

Gamified Role-Play for Teamwork, Empathy and Entrepreneurial Mindset Development: Insights from a International Faculty Workshop

Dr. Jamie R Gurganus, University of Maryland, Baltimore County

Dr. Jamie Gurganus is an Assistant Teaching Professor in the Engineering and Computing Education Program within the College of Engineering and Information Technology and Director of the Center for the Integration of Research, Teaching and Learning (CIRTL) in the Graduate School at the University of Maryland, Baltimore County (UMBC), as well as a Faculty Fellow with the Alex. Brown Center for Entrepreneurship. Her work focuses on developing engineers, educators, and communities from P12 through post-graduate levels, with scholarship and teaching centered on engineering identity development, global and entrepreneurial competencies, failure culture, and inclusive pathways into engineering. She designs high-impact, student-centered learning experiences across the engineering curriculum including first-year courses, human-centered design, work-integrated learning, and multidisciplinary capstone projects; connecting students with real-world challenges and community partners. Committed to innovative teaching, she integrates experiential learning, gamification, and authentic design challenges to foster engagement and professional skill development, and collaborates globally on STEM education initiatives, including teaching a Collaborative Online International Learning (COIL) Global Engineering course with partners in Brazil, Portugal, and Germany.

Steven McAlpine, University of Maryland Baltimore County

Steven McAlpine is a lecturer in the Entrepreneurship, Engineering, and Individualized Study programs at UMBC. He has been teaching role playing game design and leading campus wide RPG events for the past ten years. He also leads the multidisciplinary sustainable design course entitled INDS 430: The Kinetic Sculpture Project, which won the grand prize in the 2015 Baltimore Kinetic Sculpture race.

Diana Mesquita

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I. Introduction / Motivation

Teamwork remains one of the most essential yet persistently underdeveloped competencies in engineering and STEM education. While team-based projects are widely embedded across curricula, many students still struggle to internalize how effective teams form, communicate, manage conflict, and sustain accountability. This gap is especially visible in early-stage teamwork behaviors such as role negotiation, shared responsibility, and constructive communication when disagreements emerge.

Post-pandemic learning environments have further shifted expectations around engagement and professionalism, creating additional challenges for instructors attempting to cultivate collaborative learning cultures. Students may arrive with different assumptions about participation, communication norms, and responsibility in team settings. At the same time, workforce demands increasingly emphasize the ability to collaborate effectively across diverse teams, making teamwork readiness a critical professional preparation outcome.

A 2024 international survey of over 1,000 hiring managers identified a lack of professionalism in team settings as a major concern when hiring new graduates [1]. This finding reinforces that engineering education must go beyond assigning group work and instead provide structured, experiential opportunities that help students practice teamwork behaviors in realistic, high-pressure scenarios. Additionally, because modern engineering work increasingly requires innovation, adaptability, and the ability to create value in uncertain contexts, teamwork development must also be paired with opportunities for students to think entrepreneurially within collaborative environments.

This paper presents the design, implementation, and evaluation of *Team Mode Unlocked*, a gamified role-play workshop that integrates Tuckman's stages of group development (forming, storming, norming, performing) with key dimensions of entrepreneurial thinking, including creativity, opportunity recognition, and value creation. The workshop was facilitated in multiple contexts, including an initial implementation in the United States and later in international settings across Europe and the Middle East. Participants assumed hidden teammate archetypes that intentionally surfaced common teamwork challenges, and teams worked under time constraints to develop a solution to a fictional engineering design challenge aligned with the United Nations Sustainable Development Goals (SDGs), culminating in a one-minute venture pitch.

This work is framed as a case study examining how participants engaged with the workshop and how teamwork behaviors and learning outcomes manifested in practice. To guide the analysis, the following research questions were investigated:

RQ1: What teamwork interaction patterns were observed during the *Team Mode Unlocked* workshop across cultural and disciplinary lines?

RQ2: What learning gains and design recommendations did participants report in post-session surveys regarding teamwork development, innovation-driven collaboration, and improvements to the game's instructions, role archetypes, and facilitation?

II. Background / Literature Review

Gamification and Role-Play in Higher Education: Gamification and role-play have become increasingly relevant in higher education as strategies to improve engagement, motivation, and active participation, particularly in settings where traditional lecture formats may limit meaningful interaction and retention [2]–[4]. Rather than positioning students as passive recipients of information, game-based and role-immersive approaches create structured experiences requiring collaboration, persuasion, and decision-making under authentic constraints [2], [5]. Through interaction, identity exploration, and problem-solving, gamification bridges conceptual understanding and applied practice, providing a strong foundation for role-play-based learning [3], [6].

