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Cultivating the Entrepreneurial Mindset in Hackathons: Lessons from Initial Implementation of EM in an Informal Learning Environment

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Abstract

Hackathons have emerged as a beneficial platform for fostering innovation and practical problem-solving skills among students. These events encourage participants to prototype solutions to complex problems rapidly and promote personal and professional growth. As one part of a grant effort, it was proposed to study how students reflect upon, articulate, and exhibit the entrepreneurial mindset (EM) in their hackathon-based problem-solving approaches. As defined here, the entrepreneurial mindset is based on the KEEN framework. The KEEN framework consists of the 3Cs: Curiosity, Connections, and Creating Value. The Curiosity construct encourages learners to explore different perspectives and question the norm. The Connections construct emphasizes integrating information from diverse fields and linking theory or knowledge to create and innovate solutions. Lastly, the creating value construct is about identifying opportunities and delivering meaningful outcomes that address and tackle complex, real-world challenges and transform ideas to create real-world impact.

As a standalone vehicle for learning and problem-solving, this wholly informal learning space for EM has yet to be explored. Students are believed to develop more innovative and impact-driven projects by explicitly infusing EM into the program. Thus, the EM pedagogy would enhance the existing experiential learning activities. It is also suggested that informal Hackathon-based learning can complement formal education (e.g., capstones and other project-based courses), many of which have already adopted EM. The overall effort employs a mixed-methods approach to evaluate the impact of Entrepreneurial mindset-based interventions. The approach is described in more detail in Section 3.

This paper will describe the overall hackathon program and the implementation of specific EM-infused interventions. It addresses early lessons learned in relation to the two informal learning vehicles, a hackathon and a makeathon, into which EM is integrated. Each intervention will be discussed in terms of its student impact and practical implications. Interventions include developing an EM-based competition rubric and supporting materials such as updated student, judge, and mentor guides. The parallel implementation of an EM student leadership series and capstone course intervention is also discussed. Video data from legacy hackathons will be compared with the new data extracted from the first full run of the EM-infused competition. Finally, the paper will discuss lessons learned from the initial implementation of the interventions that can be applied to future competition trials.

1. Introduction

Hackathons have emerged as a beneficial platform for fostering innovation and practical problem-solving skills among students. These events encourage participants to prototype solutions to complex problems rapidly and promote personal and professional growth. As one part of a grant effort, it was proposed to study how students reflect upon, articulate, and exhibit the entrepreneurial mindset (EM) in their hackathon-based problem-solving approaches. As defined here, the entrepreneurial mindset is based on the KEEN framework. The KEEN framework consists of the 3Cs: Curiosity, Connections, and Creating Value. The Curiosity construct encourages learners to explore different perspectives and question the norm. The Connections construct emphasizes integrating information from diverse fields and linking theory or knowledge to create and innovate solutions. The last construct, creating value, involves identifying opportunities and delivering meaningful outcomes (i.e., real-world challenges and impact). Hackathons, as a standalone vehicle for learning and problem-solving, have yet to be explored within the KEEN network. This work proposes that students develop more meaningful project outcomes by explicitly infusing the EM framework into the OHI/O program, thus enhancing the existing experiential learning activities. It is also suggested that informal Hackathon-based learning can complement formal education (e.g., capstones and other project-based courses), many of which have already adopted EM. As one part of a grant effort, it was proposed to study how students reflect upon, articulate, and exhibit the entrepreneurial mindset (EM) in their hackathon-based problem-solving approaches. This paper focuses on early implementation, specifically, it provides a brief overview of hackathons, then describes the OHI/O hackathon program, the combinations of interventions the team has implemented, provides an overview of the method, speaks to preliminary findings, and discusses early lessons learned from implementation.

1.1 Overview of Hackathons

Hackathons are informal experiential learning events where participants often collaborate over 24-48 hours to develop solutions to specific challenges. They provide a hands-on environment to experiment with technology, apply theoretical knowledge, and build prototypes. As noted by La Place and Jordan [1], hackathons are "time-constrained prototyping marathons, where students motivated to learn new technologies… design and implement prototypical solutions," culminating in a final demonstration at the end of the event. Participants engage in various technical explorations, including software or hardware development. Hackathons foster problem-solving, teamwork, and creative thinking. Participating students form teams, move through a complete design-build-test cycle, and receive real-time feedback on their efforts. According to Horton et al. [2], these events "simulate project-based learning environments" where students "enhance critical thinking, problem-solving abilities, and understanding of complex issues" through applied learning.

Events begin with an orientation session introducing an event theme, structure, challenges, resources, and rules. Some hackathons define specific problem domains—healthcare, sustainability, artificial intelligence, or cybersecurity—while others allow open-ended innovation. Teams form before or during the event, often facilitated by structured networking activities to encourage collaboration among diverse skill sets. As Chau and Gerber [3] observed, hackathons "unite diverse stakeholders… participants representing unique viewpoints," encouraging interdisciplinary collaboration that simulates real-world development teams.

Once underway, teams engage with ideation, design, and technical development. Participants typically have access to a wide range of mentors or subject matter experts who guide their work's technical and project management. The types of prototypes developed at hackathons vary widely depending on the event's focus, including various software solutions (desktop, mobile, web) and hardware prototypes at different levels of refinement. Projects often emphasize social good, tackling challenges such as food insecurity, accessibility, disaster response, or other community needs. At the same time, others may focus on industry-driven innovation, such as optimizing supply chains, improving cybersecurity protocols, advancing financial technology, or the next generation of microchip fabrication.

At the conclusion, teams present their prototypes to a panel of judges, including professionals and academics, who provide evaluation and feedback. Judges evaluate projects based on criteria such as user experience, technical feasibility, social impact, and creativity. Many hackathons also incorporate public demonstrations or expo-style showcases, allowing participants to practice pitching their ideas and participate in peer-to-peer feedback. These closing activities are not just about winning; they offer valuable opportunities to develop communication skills and receive external validation. "In focus group discussions, participants expressed satisfaction with the process, feeling they had learned something new by the hackathon's end. Follow-up discussions with incubated teams revealed they had gained useful and otherwise unacquired skills [4], [5], [6], [7]."

1.2 Hackathons as a High-Impact Practice

High-impact practices (HIPs) are educational experiences that promote deep learning by facilitating learning outside the classroom, requiring significant time or effort, requiring meaningful interactions with faculty and peers, encouraging collaboration with diverse others, and providing frequent and substantive feedback [8]. These practices, such as collaborative projects and service learning, are proven to enhance student engagement and success. Hackathons align with HIPs by immersing students in intensive, team-based problem solving, often over a short but focused timeframe. Students apply interdisciplinary knowledge, interact with peers and mentors, and develop tangible solutions to real-world challenges.

Hackathons are an informal learning experience incorporating several key elements of HIPs that contribute to student success.

