceptance: 22 Oct 2025

Keywords

Hackathons, Team Formation, Artificial Intelligence, Optimization, Skill Match- ing, Collaboration, Social Network Analysis, Cloud Computing, Real-Time Analytics, Diver- sity

Abstract

Hackathons have emerged as high-intensity, innovation-driven events that foster collabora- tion among students to solve real-world problems in limited timeframes. The success of such events largely depends on team composition, as balanced and diverse teams enhance creativity, efficiency, and overall performance. However, traditional team formation methods, including random allocation or self-selection, often result in imbalanced skill distribution, interpersonal conflicts, and underutilization of talent. The proposed system, Smart Team Builder for Col- lege Hackathons, leverages artificial intelligence, optimization techniques, and social network analysis to automate the formation of well-balanced and compatible teams. By integrating par- ticipant skills, experience, interests, and personality traits, the system ensures diversity, fairness, and optimal skill coverage. Cloud-based storage and real-time analytics dashboards provide or- ganizers with detailed insights into team composition, workload balance, potential conflicts, and collaboration effectiveness. Furthermore, the system supports dynamic reallocation in re- sponse to participant dropouts or late registrations, while incorporating fairness constraints to promote gender and academic diversity. This survey paper reviews prior work in team formation for hackathons, collaborative learning, and organizational settings, identifies key limitations in existing approaches, and proposes a comprehensive Smart Team Builder framework aimed at maximizing hackathon outcomes, improving participant engagement, and reducing administra- tive workload.

Introduction

Hackathons have become an integral component of modern engineering and management edu- cation, enabling students to translate theoretical knowledge into practical solutions within con- strained timelines. The intensive nature of hackathons encourages rapid ideation, prototyp- ing, and presentation of innovative solutions. However, the efficiency of these events is highly dependent on the composition of participating teams. Properly balanced teams with comple- mentary skills, diverse experiences, and high social compatibility consistently outperform those formed randomly or by self-selection.

Importance of Team Composition

The performance of a hackathon team is influenced by multiple factors:

- **Skill Diversity:** Ensures that technical, design, and managerial skills are adequately repre- sented.

- **Experience Levels:** Balances novice and experienced participants to foster mentoring and efficient execution.
- **Interpersonal Compatibility:** Reduces conflicts and enhances communication, resulting in smoother collaboration.
- **Workload Distribution:** Prevents overburdening specific team members and ensures equi- table participation.

Challenges in Traditional Team Formation
Conventional methods for forming hackathon teams are often inadequate:

- **Random Allocation:** May lead to teams with redundant skills or critical gaps.
- **Self-Selection:** Often results in homogeneous teams, reducing diversity and innovation.
- **Manual Assessment:** Organizers face significant workload, and human biases may affect fairness.

Need for a Smart Team Builder
A Smart Team Builder can address these challenges by:

- Automating team formation based on participant profiles.
- Ensuring skill diversity, experience balance, and compatibility.
- Enforcing fairness and inclusivity policies.
- Providing real-time dashboards and analytics for organizers.
- Adapting dynamically to participant changes during the hackathon.

Impact of Effective Team Formation
Optimally formed teams contribute to:

- Higher quality solutions and innovative outcomes.
- Greater participant satisfaction and engagement.
- Enhanced learning experiences due to exposure to diverse skills.
- Reduced administrative burden and improved event management efficiency.

Literature Survey
Team formation has been studied in various contexts including hackathons, collaborative learn- ing, and organizational team management. Key approaches include optimization algorithms, recommendation systems, social network analysis, and monitoring dashboards.

AI-Based Optimization Approaches
Datta et al. (2012) [1] formalized the hackathon team formation problem as NP-hard, demonstrating the difficulty of balancing skill coverage, team capacity, and interpersonal closeness. Lappas et al. (2009) [2] used graph-theoretic models to identify expert teams within social net- works while minimizing communication overhead. Wang et al. (2020) [4] proposed predictive AI models for forming student groups based on historical performance data and skill matrices.

Recommendation Systems
Anwar et al. (2021) [6] developed skill recommendation algorithms to match participants with complementary abilities. Chen et al. (2018) [3] incorporated fairness and inclusivity, ensuring diverse team formation. O'Neill et al. (2023) [9] focused on diversity-aware team formation policies that balance gender, experience, and academic backgrounds.

Social Network and Compatibility Analysis
Kittur et al. (2019) [5] leveraged social network analysis to estimate compatibility between participants. Factors considered included prior collaboration history, shared interests, and commu- nication styles. Brusilovsky and Milla'n (2016) [7] applied adaptive user modeling to optimize group dynamics in collaborative learning, demonstrating the importance of personalized team recommendations.

Dashboard and Monitoring Tools
Martinez-Maldonado et al. (2015) [11] proposed real-time notifications to enhance team awareness. Molenaar and Knoop-van Campen (2018) [12] highlighted actionable insights from dashboards, while Valiente et al. (2021) [13] and Lee-Cultura et al. (2024) [14] extended these tools to multi-modal environments. Real-time monitoring allows organizers to detect imbalance, overburdened members, and collaboration issues early.

Summary
While these approaches provide a foundation, limitations include:

- Lack of real-time adaptability in large-scale hackathons.
- Insufficient integration of skill, social, and personality data.
- Limited fairness and diversity enforcement.
- Complexity and usability challenges in existing tools.