One well-known example is *Reacting to the Past* (RTTP), developed by Carnes, which uses role immersion to increase engagement and deepen learning [7]. Early evaluation of RTTP demonstrated positive outcomes including increased empathy, self-esteem, and rhetorical skill development, suggesting role-play can produce both psychological and academic benefits [8]. Carnes later emphasized that role-immersion games support experimentation, reflection, and learning through productive struggle [9], while the “freedoms of play” framework highlights experimentation, identity exploration, and low-risk failure as key mechanisms for learning in gamified environments [10].

Role-Play, Failure Culture, and Learning through Experimentation: Related scholarship suggests that games foster a positive failure culture by allowing learners to experiment without personal risk [11], offering a contrast to high-stakes training environments where evaluation anxiety can inhibit participation as explained by a recent interview with a Sales executive, Howard Cramer[12]. Within engineering education, role-playing approaches have been used to support communication, systems thinking, and problem-solving, although alignment with broader curricular objectives remains a challenge [4], [16].

Team Development and Collaborative Learning: Beyond engagement, the relevance of gamification for teamwork development is supported by broader studies showing that team effectiveness is shaped by communication, coordination, role negotiation, and conflict management rather than outcomes alone [17], [18]. Common challenges in group work including uneven participation, interpersonal tensions, and perceptions of unfairness, highlight the need for

structured interventions that make team processes visible and discussable [13]. These dynamics align with Tuckman's model of group development, which describes progression through forming, storming, norming, and performing as teams negotiate roles and cohesion [14], [15].

Entrepreneurship Education and Team-Based Innovation: In parallel, entrepreneurship education scholarship increasingly emphasizes practice-based learning environments that develop opportunity recognition, value creation, and collaborative problem-solving rather than focusing solely on individual entrepreneurial traits [19], [20]. Entrepreneurship is therefore understood not only as an individual capability but also as a social and team-based process shaped through interaction, experimentation, and adaptation under uncertainty [21]. Positioning gamified role-play at the intersection of team development and entrepreneurship education provides a framework for understanding how collaborative, role-based experiences can simultaneously strengthen teamwork processes and entrepreneurial thinking within engineering and interdisciplinary learning environments.

III. Workshop Design: Team Mode Unlocked

Team Mode Unlock was designed as a short-format, high-engagement teamwork intervention that uses gamification and role-play to surface realistic collaboration challenges while simultaneously strengthening innovation-oriented problem-solving. The workshop intentionally integrates Tuckman's stages of group development (forming, storming, norming, performing) with entrepreneurial thinking behaviors, including opportunity recognition, creativity, stakeholder empathy, and value creation. Rather than treating teamwork as an assumed outcome of group work, *Team Mode Unlock* positions teamwork as an explicit learning objective supported through structured facilitation, time constraints, and reflective prompts.

Game/Workshop learning objectives: The workshop was designed to support participants in developing teamwork competencies that are often underdeveloped in traditional project-based learning environments. By the end of the session, participants were expected to demonstrate increased awareness of how teams form and function, and to practice behaviors that support productive collaboration under constraints. Specifically, ***Team Mode Unlocked*** targeted participant growth in the following areas:

- Team communication and inclusion: identifying participation imbalances, encouraging voice equity, and practicing clear communication in ambiguous situations
- Conflict navigation: recognizing storming-stage behaviors and responding with repair strategies rather than avoidance or escalation
- Role negotiation and coordination: identifying how individual behaviors and working styles affect team effectiveness and aligning contributions toward a shared goal
- Entrepreneurial thinking within teamwork: framing problems as opportunities, generating creative solutions, and articulating value for stakeholders

- Time-bound collaboration and synthesis: making decisions under pressure and converging on a coherent solution narrative

These objectives were intentionally mapped to the workshop's mechanics: role archetypes that trigger predictable team dynamics, a staged design prompt, and a pitch deliverable that forces teams to align on value and feasibility.

Core scenario structure: To create a motivating and authentic context, the workshop positions each table of participants as a newly formed engineering team within a company that has been contracted to address a United Nations Sustainable Development Goal (SDG). Participants are explicitly told that they have not worked together previously and must learn one another's skills and working styles during a time-limited orientation session.

The scenario establishes three required outcomes:

1. teams must learn how to collaborate effectively,
2. teams must propose a solution to the assigned SDG challenge, and
3. teams must develop a short venture pitch intended for a potential funder.

This framing is intentionally entrepreneurial: teams are not simply generating “ideas,” but developing a solution that must be both viable and fundable, strengthening the need for clarity, value articulation, and stakeholder alignment.

Role-play mechanic: hidden teammate archetypes: A core feature of *Team Mode Unlocked* is the use of hidden role-play character archetypes that represent common teamwork dynamics. Each participant receives an individual character sheet and is instructed not to share its content with teammates. These archetypes are designed to surface recognizable behaviors that often appear in student teams (and professional teams), such as over-dominating communication styles, disengagement, over-caution, and culturally distinct interaction patterns. An example of the character sheet is shown in figure 1.