1. **Outside the Classroom:** Hackathons are often co-curricular or extracurricular, allowing students to apply theoretical knowledge in a practical context. Horton et al. [2] observed that "Hackathons in CS education were largely observed as an extracurricular activity… to reinforce students' learning and provide them with a tangible project for resumes." This situates hackathons squarely within the realm of experiential and applied learning.

2. **Time and Effort:** The intensive nature and condensed timeline of hackathons demand a significant investment of time and effort as "participants spend the weekend engaging with hosted events and resources, culminating in a final demonstration at the end of the event [1]."

3. **Collaborative Work**: Hackathons cultivate rich interactions between students, faculty, industry professionals, and mentors, creating opportunities for collaborative learning and networking. Students must organize, divide tasks, and work towards a collective goal. Participants are often "relying on friends with more expertise, mentorship from sponsors or stakeholders, or reviewing tutorials and online forums for specific fixes to their code, where applicable [1]."

4. **Wide Range of Interactions**: By forming diverse, interdisciplinary teams, students gain exposure to new perspectives and develop intercultural competence, strengthening their ability to work with peers from different backgrounds. "Hackathons unite diverse stakeholders toward a common goal… participants representing unique viewpoints so that together they can address issues in society systemically [3]."

5. **Feedback**: Hackathons provide frequent, real-time feedback through team discussion, mentor input, and judging feedback. Mentors provide technical guidance, project critiques, and strategic advice throughout the event. This ongoing feedback promotes reflection and iterative problem solving.

These elements position hackathons as an accessible and inclusive HIP, potentially benefiting students from underserved backgrounds who may lack opportunities for traditional experiential learning experiences like internships, service-learning trips, or research positions. Because hackathons are often free to attend and require only a short-term, intensive commitment, they can reduce barriers to participation, ensuring more students can engage. Oyetade [4] suggests that hackathons are deserving of further research on "how they can help reduce educational disparities [4]." Hackathons can equip students with the skills and confidence needed for future academic and professional success by fostering creativity, teamwork, and applied problem-solving.

1.3 Program Overview

OHI/O is an informal learning initiative at Ohio State University designed to cultivate a thriving tech culture through dynamic, student-led events. By empowering students to take the lead in organizing events and shaping program offerings, OHI/O fosters a culture of peer-driven innovation where opportunities are created by students, for students. Since its inception in 2013, the program has grown from a single hackathon into a diverse ecosystem of technology-focused events that emphasize innovation, collaboration, and hands-on learning (**Figure 1**). At its core, OHI/O offers students the opportunity to apply classroom knowledge in real-world contexts, develop meaningful industry connections, and build technical and soft skills through experiential activities.

The program supports a portfolio of four flagship and nine partner events throughout the academic year, including events focused on software, hardware, high school computer science, middle school computer science, tech entrepreneurship, big data, biomedical, community outreach, artificial intelligence, and cybersecurity. These events range from 24-hour competitions to educational workshops and entrepreneurial showcases. Each event is tailored to support a wide range of skill levels, academic backgrounds, and interests, aimed at creating a welcoming space for participants to explore new ideas, technologies, and career paths.

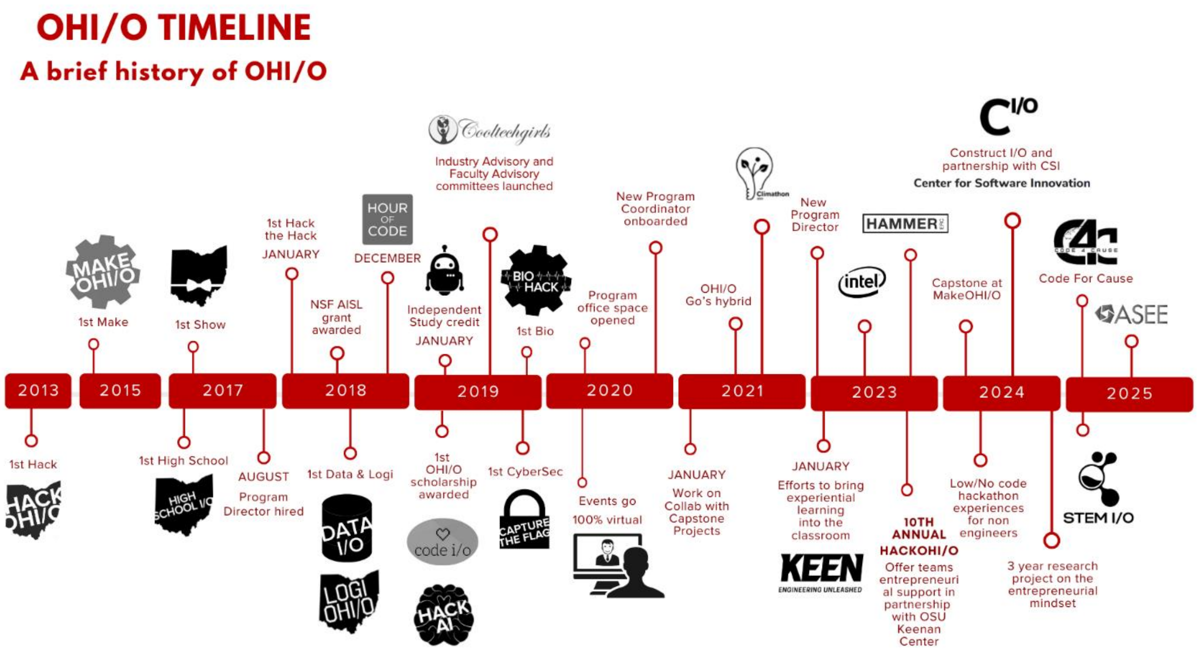

Figure 1. OHI/O Historical Timeline

OHI/O serves a diverse and interdisciplinary student population, drawing participants from over 60 academic majors, with a strong representation from computer science, computer engineering, and electrical engineering. This diversity fosters a rich collaboration, innovation, and peer learning environment, ensuring that students from various backgrounds and experiences can contribute meaningfully to and benefit from OHI/O's events and resources.

OHI/O's mission is deeply rooted in supporting students excited about and invested in tech development, guided by curiosity, connection, and creating value. Students are encouraged to identify problems worth solving, collaborate across disciplines, and design impactful solutions that address societal and industry challenges. This practice is reinforced by OHI/O's partnerships with faculty, alumni, and industry professionals who mentor teams, present keynotes, offer challenges, and provide resources that bridge the gap between academic study and career readiness.

Through its events and partnerships, OHI/O aims to strengthen the university's tech community and contribute to workforce development. The program's emphasis on self-directed learning, real-world engagement, and hands-on experiences seeks to position it as a vital contributor to its participants' academic and professional growth. By integrating technical skill-building with leadership development and interdisciplinary collaboration, OHI/O equips students with the competencies necessary to excel in evolving technological fields and to drive meaningful impact within their communities and industries.