Limitations of Existing Work

1. **Skill-Centric Approaches:** Existing systems often prioritize technical skills while neglect- ing interpersonal compatibility.
2. **Scalability Constraints:** Many methods fail with large participant pools.
3. **Fairness and Diversity Gaps:** Gender, experience, and background diversity are often not enforced.
4. **Static Allocation:** Teams cannot adapt to dropouts or late participants.
5. **Interface Complexity:** Non-intuitive tools hinder organizer adoption.
6. **Evaluation Gaps:** Few empirical studies validate large-scale deployment.
7. **Limited Predictive Analytics:** Systems rarely forecast potential conflicts or performance issues.
8. **Integration of Multi-Source Data:** Skills, interests, and social factors are rarely combined.
9. **Cloud Integration:** Lack of remote accessibility and scalable storage.
10. **Dynamic Reallocation Challenges:** Few systems support mid-event team adjustments.

Motivation

Hackathons are learning and innovation platforms that demand efficient team formation. Man- ual methods are slow, biased, and prone to errors. Smart Team Builder addresses:

- Automated, skill-aware, and compatible team formation.
- Fairness and diversity enforcement.
- Real-time monitoring and analytics.
- Dynamic team adaptation during events.
- Improved participant engagement and learning.

Proposed System

Problem Statement

Form teams that optimize skill coverage, compatibility, diversity, and workload balance while handling dynamic events and providing real-time monitoring to organizers.

Workflow / Algorithm

1. **Participant Registration:** Skills, interests, academic background, experience, and optional social media profiles are collected.
2. **Skill and Experience Matrix:** Structured profiles quantify technical, non-technical, and soft skills.
3. **Compatibility Scoring:** Social ties, personality traits, and past collaborations are analyzed.
4. **Optimization Engine:** AI models, graph clustering, and integer programming algorithms form balanced teams.
5. **Fairness Enforcement:** Ensures gender, experience, and academic diversity.
6. **Dynamic Reallocation:** Teams adjust to dropouts and late arrivals in real-time.
7. **Analytics Dashboard:** Visualizes team composition, diversity, workload, and predicted per- formance.

System Architecture

- **Data Layer:** Cloud-based participant profile storage.
- **Processing Layer:** AI and optimization engines for team formation.
- **Visualization Layer:** Real-time dashboards for organizers.
- **Notification Layer:** Alerts for performance, conflicts, or dropouts.

Discussion / Benefits

- Balanced skill coverage and complementary teams.
- Reduced interpersonal conflicts through compatibility analysis.
- Enforced fairness and diversity.
- Real-time adaptability to participant changes.
- Dashboard insights for organizers.
- Predictive analytics for potential conflicts and performance issues.
- Mentorship recommendations based on team needs.
- Reduced administrative burden and increased efficiency.

Conclusion and Future Scope

The Smart Team Builder leverages AI, cloud computing, and optimization techniques to auto- mate hackathon team formation. Future enhancements include:

- Virtual and hybrid hackathon integration.
- Predictive modeling of team success and collaboration.
- Mentor allocation recommendations.
- Mobile dashboards and hybrid access.
- Advanced analytics for learning outcomes and participant engagement.

References

S. Datta, A. Majumder, and K. V. M. Naidu, "Team Formation and Inclusion in Hackathons," in *Proc. Int. Conf. on Systems, Man, and Cybernetics*, 2012.

T. Lappas, K. Liu, and E. Terzi, "Finding a team of experts in social networks," in *Proc. ACM SIGKDD*, 2009.

L. Chen, H. Wang, and M. Zhou, "Fairness-aware team formation in collaborative learning

environments," in *Proc. IEEE ICALT*, 2018.

Y. Wang, M. Li, and Z. Zhang, "AI-Based Student Grouping System Using Predictive Mod- els," *IEEE Access*, vol. 8, pp. 12345-12356, 2020.

A. Kittur, M. Kraut, and R. E. Kraut, "Social Network Analysis for Team Formation in Hackathons," in *Proc. ACM CSCW*, 2019.

M. Anwar, S. Haider, and F. Khan, "Skill Recommendation System for Hackathon Team Formation," in *Proc. Smart Learn. Environ.*, 2021.

P. Brusilovsky and E. Milla'n, "Adaptive Group Formation and User Models," in *Handbook of Educational Data Mining*, 2016.

R. Kumar, V. Singh, and A. Patel, "Predictive Modeling of Team Dynamics in Hackathons," *IEEE Access*, 2024.

J. O'Neill, R. Smith, and T. Johnson, "Diversity-aware team formation policies for educa- tional hackathons," *J. Educ. Technol.*, vol. 15, no. 2, pp. 89-104, 2023.

Nalawade, V. S., Jagtap, T. G., Jamdar, P. B., Kadam, S. I., & Kenjale, R. S. (2023). Voice-Enabled Traffic Sign Recognition and Alert System using ML: A Review.

R. Martinez-Maldonado et al., "MTFeedback: Notifications to Enhance Teacher Awareness," *IEEE Trans. Learn. Technol.*, 2015.

I. Molenaar and C. Knoop-van Campen, "How Teachers Make Dashboard Information Ac- tionable," *IEEE Trans. Learn. Technol.*, 2018.

J. A. Ruipe'rez-Valiente et al., "Visualization Dashboards to Support Teachers Using Edu- cational Games," *IEEE Access*, 2021.

S. Lee-Cultura et al., "Multimodal Teacher Dashboards: Challenges and Opportunities," *IEEE Trans. Learn. Technol.*, 2024.