Each character includes two design elements: Traits, which function as behavioral rules the participant must follow during the workshop, and Motivators, which represent conditions that must be met by the team in order for the participant to shift toward more productive collaboration (see figure 1). This mechanic reinforces empathy and intentional communication. Participants must learn to recognize what motivates their teammates (e.g., being asked to contribute a specific skill) and adapt their communication approach accordingly. As described in the directions, game teams are encouraged to motivate colleagues by naming skills and strengths (e.g., “We could use your expertise in SolidWorks to design a prototype”).

Character Description You are a very social individual that loves to chit-chat and make friends with the people around you. While this quality has helped you mingle outside of work, you tend to have a hard time staying on topic when you're working in a professional setting. Others have told you that the time that you spend talking could be spent on better things.	
Field: Civil Engineering Your specialty is infrastructure, and assessing if rooftop structures can support the weight of garden systems, water tanks, and solar panels.	
Traits * Every time that you go to speak, you must speak using 3 sentences minimum. * For every time that you've spoken, you must include at least one unnecessary detail. * You cannot go one minute without speaking.	Motivators * Someone talks to you about one of your tangents for at least 3 sentences. ☐ * Someone gives you a people-oriented task, like talking to a team member. ☐

Figure 1: Sample taken from one of the Archetype character sheets.

Importantly, the game design includes built-in constraints: participants are not expected to “fix” every team dynamic completely. In the facilitator (accountant, explained later) FAQ, the instructions clarify that not all traits will be eliminated, and that at least one trait will remain active throughout the entire game. This design choice intentionally mirrors real teamwork, where not all interpersonal friction disappears, and teams must learn to function productively despite persistent differences.

Design phases and timing: The workshop is structured as a two-part challenge sequence that mirrors early-stage team development and escalation of constraints. Participants first engage with a general prompt (Part 1) to establish team norms, roles, and communication patterns. Teams then transition into a more detailed design request (Part 2), which introduces specifications and pushes teams toward convergence and decision-making.

The game is intentionally time-bound to simulate realistic team pressure. A facilitator role (in some versions, the “Accountant” character) is responsible for timing both phases, announcing the start of the challenge, and tracking performance. The use of timed phases increases urgency and often accelerates movement into storming-stage behaviors, making team conflict and negotiation visible in a short period.

To reinforce engagement and provide a playful performance incentive, teams can earn “funding” based on how quickly they complete the initial phase. For example, teams that complete the first stage within a specified time window earn higher funding per team member, while slower completion yields reduced earnings. This mechanic introduces a low-stakes form of competition while keeping the primary focus on teamwork behaviors rather than “winning.”

Facilitation approach: The culminating deliverable for *Team Mode Unlock* is a short venture pitch delivered to a mock investor or venture capitalist. The scenario instructions specify a brief elevator pitch (typically 1 minute to 1 minute 30 seconds depending on the implementation context). This pitch requirement is intentionally aligned to entrepreneurial thinking because it forces teams to synthesize their design into a persuasive narrative that highlights both feasibility and value.

In at least one implementation version, the pitch is evaluated using a structured checklist that includes both technical feasibility and community-centered criteria. For example, the design must address constraints such as low-cost materials, ease of maintenance, and resilience to environmental conditions, while also reflecting contributions from every team member. The inclusion of contribution equity as a scoring criterion reinforces the workshop’s teamwork goal: teams must not only produce a solution, but also demonstrate inclusive collaboration and shared ownership.

The pitch component also functions as a “forcing function” for teamwork development. Teams must negotiate priorities, select a final direction, assign speaking roles, and converge on shared language; activities that often reveal whether the team has progressed from storming into norming and performing behaviors.

Below in Figure 2 shows a process map of the game broken down into three stages, Setup, Team dynamics and Design and Pitch output.