2. Entrepreneurial Mindset Interventions

Integrating the Entrepreneurial Mindset as an element of guiding philosophy into the program has been comprehensively involved in a series of ongoing interventions. Specifically, an EM-based rubric, applicable to the program's competitions, has been applied to most challenges. The participants', judges', and mentors' guides were modified to include the EM framework. Next, a five-unit EM leadership training program was implemented to engage the student leaders, and a series of modifications were made to the competition. Lastly, a capstone-specific track was added to the competition to study the potential benefits of linking this informal space to formal coursework. This section discusses the implementation of EM into student leadership, student participation, judging, mentorship spaces, and other program modifications, as well as how each interacts with elements of EM.

2.1 Development EM Values-Based Rubric

The OHI/O program's traditional judging criteria were realigned with the EM framework through systematically mapping to Ohio State's College of Engineering's Entrepreneurial Mindset Learning Outcomes (EMLOs) [9], [10]. The traditional judging criteria included Technical Difficulty, Social Impact, Wow Factor, Creativity, and Innovation. Though not formally developed into a rubric, these principles have long been the judging criteria for the OHI/O hackathons. **Figure 2** below highlights the traditional criteria and provides additional context. Importantly, these values served as the judging criteria for the OHI/O events.

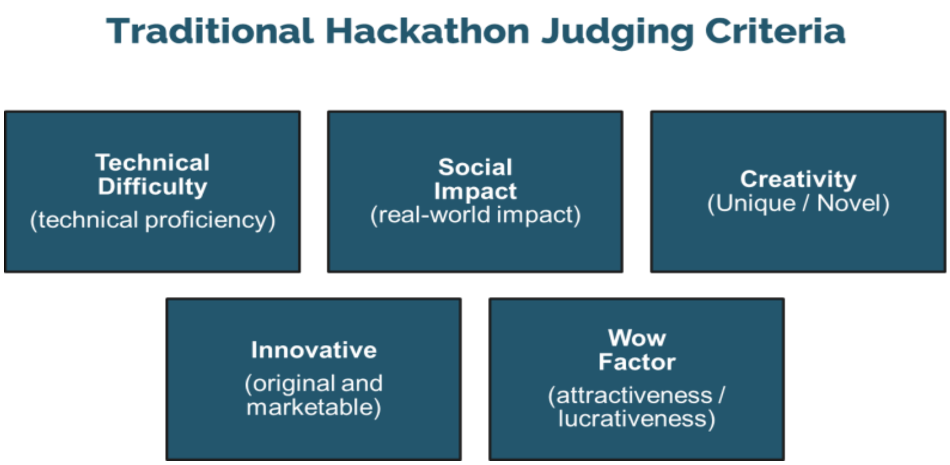

Figure 2. Traditional Program Judging Criteria

These core values were systematically re-aligned with the college of engineering's EMLOs through a process that leveraged OHI/O program staff, academic advisors, student leadership, and KEEN EM veterans. Notable as a student-run program, it was important to cultivate buy-in from the student leadership. The new rubric draws from 14 learning outcomes, including the six defined by the KEEN framework. The 14 learning outcomes are further divided into beginner, intermediate, and advanced levels. Nine of fourteen established learning outcomes were mapped to the traditional judging criteria and hackathon experience. The final mapping connects the KEEN 3Cs, OHI/O's legacy values, to the nine EMLOs, as shown below in **Figure 3.**

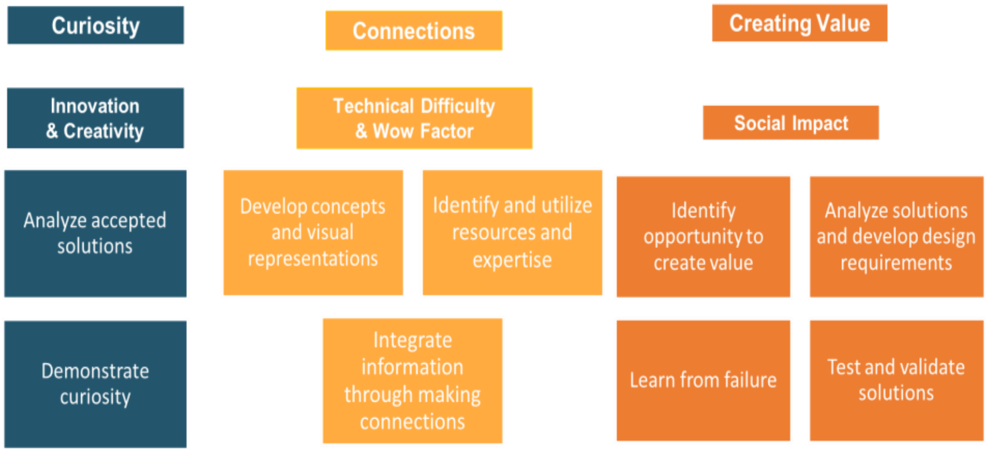

Figure 3. EM Learning Outcomes Mapping the 3C, Legacy Judging Criteria, to EMLOs

These nine EMLOs were then grouped into the six new core values illustrated in **Figure 4**. Below are the values: Innovation, Curiosity, Communication, Project Breadth and Complexity, Impact, and Navigating Challenges. These new core values were further developed into a detailed rubric based on the EMLOs and engagement with stakeholders, including students, staff, OHI/O faculty advisors, and EM educators.

Figure 4. Enhance Hackathon Values

The rubric includes a description of each value, a description of "what this might look like," example questions to ask, and detailed evaluation criteria ranging from developing to advanced, on a five-point scale (1-5) with a five, or "accomplished" rating, representing exceptional achievement. Among other elements, the rubric integrates benchmarks of creativity, technical expertise, and entrepreneurial thinking. To support consistency, the rubric is distributed to students, judges, and mentors through handbooks, team pre-judging self-assessments, judging tools, and the rubric is embedded thematically in orientation videos. The authors believe this ensures consistent, fair, and transparent expectations for students and enhances the ability to provide meaningful feedback on qualities contributing to successful projects. While the rubric is usually displayed as a six-by-eight consolidated tool, we have split it here into **Table 1** and **Table 2**.

Table 1. Rubric Criteria with Definitions and Guidance

Criteria	What this might look like	Questions to Ask
Innovation Challenge the norm by analyzing existing solutions through testing or research, then exploring ways to improve or reinvent.	This might look like a project that improves an existing solution in a way that increases value (access, affordability, opportunity, empowerment). It may also be a brand-new approach or potential solution that addresses a problem. Both cases involve a team identifying a problem and examining existing solutions.	How did your team challenge commonly accepted ideas, and what did you do differently in your project?
Curiosity Being curious, ask questions that inspire growth and result in the artful application of scientific principles.	This might look like a team that questioned existing limitations, a team that sought to discover an unaddressed problem, an outside-the-box project, or a project that leveraged unique ideas and processes.	Can you share some examples of questions your team asked while exploring possibilities? Show us something unique, beautiful, or clever in your project.
Communication Effectively communicating project concepts, including a visual representation that explains the project's development process and purpose.	This can be seen in a team's project video or slide deck, and the examples shared during the interview process. It may be a slide deck, a physical prototype, a poster, a video, or other representation that describes their project and process.	What part of your presentation shows off your work best? Can you show me your prototype and how it explains your concept?
Project Breadth and Complexity Leveraging humanities, engineering, and science knowledge and skills to make complex/ nontrivial innovations successfully.	This might involve using diverse frameworks, APIs, data, perspectives, and programming best practices. Teams may use resources from domains like Medicine, Robotics, Environmental Sciences, and Economics. It may also include projects that consider future growth, scalability, and sustainability, connecting current and future needs with a flexible concept that might be a sustainable, future-oriented solution.	How did you use information from two areas to explore a new idea? What was the most complicated piece of this project to build? What changes if this project is scaled? What could this project look like if it were 10X as big or reached 10X the people?
Impact The project seeks a solution with potential social, economic/ business, environmental, or other tangible value.	This could look like a project with well- defined user needs or projects that consider their implementation's reach, adoption, and long-term effects.	What does your project improve, or who might it help? What user needs did you keep in mind while working on this? Did you get any feedback from your target audience about your proposed solution?
Navigating challenges Testing ideas, recognizing barriers or failures as important feedback moments, and pivoting accordingly.	This might include teams that chose a crucial pivot in their project due to a gap in knowledge or teams that made changes to their project after testing it and discovering a problem.	Name one thing you struggled with or that didn't work at all. How did you pivot your plan from there? How did you test your ideas and make changes based on the results?

Table 2. Rubric with Scoring Criteria

Criteria	Accomplished 5 points	Advanced 4 points	Intermediate 3 points	Beginning 2 points	Developing 1 point
Innovation Challenge the norm by analyzing existing solutions through testing or research, then exploring ways to improve or reinvent.	The team based their project on research, analyzed currently accepted solutions to identify strengths or weaknesses, and explored one or more new or alternative successful solutions.	The team developed a project, conducted research on existing solutions, and analyzed current accepted solutions to identify strengths or weaknesses, but they did not explore new or alternative solutions.	The team developed a project, researched existing solutions, did not analyze current accepted solutions to identify strengths or weaknesses, and did not explore new solutions.	The team developed a project and did not examine existing solutions for potential improvements; instead, they used an already known or given area of improvement.	The team developed a project but did not research or analyze existing solutions, and no potential improvements were identified.
Curiosity Being curious, ask questions that inspire growth and result in the artful application of scientific principles.	The team worked together to identify knowledge gaps, asking unique or new questions, and acted on that plan to explore and create project outcomes.	The team worked together to identify knowledge gaps, asking unique or new questions, and made a plan that explored answers to improve project outcomes.	The team worked together to identify knowledge gaps, asking unique or new questions to bridge the gaps.	The team asked questions to understand their area of interest better.	The team did not ask questions that addressed their understanding of the project topic areas.
Communication Effectively communicating project concepts, including a visual representation that explains the project's development process and purpose.	The team communicates its idea through a functional prototype of the project's essential elements, including sketches, drawings, diagrams, etc.	The team communicates its idea through a prototype of the project's essential elements, sketches, drawings, diagrams, etc.	The team communicates their project's idea through detailed sketches, drawings, diagrams, etc., representing essential elements, OR has a prototype without any additional detailed documentation.	The team communicates the idea of their project through basic sketches, drawings, diagrams, etc., which represent some elements.	The team does not present a prototype or representation of their project.
Project Breadth and Complexity Leveraging knowledge and skills from the humanities, engineering, and science to successfully	Synthesize ideas from a wide variety of sources across the humanities, sciences, and engineering to create something new,	Connect ideas from more than two sources across different humanities, engineering, and science areas.	Connect ideas from more than one technical area of knowledge.	Connect ideas from the same technical area of knowledge or skill	The team does not connect more than one idea to inform their concept.

Criteria	Accomplished 5 points	Advanced 4 points	Intermediate 3 points	Beginning 2 points	Developing 1 point
make complex/nontrivial innovations.	future-oriented, and effectively complex.				
Impact The project seeks to provide a solution with potential social, economic/business, environmental, or other tangible value.	The team proposes and justifies a detailed concept (solution, prototype) with potential social, economic, or environmental value, and it is feasible for development.	The team proposes and justifies a detailed concept (solution, prototype) with potential social, economic, or environmental value, but it is not feasible for development.	The team refines the features of their solution using research to enhance the potential social, economic, and environmental value.	The team identifies features of their solution with potential social, economic, and environmental value.	The team does not identify features of their solution with potential social, economic, or environmental value.
Navigating challenges Testing ideas, recognizing barriers or failures as important feedback moments, and pivoting accordingly.	The team demonstrated that they reflected on their failures and shifted their approach to create a more successful solution based on identified lessons learned.	The team identifies failures or areas for improvement, considers alternative approaches, and implements alternatives based on the lessons learned.	The team identifies failures or areas of improvement and demonstrates reflection by considering alternative approaches.	The team identifies failures or areas of improvement in their approach.	The team did not identify failures or areas of improvement in their approach.

2.2 Participant Guide

The Participant Guide is a resource for members of the Hackathon teams, designed to support them through the hackathon experience. It outlines the event's purpose, emphasizing hands-on learning, innovation, collaboration, feedback, and iteration. The guide provides step-by-step instructions for forming teams, identifying problems, planning projects, and leveraging resources like mentorship and workshops. It highlights the criteria for successful projects, including curiosity, connecting information, and creating value. It also reviews the six core values: innovation, creativity, communication, project breadth and complexity, impact, and navigating challenges. Additionally, it details the submission process, tips for maximizing the experience, and the benefits of participation, such as networking opportunities, skill development, and resume enhancement.

2.3 Mentor and Judges Guides

The Mentorship and Judging Guide provides a cohesive framework for mentors and judges participating in events, emphasizing their integral roles in fostering an entrepreneurial mindset among participants. Both guides highlight the entrepreneurial mindset (3Cs) and the six core values mentioned. Mentors and judges are also given a video to watch that provides an overview of the competition and EM. Mentors guide participants through problem-solving and exploration without directly contributing to their work. They are encouraged to offer constructive feedback and encourage persistence throughout the event. On the other hand, judges are responsible for evaluating projects using a structured rubric while providing objective and constructive feedback during evaluations. Together, mentors and judges play critical roles in creating a supportive environment that promotes learning, growth, and the development of creative problem-solving skills.