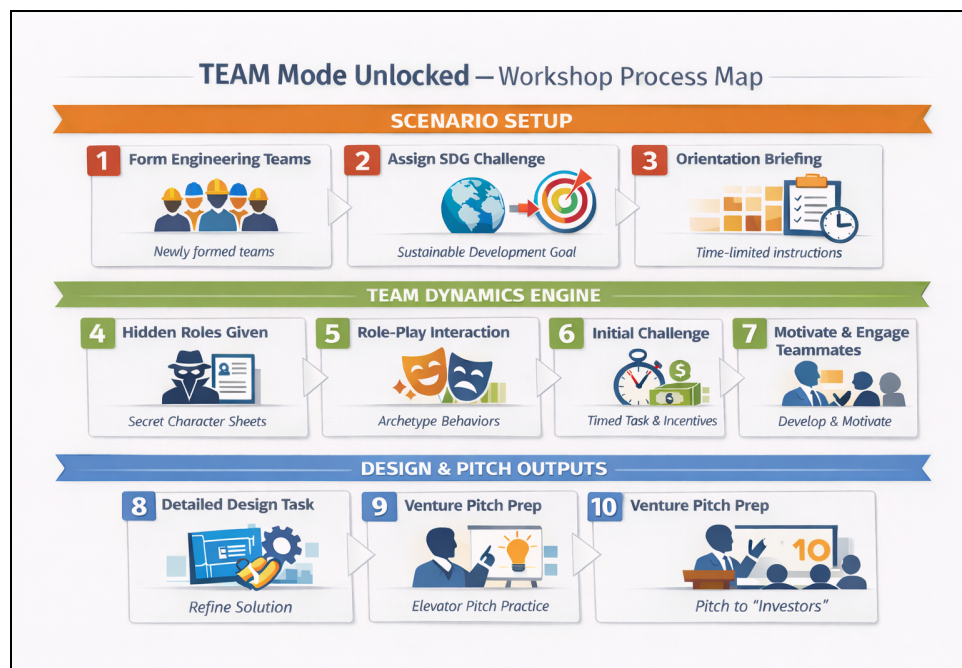


Figure 2: Workshop/Game Process Map (created using ChatGPT)

Facilitation Model and Implementation Fidelity: *Team Mode Unlocked* is designed to be facilitated in flexible contexts (classrooms, conference workshops, faculty development sessions) while maintaining consistent core mechanics. Facilitators follow a structured sequence: distributing character sheets, ensuring confidentiality of roles, clarifying rules, reading the challenge prompt aloud, initiating timers, and transitioning teams from Part 1 to Part 2. Facilitation emphasizes two priorities: maintaining psychological safety, so participants are willing to take risks and engage in role-play, and preserving the integrity of the mechanics, particularly the hidden roles and motivator-based collaboration structure. The facilitator also monitors team progress and documents behavioral patterns during the activity.

IV. Implementation Contexts / Participants

As a portable offering, the game was developed to function across multiple educational and professional development environments. To examine how teamwork dynamics and entrepreneurial thinking behaviors surfaced across diverse contexts, the workshop was facilitated in four distinct sites: the United States, two sites in Portugal, a fourth international site in Turkey. Each setting provided a unique cultural, disciplinary, and professional composition of participants, allowing the workshop to be evaluated as a multi-context case study focused on observable teamwork behaviors and participant-reported learning outcomes.

Settings *Team Mode Unlocked* was facilitated across four implementation sites to examine how teamwork behaviors and entrepreneurial thinking surfaced in varied cultural and professional learning environments. The first implementation occurred in the United States at the University of Maryland, Baltimore County (Site 1: Initial Pilot Implementation) and served as an early test of the workshop structure, pacing, and role-play mechanics. This setting supported refinement of facilitation procedures and provided initial observations of how teams navigated early-stage dynamics such as forming and storming under time constraints.

Following the pilot, the workshop was delivered in Portugal in two distinct contexts. Site 2: Portugal (International Engineering Education Conference) provided an international professional learning environment in which participants brought diverse disciplinary perspectives and prior teamwork experiences. This conference setting created opportunities to observe interaction patterns, role negotiation, and communication behaviors as participants collaborated with unfamiliar teammates under a shared design challenge. In contrast, Site 3: Portugal (European Training Alliance) represented a more structured training-focused environment, allowing the workshop to function as a targeted professional development activity while still maintaining the same core mechanics, including hidden role archetypes, phased design prompts, and an entrepreneurial pitch deliverable.

The fourth implementation was conducted in Site 4: Istanbul, Turkiye, expanding the workshop into an additional global context. This setting provided further opportunities to examine cross-cultural teamwork behaviors, particularly how participants navigated collaboration norms,

conflict management strategies, and inclusion dynamics while working through the SDG-aligned challenge and preparing a short venture pitch.

Participants Across all settings, the total number of participants ranged $n = 10 - 60$. Participants represented diverse disciplinary backgrounds and professional roles, including educators, students, administrators and engineering education stakeholders.

Implemented in international contexts, participant teams often included individuals with different communication norms, cultural expectations, and prior experiences with team-based learning. This diversity was central to the workshop's design intent: to create an environment where team dynamics and collaboration behaviors could be surfaced quickly and meaningfully through role-play and time pressure.

Team Formation and Group Structure At each site, participants were organized into small teams at their tables and were informed that they were functioning as a newly formed engineering firm. Teams were provided character sheets with hidden role archetypes, which participants were instructed not to reveal to others during the activity. This mechanic ensured that teamwork challenges emerged authentically through interaction rather than being explicitly assigned or negotiated upfront.

V. Methods

This study employed a multi-site, qualitative-dominant case study approach to examine how teamwork behaviors emerged during the *Team Mode Unlocked* workshop and how participants perceived their learning gains following the experience. Data collection emphasized in-the-moment team behaviors captured through structured behavioral observations and field notes, complemented by post-session survey feedback. This approach aligns with established practices in teamwork research, where direct observation and reflective participant data are frequently used to capture interaction patterns, coordination behaviors, and conflict dynamics that may not be fully visible through outcome-based assessment alone [17], [18].

Study Design and Data Sources

This implementation-focused case study in which the workshop served as the intervention and the primary goal was to document how participants engaged with the experience and what behaviors and outcomes were observable in practice.

Two primary data sources were collected:

1. Behavioral observations and facilitator field notes documenting team interactions throughout the workshop

2. Post-session open ended discussion and surveys capturing participant perceptions of learning gains and recommendations for improving workshop design and facilitation [22]-[24].

Behavioral Observations and Field Notes: Behavioral observations were conducted during each workshop session to document how teams communicated, navigated tension, and negotiated roles while progressing through the two-part design challenge. Facilitators recorded field notes during and immediately after each workshop phase, capturing both descriptive interaction patterns and notable behavioral shifts. Observation-based approaches are commonly used in teamwork research because team performance and effectiveness are strongly influenced by real-time processes such as coordination, communication, and conflict management [17], [18].

Observation notes focused on behaviors that are frequently identified as core teamwork processes in the literature, including [18]:

- Communication behaviors (e.g., turn-taking, interruptions, clarification requests, synthesis of ideas)
- Participation equity and inclusion behaviors (e.g., inviting quieter members, dominance patterns, voice distribution)
- Decision-making and coordination behaviors (e.g., assigning responsibilities, convergence strategies, negotiation of priorities)
- Conflict indicators and repair strategies (e.g., disagreement escalation, reframing, compromise, humor, redirection)
- Role negotiation and leadership emergence (e.g., leadership shifts, task allocation, alignment around deliverables)

Analytical Framework: Tuckman's Stages of Group Development

To interpret observed behaviors through a developmental lens, field notes were examined using Tuckman's stages of small group development as the primary analytic framework. Tuckman's foundational model describes how teams commonly progress through forming, storming, norming, and performing as members establish structure, navigate conflict, build shared norms, and coordinate toward shared goals [14]. The model was later revisited and reinforced by Tuckman and Jensen, highlighting the enduring relevance of stage-based development for interpreting group behavior across contexts [15].

This framework was selected because *Team Mode Unlocked* is explicitly designed to accelerate early-stage team development. In short-format workshops where participants are unfamiliar with one another, teams often display observable transitions consistent with developmental stages; moving from uncertainty and surface-level coordination to moments of conflict, negotiation, and eventual alignment [14], [15]. Using this framework provided a structured way to interpret

behavioral shifts over the course of the workshop rather than treating teamwork behaviors as isolated events.

Stage-Based Behavioral Mapping and Developmental Alignment: Following each workshop sequence, facilitators reviewed field notes and mapped observed behaviors to the corresponding Tuckman stages. This process was used to strengthen analytic consistency and ensure that observed behaviors were interpreted relative to established patterns of group development [14], [15].

Specifically, behaviors were categorized using stage-consistent indicators [23], [24]:

- Forming: politeness, uncertainty, tentative contributions, limited role clarity
- Storming: disagreement, competing priorities, interruptions, tension, uneven participation
- Norming: establishment of shared expectations, improved turn-taking, negotiated roles, compromise strategies
- Performing: coordinated execution, effective synthesis, shared ownership, task completion toward a deliverable

Post-Session Discussion & Surveys: At the conclusion of the workshop, participants would talk through reflection questions (Figure 3) around what they experienced. These questions are shown in table one.

Forming & Storming	Norming & Performing
<u>Reflection Questions (Forming & Storming):</u> ● How did you feel during the forming stage vs. storming? ● Did you feel heard and included? ● Was there tension? How did it get resolved? ● What bothered you the most?	<u>Reflection Questions (Norming & Performing):</u> ● How did the team start working together more smoothly? ● Did you notice anyone helping include quieter members? ● Did you notice anyone stepping in to help resolve tension or support a teammate's idea? How did that feel for the group?

Figure 3: Post Game Discussion Questions

A post-session survey was also administered to capture immediate perceptions of learning outcomes and workshop design. Surveys included open-ended questions. The use of post-session participant recommendations were used for refinement [19].

Survey prompts focused on:

- perceived ability to identify and leverage diverse contributions
- perceived ability to navigate team dysfunction and conflict

- perceived ability to integrate innovation-driven problem solving within collaborative work
- clarity and usability of game instructions and role archetypes
- recommendations for improving facilitation, pacing, and workshop structure

Data Analysis Procedures: Qualitative data from field notes and open-ended survey responses were analyzed using thematic analysis procedures informed by established qualitative coding practices [23], [24]. Initial codes were developed deductively based on the research questions and observation categories (communication, conflict management, role negotiation, inclusion behaviors, entrepreneurial framing). Additional inductive codes were added as recurring patterns emerged across sites.