2.4 Leadership Training

The student-driven focus of the OHI/O program necessitates that student leaders not only adopt the EM framework but also understand, communicate, and apply the framework. For this purpose, OHI/O program staff worked with the KEEN EM team to develop an EML Student Champion Program to support OHI/O leadership development. The program is designed to equip students with the mindset and frameworks to connect their technical expertise to value-driven impact. The program is intended to foster entrepreneurial thinking grounded in the principles of curiosity, connections, and value creation, and it encourages students to apply these concepts within academic, professional, and societal contexts.

Participants engage in four one-hour sessions and a final reflection. Lessons emphasize opportunity identification, interdisciplinary connections, and the creation of context-specific values. Session topics and outcomes included:

- **The Mindsets of Career Transformation**
    - The development of proactive career mindsets enables students to navigate uncertainty and leverage opportunities.
- **How To Capture an Audience's Attention**
    - Communication skills are crucial for effectively conveying ideas and influencing audiences.
- **The Incredible Motivational Power of Curiosity**
    - Motivation through curiosity, fostering a long-term commitment to exploration and learning.
- **The Surprising Consequences of Self-Awareness**
    - Enhanced self-awareness, allowing students to align their strengths and aspirations with meaningful goals.

Training student leaders in EM principles is critical in shaping the structure and educational impact of the hackathons they organize. As these leaders engage with and apply the EM framework, they are better equipped to design hackathon experiences that intentionally foster EM attributes of curiosity, connecting information, and creating value. Their informed leadership influences key aspects of event planning, including challenge formation, integrating mentorship, developing evaluation tools, and reinforcing alignment with EM across all aspects of the programming. This, in turn, reinforces the adoption of EM principles among participants and strengthens the broader educational goals of the OHI/O program.

2.5 Competition Changes

Operational changes were made to facilitate this work, including adding a student pre-judging self-assessment to help understand student perceptions of their performance over the 24 hours. The introduction of self-reflection through a survey, aligned with the judging rubric, enhances the hackathon experience. This reflection activity encourages students to critically assess their performance before receiving judges' feedback or formal scores. The goal is to foster a deeper understanding of their strengths and areas for improvement. After completing their work, the survey is delivered as part of the project submission process before presenting to judges. This timing ensures that students have a comprehensive view of their efforts while maintaining the autonomy of their judgment. This reflective practice enriches the learning experience and promotes a growth mindset.

Adding a dedicated capstone track to hackathons provides a unique opportunity for students to leverage the event's innovative environment and extensive resources to advance their capstone projects. By bringing work created within their courses under the guidance of faculty, capstone teams can use the hackathon as a platform to kickstart or refine prototypes, test ideas, and gather valuable insights. Hosting a dedicated track ensures fair competition by allowing capstone teams to compete exclusively against one another. This separation prevents capstone teams from gaining an unfair advantage over other participants due to their early start on projects and the support they receive from faculty.

The hackathon judging tool was updated and iterated upon to facilitate judges' better understanding of the criteria. The updated judging rubric for hackathons aligns traditional hackathon success criteria with Entrepreneurial Mindset learning outcomes, creating a values-based approach to assessment.

2.6 Capstone Integration

Capstone, similar to Ohio State University's first-year programs, was an early integration point within the College of Engineering for the EM framework; thus, students enrolled in capstone have likely been exposed to EM previously. This offered a natural opportunity to explore the synergy between the formal and informal spaces' ability to interface with EM and each other. Therefore, as an auxiliary element of the study, this work proposes that formal learning can benefit from engagement with independent informal learning spaces, specifically hackathons. This bridges formal and informal learning by aligning the competition with elements of the capstone experience.

After conversations with faculty, it was suggested that the greatest alignment exists between traditional design-build-test capstones (hardware and software). It was also suggested that early prototyping during a capstone's "Concept Design" phase would be the most applicable, where it could potentially jumpstart their prototyping and provide them with immediate feedback. It is believed that offering students a low-stakes, focused rapid prototyping opportunity will encourage students to engage more readily in hands-on work as part of their design process. To that end, instructors are encouraged to create simple assignments offering regular credit, an assignment substitution, or extra credit. A template assignment is provided to instructors to ease the workload.

Capstone teams, except for their own track, proceed through the competition in the same way as any other team. The track is provided to accommodate the additional lead time capstone students have in preparing for the competition. The data collected for the capstone teams is the same as for all other teams, except for instructors being surveyed for feedback on their team's performance.

3. Early Data Analysis and Initial Results

3.1 Methods Overview

The overall effort employs a mixed-methods approach to evaluate the impact of Entrepreneurial mindset-based interventions. Participants include student teams participating in the makeathons and hackathons, volunteer judges, mentors, and capstone instructors recruited through event registration and pre-event information sessions. Student teams are comprised of 2-4 individuals ranging from freshman to senior and are open to all disciplines. Project outcomes were documented through student presentation videos and self-reflection surveys. Other participants (e.g., mentors, judges, instructors) were also surveyed for feedback. The video data was transcribed, and a thematic analysis was conducted using qualitative analysis software to identify patterns and themes within the data. The survey data collected from students, judges, and instructors were statistically analyzed to quantify learning outcomes, contextualize the findings, and provide recommendations on using EM-based interventions and feedback on student engagement.

3.2 Data Selection

The data selection process for this study included reviewing, organizing, and sorting data present in the Excel scoring submission spreadsheets from each event. There are four events from which the data was selected: Make 2022, Hack 2022, Make 2023, and Hack 2023, which are referred to as Legacy data. Each event has a scoring submission form (scoring Excel spreadsheet) that lists student teams, judges' feedback for each student team, and the judges' scores based on the EML-based rubric. The EML-based rubric includes five items: Technical Difficulty, Social Impact, User Experience, Innovative, and Wow factor; each item is scored on a scale of 1 - 10. The averages of these scored rubric items are calculated and listed on each of the event’s associated Excel spreadsheets.

The total of these average scores was calculated and further sorted into three categories: As the data was normally distributed, the authors used +/- one standard deviation as the defining boundaries for high (> +1 Sigma), (+/- 1 Sigma) medium, and low (< -1 Sigma). After the scores were sorted and organized into relevant categories, the scores from each category were inserted into a random picker algorithm that randomizes the selection. For example, all high scores from the Hack 2023 event were inserted into the randomizer, and the number of items to pick was set to four. Similarly, this process was repeated for the other two categories: medium and low. We extracted 12 items from each event, adding up to 48 data items from the legacy data set and 12 items from the Hack 2024 data set (post-intervention data) for this study.

3.3 Data Analysis

The video data was transcribed using Otter.ai, a real-time transcription service [11], [12]. The student presentation videos were stored in a YouTube playlist and extracted for transcription. Each video was between 3 – 4 minutes in duration. The authors randomly selected 12 video presentations from each event as part of the data selection process. Thematic analysis was conducted using qualitative analysis software, NVivo 14, to identify patterns and themes within the transcribed data [13], [14]. First, the new data (Hack 2024) was analyzed, and initial themes were drafted. Following this, the legacy data was analyzed in the following order: Hack 2023, Make 2023, Hack 2022, and Make 2022. Preliminary themes were drafted from the legacy data and compared with the new data (Hack 2024) to find similarities and differences between the interventions.

Thematic analysis is a qualitative technique used to explore and discover patterns or themes within a given data set. This method follows a six-step process. First, the authors familiarized themselves with the data through reading, in this case, through reading the transcribed data. Second, NVivo 14 qualitative analysis software was used to code the transcribed data. The transcribed data was uploaded to the NVivo platform, and an analysis was conducted to generate initial codes. Third, post-coding, the authors looked for patterns and themes within the data. Fourth, the authors discussed the generated themes by exchanging findings from the analysis. Fifth, post-discussion, the identified themes were organized in a summary table (**Table 3**) outlining each high-level theme and its corresponding sub-themes. Lastly, after organizing the themes in a tabular format, the legacy and new data themes were compared to check for patterns and common emerging themes. Based on the last step, the themes were revised. Direct quotes of the participants were pulled from the analysis to represent each theme. The following section provides an overview of the preliminary themes and sub-themes identified through the analysis.

3.4 Preliminary Results

The thematic analysis of the legacy and new transcribed data yielded three high-level themes and their corresponding sub-themes.

Theme 1: Motivation and Opportunity

Motivation and Opportunity theme includes attributes of problem identification, context (reasoning and explanation of choosing a specific problem), benefits, and novelty of the design development.

<u>Sub-theme 1: Problem Identification</u>

This sub-theme highlights participants identifying and explicitly stating the problem chosen for the project in their presentations.

“We created [product] because a lot of people have language barriers, don't know many lesser-known ingredients and often have vision impairments. 3.4 million Americans visit the emergency room yearly for a food allergy related instance, safely can reduce food allergy incidents with one simple picture, eliminating risk and allowing more space and emergency rooms for more other testing incidents”.

Sub-theme 2: Context

This sub-theme highlights participants providing the context or reasoning for pursuing a specific problem or challenge for their team project.

“According to a 2015 study on the world energy output by the International Energy Agency, it's predicted at our current rate of consumption, oil reserves will run out in 53 years. Natural gas at 54 and coal 110 global fossil fuels usage has doubled since 1980 and it's just absolutely no signs of stopping. Thus, it is imperative to find additional renewable sources of energy. Solar power is a promising alternative, but its main limitation is a lack of consistent power generation. To help mitigate this issue, we created a prototype for both absorbs reflective light and has dual access and light tracking.”

Sub-theme 3: Benefits

This sub-theme highlights participants explicitly stating the benefits and advantages of their final product. This includes information such as the product's usefulness for specific populations, how well it mitigates the problem/issue, and its overall design relevance to the chosen consumer audience.

“Is it reasonable to implement this project in the real world? Yes, first, it's easy because it's an easy method to find survivors that have access to their phones and can connect to an automated internet source. Second, it's useful in hazardous situations like the Turkey earthquake, like mentioned before. Third, it offers quick response to people, minimized lives blasting the aftermath.”

Sub-theme 4: Novelty

This sub-theme highlights participants acknowledging the novelty and uniqueness of their created solutions (e.g., how the product stands out).

“Our project, Flowware, stands out by using ChatGPT API to offer smart, personalized financial management while displaying your finances through react flow, creating a dynamic, real-time map of your money.”

Theme 2: Design and Application

The design and application theme includes challenges, design considerations, and implementation.

Sub-theme 1: Challenges

This sub-theme highlights participants acknowledging facing challenges and barriers in their product/design development, including challenges due to limited time and resources.

“Some of the challenges we faced along the way include the 24-hour time constraint that made

3d printing an intricate model impossible. We also lacked a second microcontroller, so we could not test activity between masks. We also had to get creative in coming up with a proof of concept for our solution, we lacked some other materials, including a strong enough voltage supply for the fans, well as various connectors and wires. Finally, as we progressed through the event, we brainstormed more and more ideas and features that we wanted to implement but were unfortunately unable to implement in time."

Sub-theme 2: Design Considerations

This sub-theme highlights participants considering alternatives and making assumptions related to the design process. For example, during their design development phase, participants explored alternative approaches that would work given certain conditions, such as temperature, function, material durability, and more.

"By absorbing reflecting light, solar panels can capture more sunlight and generate more energy even on cloudier overcast days, this can make a significant difference in terms of the energy output and cost savings for solar power system. Additionally, solar panels that can absorb reflecting light to be particularly useful in urban areas. In these areas, buildings and other structures may reflect sunlight onto nearby solar panels. This can create a situation where indirect sunlight can actually provide a significant portion of the energy output for solar panels. By optimizing the angle of solar panels to constantly face reflected light, we can maximize the cell's energy output, resulting in cost savings. This would also keep solar panels at a more consistent and optimal temperature, resulting in a longer life."

Sub-theme 3: Implementation

This sub-theme highlights participants demonstrating the functionalities of their created prototypes.

"We implemented dual access tracking system to dynamically move the solar panel in responses to changes in the angle of assembly. We attached four photoresistors solar panel setup, and the two servos moved either left or right or up or down towards the photoresistor pairs reporting the highest voltage."

Theme 3: Impact and Growth

The Impact and Growth theme includes attributes of impact and future work.

Sub-theme 1: Personal/Societal

This sub-theme refers to participants expressing content and satisfaction while engaging and participating in the event. The participants also stated broader impacts and implications their designs would have in the real-world context.

"We really enjoyed this challenge. It let us experiment with new electronics and software, as well as letting us flex our problem-solving muscles. Yeah, this is easily the most fun and unique challenge that we've done in the about four megathons and hackathons that we've done. And I hope that you enjoy the device that we spent the past 24 hours making as much as we did.”

“The actual impact or app would have, it would have more sustainable cities, as more walkers moves less cars more efficient walkers as they avoid disturbances, more accessible cities as disabled people can walk around without fear, and a safer everyone as they avoid danger.

Sub-theme 2: Future Work

This sub-theme refers to participants stating future goals and plans for their prototypes showcased and presented during the event.

“For our future plans, we want to allow users to have accounts that store their data. This way, the app can cater pathways towards specific disabilities. For example, if you go by a wheelchair, you can avoid bumpy walkways but still go through routes without audio cues.”

3.5 Data Analysis Summary

Table 3 below summarizes the data analysis completed thus far in this work. It shows the two years of historical data that have been thematically analyzed across both software and hardware-centric events (MAKE and HACK) and the themes that emerged. The table also indicates that the authors have been able to evaluate HACK 2024 and shows, for comparison, the themes that have emerged. Notably absent is data from MAKE 2025, which is the first hardware-centric event that will contain the full implementation (MAKE 2024 piloted the rubric in the background). There were no obvious emergent lessons relative to the implementation or logistics of the core data collection.