Open-ended survey responses were collected and coded to identify themes related to perceived learning gains and recommended improvements. Findings were then synthesized across data sources to triangulate observed behavioral patterns with participant perceptions and to identify consistent opportunities for improving the workshop design.

VI. Results / Findings

RQ1: *What teamwork interaction patterns were observed during the Team Mode Unlocked workshop across cultural and disciplinary lines?*

Behavioral observations and facilitator field notes were analyzed using Tuckman's stages of group development as an interpretive framework to document how teamwork behaviors emerged and shifted throughout the workshop [14], [15]. Following each workshop sequence, recorded behaviors were paralleled to stage-consistent indicators (forming, storming, norming, performing) to support consistent interpretation of team development across the two-phase challenge structure. This section reports observed interaction patterns across sites, highlighting how communication behaviors, conflict management, and role negotiation unfolded in practice.

Below include summary findings from each site along with Table of observed teamwork behaviors across sites using Tuckman's developmental framework (Table 1).

Site A: United States (Initial Pilot Implementation) n=8

The United States implementation served as the initial pilot of *Team Mode Unlocked* and included one team composed of faculty and staff participants. Additional time was provided to clarify game structure, role-play expectations, and deliverables, with minor pacing adjustments



made to support transition from design activity to pitch preparation. These facilitation supports were used to strengthen implementation fidelity and identify instruction or timing challenges prior to international rollout.

Teams initially demonstrated forming-stage behaviors characterized by role uncertainty, polite engagement, and cautious participation, often relying on facilitator guidance before committing to decisions, reflecting early dependence on structure and avoidance of conflict [1]. As the design phase began under time pressure, storming behaviors emerged through competing solution directions, differences in communication style, and moments of conversational dominance and uneven participation, consistent with negotiation of authority and task demands typical of this stage [14], [15]. Norming behaviors appeared as teams established shared strategies, including role assignment, improved turn-taking, inclusion of quieter members, and structured decision-making language that supported cohesion [14]. During the final phase, teams transitioned to performing behaviors marked by coordinated execution, delegation, idea synthesis, and collaborative pitch preparation; communication became more solution-focused, reflecting shared focus and efficient resource use [2]. Teams that reached stronger performing outcomes had established clear coordination during norming, enabling cohesive final pitches despite time constraints.

Site B: Porto, Portugal (PAEE/ALE'2025 International Conference) n=+/-50

Site B was implemented at an international engineering education conference, Project Approaches in Engineering Education & Active Learning in Engineering Education (PAEE/ALEE), with participants from multiple national and disciplinary backgrounds. The multilingual, cross-cultural setting provided opportunities to observe teamwork behaviors shaped by varied communication norms and levels of English fluency.

Teams demonstrated forming-stage behaviors characterized by professional courtesy, cautious engagement, and frequent clarification of task expectations, with participants often checking understanding before committing to decisions, reflecting early-stage uncertainty and reliance on shared structure [14]. As teams entered time-constrained design work, storming behaviors emerged through differences in communication pace, directness, and decision-making preferences, with uneven participation occasionally appearing when more fluent speakers assumed leadership roles, consistent with negotiation of authority and task direction typical of storming dynamics [14], [15]. Norming behaviors became evident as teams adopted explicit collaboration strategies such as inviting quieter members, paraphrasing ideas, and establishing decision checkpoints, which improved alignment and inclusion across language differences and supported coordination [15]. During pitch preparation, teams shifted toward coordinated execution with clearer role allocation and stakeholder-focused synthesis; teams demonstrating stronger norming behaviors produced more cohesive pitches, reflecting shared focus and collaborative problem-solving under time constraints [15].



Site C: Portugal (Arqus European Alliance) n=+/-50

Site 3 was facilitated within a faculty-focused European training content, Arqus European Alliance, involving participants from nine countries and universities from Austria, Germany, Ireland, Italy, Lithuania, Poland, Portugal, Spain and France, multiple disciplines including STEM, social sciences, and arts and humanities. This setting allowed observation of how disciplinary and cultural norms shaped team interaction and decision-making.



Teams exhibited forming-stage behaviors through clarification of goals, process-oriented discussion, and cautious participation prior to decision-making, with participants frequently restating prompts to establish shared understanding, consistent with early-stage uncertainty [14]. Storming behaviors emerged as teams negotiated collaboration pace and competing disciplinary perspectives, particularly tensions between technical feasibility and narrative or stakeholder framing, reflecting typical storming-stage negotiation of priorities and authority [14], [15]. Norming became visible as teams established explicit procedures such as turn-taking, role assignment, and agreement checks, which supported cohesion and helped calibrate role-play expectations within the professional training environment [15]. Performing behaviors appeared during pitch development, where teams demonstrated efficient delegation, synthesis of complementary strengths, and alignment around a shared narrative; teams that achieved clearer coordination during norming produced more coherent final pitches [15].

Site D: Türkiye n=+/-45

Site D was facilitated in Istanbul at Koç University with mixed faculty and graduate student participants working primarily in a second-language English context. Gameplay included an early-finish mechanic tied to trait identification, which influenced pacing and team coordination during the activity.



Teams demonstrated forming-stage behaviors through repeated clarification requests, reliance on facilitator confirmation, and early trait-seeking while establishing shared structure [14]. As teams entered the timed design phase, storming behaviors emerged through pacing mismatches, overlapping solution directions, and participation imbalance, reflecting negotiation of task direction while simultaneously managing design work and trait identification [14], [15]. Norming behaviors appeared when teams established clearer decision processes, assigned responsibilities, and

adapted communication strategies based on partial trait recognition, with inclusion prompts and paraphrasing supporting alignment across language differences [15]. Performing behaviors were most visible during pitch preparation, particularly after additional pitch time was provided, as teams demonstrated stronger synthesis, clearer role division, and coordinated delivery, reflecting shared ownership and efficient execution despite persistent role traits [14].

Summarized Teamwork findings: Table 1 summarizes cross-site teamwork behaviors using Tuckman’s framework. Teams showed a consistent developmental progression, with variations shaped by language, disciplinary composition, and facilitation context. The table highlights shared patterns while retaining site-specific differences.

Table 1. Cross-Site Summary of Observed Tuckman Behaviors

	Forming	 Storming	 Norming	 Performing
Site A	Clarification of goals Restating prompts, seeking facilitator confirmation, interpreting rules	Disciplinary tensions Negotiation of competing disciplinary perspectives, technical feasibility vs. narrative framing, early tensions	Turn-taking, Role checks Explicit procedures, agreed roles, calibration for role-play expectations, alignment of ideas	Aligned synthesis Efficient delegation, synthesis of mixed strengths, aligned narrative, re-emphasis of target needs
Site B	Cautious engagement Repeated clarification of goals, initial process, oriented discussion, exploratory participation	Pacing conflicts Negotiation of collaboration pace, competing solutions, technical feasibility vs. stakeholder relevance	Paraphrasing ideas Clearer decision stages, inclusion prompts, paraphrasing across language differences	Cohesive pitch Clearer role division, structured pitch, coherent narrative, emphasis on opportunity value
Site C	Facilitator reliance Repeated confirmation of rules from facilitators, calls for help assigning order, early trait exploration	Solution overlap Task direction negotiation, overlapping solutions, participation imbalance, task-framing friction	Assigned roles Established decision stages, reassignment/clarification of roles, task-focused communication	Clear division Stronger role division, pitch refinement, better synthesis, reinforced focus on audience
Site D	Trait identification Repeated rule interpretation, trait-seeking, reliance on facilitators, teammate trait observation	Participation imbalance Pacing mismatches, overlapping ideas, negotiated persistent imbalanced engagement	Decision processes Assigned decision process, communication adjusted to partial trait recognition	Coordinated delivery Stronger synthesis, adapted role division, coordinated pitch delivery reflecting task ownership

Participant-Reported Learning Gains and Design Recommendations (RQ2)

RQ2: What learning gains and design recommendations did participants report in post-session surveys regarding teamwork development, innovation-driven collaboration, and improvements to the game’s instructions, role archetypes, and facilitation?

Following each implementation, participants completed a post-session survey capturing perceptions of learning gains and recommendations for improving the workshop’s design and facilitation. Survey responses were analyzed descriptively to summarize overall trends, and open-ended feedback was reviewed to identify recurring themes related to teamwork development, innovation-driven collaboration, and opportunities for refinement. A total of 22 participants participated in the survey from each site. In the USA, in-person focus groups were conducted with the 8 participants.

Reported Learning Gains: Teamwork Development and Innovation-Driven Collaboration

Participants consistently indicated that the workshop supported teamwork readiness and would be valuable for preparing student teams. Most respondents identified the activity as useful preparation, including emphatic endorsements (e.g., “Totally!! Thank you!”), suggesting the workshop made team dynamics visible and actionable during early-stage team formation. Open-ended responses further indicated that the activity accelerated recognition of interpersonal challenges, making teamwork issues “very obvious in very short time” and supporting shared discussion and reflection. Beyond teamwork development, participants described relevance to innovation-driven collaboration, noting that the constraints and pitch requirement encouraged rapid idea generation, negotiation, and synthesis consistent with collaborative problem-solving and entrepreneurial thinking. Participants also expressed interest in applying the workshop within their own teaching contexts, indicating perceived transferability across disciplines and instructional settings.

Design Recommendations: Instructions, Role Archetypes, and Facilitation

Although many participants responded positively, the survey feedback also highlighted specific areas for improvement related to instructional clarity, pacing, and participant onboarding into the role-play structure.