Table 3. Data Analysis Summary

Theme	**Motivation and Opportunity**				**Design and Application**			**Impact and Growth**	
Sub Themes	*Problem Identification*	*Context*	*Benefits*	*Novelty*	*Challenges*	*Design Considerations*	*Implementation*	*Personal / Societal*	*Future Work*
HACK 2022	✓	✓	✓			✓	✓		✓
MAKE 2022	✓	✓	✓			✓	✓	✓	
HACK 2023	✓	✓	✓			✓	✓	✓	✓
MAKE 2023	✓	✓	✓		✓	✓	✓	✓	
HACK 2024	✓		✓	✓	✓	✓	✓	✓	✓

4. Observations on Early Results, Implementation, and Feedback

4.1 Summary of All Data Collected

In addition to the core study data, quantitative and qualitative data have been collected from the student judging sign-up process and the judging process itself. Specifically, the authors gathered the following relevant data items:

- Student self-assessment: Students assess their team's performance based on the overall competition rubric.
- Capstone participation status: Students indicate whether they have participated as a part of a capstone course.
- Student project type: Students indicated the specific challenge (i.e., project) they elected to compete. For example, challenges can be industry-sponsored, low-code/no-code, or student-initiated.
- Judges' assessment – quantitative scores: Judges score the students based on the competition rubric.
- Judges' assessment – qualitative feedback: Judges are asked to provide narrative feedback to the competition teams.
- Student-leader qualitative feedback: Students provided feedback on their experience with five EM leadership training models.

When combined with the thematic analysis of the 4-minute videos, these artifacts represent a large amount of data with which in-process reflection is possible, to improve outcomes in real time. We will conclude this paper by discussing the students' observed level of self-reflection, the student vs. judges' perceptions, challenges with adoption and value added for capstone, judges' narrative feedback on student projects and implementation, and student leader training.

4.2 Student Level of Self-Reflection

As mentioned earlier, as part of the students' judging sign-up process, students are asked to independently reflect on their attainment level within the rubric criteria. For a recent competition, **Table 4** The table below shows the number of student teams participating in judging as part of an industry challenge or in an independent project of their own. It shows that 56 student teams participated in the industry-based challenge and 77 in an independent project of their own (a total of 133). With that in mind, of interest was not just how students were rating themselves but the quality, if only inferred, of those ratings.

Table 4. Number and percentage of teams participating by hackathon challenge type.

Challenge Type	**Number of Teams**
Industry + LCNC	56
Independent	77
Grand Total	**133**
Industry + LCNC	42.1%
Independent	57.9%

To that effect, one observation was the number of teams that rated themselves a single undifferentiated value across all judging categories (for example, all 3's or all 5's). As shown in **Table 5** below, 43 teams exhibited this behavior, most of which were rated as "Accomplished." Of interest was that further review of participant data showed a possible difference in the perception of industry versus non-industry challenge participants. Specifically, the data showed that while approximately 58% of students worked on their own challenge (i.e., independent) and 42% worked on an industry or OHI/O-sponsored challenge, this did align proportionately with the 48.8% and 51.2%, respectively, that effectively did not complete the self-evaluation. This suggested that industry teams, to a somewhat greater degree, tended to overlook the importance of accurately completing the self-reflection activity.

Table 5. Number and percentage of failure rate themselves differently by challenge type.

Challenge Type	**(#/%) of Teams**	
Industry + LCNC	22	51.2%
Independent	21	48.8%

4.3 Student vs. Judge's Perception

Students' and judges' perceptions of performance differ significantly depending on the evaluation category. **Table 6** The table below describes student and judge ratings of projects based on the six evaluation criteria. It contains columns for overall and screened scores. The screen scores omit any student team that scored themselves an undifferentiated rating, as described in the previous section. The table also contains columns on the right summarizing the gap between students' and judges' ratings.

As seen from the table, the gap ranges from 0.4 to 1.0. The widest gaps in perception are within the categories of curiosity, impact, and navigating challenges, with a difference of 0.8 to 1.0. As expected, the overall rating illustrates the greatest difference in perceived performance, which is expected due to the number of student teams rating themselves as having an undifferentiated score of 5. Further study will need to be conducted to discern why the difference exists between the judge's perception and student perception, particularly in the areas in which the gap is widest.

Table 6. Students' and Judges' ratings with differential

	Student Rating		**Judges Rating**		**Δ Between Student and Judges' Rating**	
Rubric Criteria	Screened	Overall	Screened	Overall	Screened	Overall
Innovation	3.9	4.0	3.4	3.4	0.4	0.6
Communication	4.1	4.2	3.6	3.6	0.5	0.6
Project Breadth	3.8	4.0	3.3	3.2	0.6	0.7
Curiosity	4.1	4.2	3.4	3.4	0.8	0.9
Impact	4.1	4.2	3.3	3.3	0.8	0.9
Navigation Challenges	4.3	4.3	3.3	3.3	1.0	1.0

4.4 Participation & Value-Add Capstone

The capstone intervention has struggled to gain ground with low engagement from both capstone faculty and students. A total of 11 capstone teams have participated in the last three events, which include the Make 2024 rubric pilot and the Hack 2024 and Make 2025 events. Approximately 9 of 11 have fully participated (i.e., prototyping and then participating in judging). An effort has been made to minimize instructor overhead and incentivize engagement within competition through the dedicated track and prizes. Effort has also been made to incentivize engagement through professional development funds offered to faculty. The following observations were made during analysis:

- Teams that have participated fully (the majority of teams) appeared to uniformly and without evaluating quality, produce a tangible result.

- Teams that have prototyped have incorporated these prototypes into their coursework (at some level).

- Notable concerns anecdotally suggested are as follows:
    - There is a perceived gap in the value of participation, and students who participate downplay the value of fully participating (i.e., going through judging) if they do not develop a complete solution.
    - While the authors are targeting an appropriate space and phase within the capstone cycle, the timing between the competition and the courses can vary.
    - Thus, individual course schedules may place the competition too early or too late within the term (i.e., if students are still in problem or requirements definition, or have progressed to when the course is pushing the team to arrive at a first cut solution).

4.5 Judge Narrative Feedback on Student Projects

The judges provided narrative feedback on the team’s performance in addition to quantitative ratings.

Table 7 summarizes judges' feedback by topic and associates a frequency count based upon 108 randomly selected feedback elements, from a total qualitative data set of 530 judges’ entries. ChatGPT was used to sort the data, suggest themes (topics), and provide a frequency count. Results were manually reviewed for accuracy. The judges' qualitative feedback strongly aligns with the values-based rubric that supports the hackathons. Specifically, the judges comment on and offer feedback to the students in the areas described by the rubric. It is noted that one additional area of feedback was captured in the teamwork area. Currently, this feedback is not provided directly to student participants.