Participant feedback highlighted several facilitation improvements to strengthen implementation. First, participants recommended clearer verbal instructions and dedicated time for questions before beginning the timed challenge, noting the importance of facilitators who “*Explain it out loud and give room for questions before the challenge.*” Second, although time pressure was intentionally built into the design, multiple respondents felt additional time would improve participation, particularly during early stages when teams were still learning rules and role-play expectations, with comments such as “*Give us more time. The time was not enough*” and “*More time would have been helpful.*” Participants also suggested incorporating a brief mock round prior to the full activity to help teams understand role-play dynamics, for example, “*By playing a mock first just to understand the dynamics.*” In addition, several responses emphasized the need for clearer explanation of role archetypes during onboarding, noting that participants did not always have enough time to fully understand character expectations. Finally, participants highlighted the value of stronger logistical scaffolding, such as clearer support roles for tracking time and rules, suggesting that explicit facilitation structures help reduce confusion and maintain focus on teamwork processes and collaborative problem-solving rather than rule interpretation.

VII. Discussion

Findings across this multi-site implementation suggest that *Team Mode Unlocked* functions as an effective short-format intervention for making teamwork processes visible and actionable during early team formation. Observed behaviors aligned with Tuckman’s developmental stages, indicating accelerated movement through forming and storming while supporting progression

toward norming and performing through coordination and repair [14], [15]. By intentionally surfacing participation imbalance, miscommunication, and decision friction under time constraints, the workshop positioned teamwork as an explicit learning target rather than an assumed outcome of group work, consistent with research emphasizing interaction processes as central to team effectiveness [17],[18],[25].

A key mechanism supporting these outcomes was the hidden role-play archetype design, which enabled low-stakes rehearsal of conflict response and role negotiation. Externalizing behaviors reduced personal attribution and encouraged constructive discussion of team dynamics, aligning with gamification research showing that structured game elements support engagement and practice of complex interpersonal skills [26]–[27]. The persistence of unresolved traits further mirrored authentic teamwork conditions, reinforcing adaptation and shared responsibility [18], [24].

The pitch requirement strengthened alignment and entrepreneurial collaboration by requiring teams to converge around a concise stakeholder-oriented narrative, functioning as a coordination and decision-making forcing mechanism [17], [18], [24]. This aligns with entrepreneurship education perspectives emphasizing value creation, opportunity framing, and practice-based learning, suggesting that entrepreneurial mindset emerges as a collaborative process shaped through negotiation and shared meaning-making [28]–[30].

Cross-cultural implementations highlighted how language and professional norms shaped teamwork expression, particularly in conflict, participation, and pacing. Multilingual contexts demonstrated increased clarification behaviors and occasional participation imbalance, reinforcing the need for facilitation strategies that promote inclusion and psychological safety [31], [32]. The workshop also supported a constructive failure culture by allowing teams to experience dysfunction and imperfect decisions within a bounded learning environment [31]–[34].

Implications for Practice

Team Mode Unlocked can serve as a targeted teamwork readiness module across multiple instructional contexts, including first-year engineering courses, capstone team formation, TA/UTA development, and global engineering or COIL collaboration. Because teamwork effectiveness is driven by interaction processes, integrating the workshop early in team-based courses may help surface norms, roles, and conflict patterns before high-stakes deliverables occur [17], [18], [24].

Participant feedback suggests several facilitation enhancements: (1) clearer onboarding with time for questions, (2) a brief mock round to reduce confusion, (3) structured debrief prompts aligned with Tuckman stages, (4) refined role cards with clearer behavioral expectations, and (5) an optional “reset moment” to model repair and norming when teams become stuck. These

recommendations align with instructional design and experiential learning research emphasizing scaffolding and reflection to support transfer beyond the activity itself [33], [34].

VIII. Limitations and Future Work

This study is limited by a small sample size ($n = 22$ for post survey) across sites and relies in part on self-reported survey feedback, which may reflect response bias or immediate perceptions rather than sustained skill development [35]. Additionally, workshop outcomes may be influenced by facilitator effects, including how instructions were delivered, how time adjustments were made, and how participant questions were addressed across contexts. Finally, the study did not include longitudinal measurement, limiting conclusions about whether teamwork behaviors and entrepreneurial thinking transfer to future team projects over time.

Future work will expand the participant pool and settings (e.g., course sections, capstone teams, and industry partner training) and incorporate pre/post measures of teamwork confidence and entrepreneurial mindset. Comparative studies could evaluate outcomes against non-role-play teamwork activities to isolate the added value of hidden archetypes and gamified constraints [25]–[27]. Lastly, the development of a reusable toolkit, to include role cards, facilitator guides, scoring rubrics, and debrief slides, will support consistent implementation and broader adoption across institutions and cultural contexts, strengthening scalability and research replication [35]–[37].

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