Table 7. Analysis of judges' narrative feedback (ChatGPT, modified response to multiple queries on author data. Open AI. Available: NA Accessed 2025/1/15).

Rubric Criteria	**Topic**	**Frequency Count**	**Description**
Innovation	Technical Implementation	16	It focuses on the solution, technical quality, depth, innovation, and suggestions for improvements.
Innovation	Innovation and Creativity	16	Comments praising or critiquing the originality of the concept.
Impact	Usefulness and Practicality	14	Feedback addressing the real-world applicability, scalability, or marketability of the project.
Project Breadth and Complexity	Social Impact and Ethics	12	Comments on the broader social or ethical implications of the project.
Navigating Challenges	Areas for Improvement	11	General suggestions for overcoming gaps in the project or presentation.
Communication	Presentation and Engagement	10	Suggestions about improving the quality and delivery of the presentation or demo.
Curiosity	Future Potential and Roadmap	10	Recommendations for enhancing the solution or taking it to the next stage (e.g., new features, scalability).
Communication	Clarity and Communication	9	Focuses on the need for clearer problem statements, explanations, or communication of the project goals and technical aspects.
N/A	Teamwork and Effort	9	Recognition of the team's effort, collaboration or dedication during the project.

4.6 Judges' Narrative Feedback on Implementation

Judges are sourced from various backgrounds, as suggested previously: academic, industry, and the broader community. As part of assessing the implementation, we collected demographic information of the judges at HACK 2024. Thirty-seven judges completed the survey tool, answering various demographic and experience-rated questions summarized below:

- Are you a returning judge? (68% Yes, 32% No)
- Have you used the new OHI/O EM-based rubric previously? (64% Yes, 36% No)
- Are you a KEEN EM practitioner in the classroom or other setting (31% Yes, 69% No)
- Are you a current practicing industry professional? (94% Yes, 6% No)
- Approximately how many teams did you review during the most recent OHI/O event? (Average of 9.4).
- I understood the evaluation criteria. (Strongly Agree, 82%, 15% Somewhat Agree, 3% Neutral)

- I was able to utilize the rubric tool effectively. (Strongly Agree 64%, Somewhat Agree 24%, Neutral 9%, Somewhat Disagree 3%).
- I believe the rubric appropriately evaluates the 3Cs of the KEEN framework as applied to informal learning at Hackathons. (Strongly Agree 61%, Somewhat Agree 24%, Neutral 3%, I am unfamiliar with the 3Cs of the KEEN framework 3%).

Qualitatively, the judges had a range of valuable feedback to consider regarding implementation. Summarized below are the judges' key elements of feedback:

- The judging process was regarded as a good experience. Judges mentioned that it was well communicated in terms of process, rules, and evaluation criteria.
- Increase the depth of training surrounding the rubric, such as adding case studies or examples from previous hackathons. The emphasis was on increasing consistency, normalizing scores, and helping reviewers more easily identify the 3Cs.
- Judges suggested providing students with a template to help guide presentations and streamline judging. Multiple judges noted a disparity in preparation for judging.
- Judges regarded the rubric as a valuable tool that seemed clear, effective, comprehensive, and efficient.
- While the implementation tool was regarded positively, the virtual environment was mentioned several times as a detractor. Some logistical elements raised concerns.

4.7 Student Leader Training

Student leaders were asked to provide feedback on the training classes. The following themes emerged from the training. First, two primary themes emerged regarding participants' experiences and insights from the entrepreneurial mindset training. Self-awareness emerged as a marker of personal and professional growth. Participants highlighted the value of self-awareness in enhancing collaboration and adaptability. These traits improved problem-solving abilities, opened unexpected opportunities, and fostered meaningful connections in academic and professional contexts.

Second, reflections valued proactive problem-solving and a focus on creating value. This mindset enabled participants to view challenges as opportunities for growth. Practical applications included organizing impactful events, enhancing teamwork during hackathons, and leveraging professional networks to uncover hidden opportunities in competitive environments.

Finally, the need for a more interactive and engaging learning environment was emphasized. Participants appreciated the training's interactive elements and suggested incorporating more tools such as group discussions, quizzes, and reflective activities to enhance engagement and information retention. Participants commented on fostering a sense of community and ensuring the practical application of learned concepts. Overall, the feedback underscores the importance of engagement and actionable learning environments.

5. Conclusions and Lessons Learned

The lessons learned from our preliminary analysis will inform next steps. First, the authors plan to observe trends in student mindset development by further comparing the pre- and post-intervention data. This analysis will aid in measuring the intervention's effectiveness in fostering an entrepreneurial mindset (EM). Second, the authors plan to refine implementation strategies based on feedback and challenges encountered. These summary observations and these next steps are discussed here.

The emerging themes highlight the potential benefits of the interventions offered to participants of OHI/O hackathons. Theme 1: Motivation and Opportunity showcased how teams identified and contextualized pressing problems, leveraging their design ideas to create tangible prototypes. Theme 2: Design and Application revealed the iterative nature of the design process, ranging from participants overcoming challenges and exploring alternatives to implementing functioning products. Lastly, theme 3, Impact and Growth, emphasized the participants' reflections on the societal significance of their work and their plans for future developments.

The emergent themes and participant quotes highlighted how students demonstrated their motivation to engage and participate in the event to create solutions for the greater good. Based on initial observations, students expressed their satisfaction in participating in the event and acknowledged seeing value in the opportunities provided. Their participation fostered professional and personal growth by offering opportunities for the participants to engage with diverse teams and problem areas/topics that align with real-world challenges, mentorship through judges, and presenting their ideas to industry professionals. Additionally, there was evidence of technical skill development as participants engaged with several open-source, digital, and technological tools. Furthermore, students expressed individual growth and showcased the potential for creating solutions with a meaningful societal impact. Preliminarily the most complete expression of all three thematic areas is seen in the Hack 2024 data, under which all interventions have been applied.

A review of the various data sources revealed several key insights. First, students often rated themselves uniformly across all categories, particularly in industry challenges. This heightens the gap between student self-assessments and judges' evaluations in areas like curiosity, impact, and navigating challenges. Second, capstone participation has shown low engagement, with only 11 teams participating, and students sometimes downplaying the value of full participation if they did not develop a complete solution. Judges provided qualitative feedback on a variety of topics that effectively map to the new rubric criteria. In terms of implementation, judges suggested more training and case studies to improve consistency in scoring. Student leader training highlighted self-awareness, collaboration, and adaptability, and emphasized proactive problem-solving. Conversely, the student highlighted the need for a more engaging learning environment.

Based on the abovementioned insights, the authors have provided some recommendations to consider for future studies. First, incentivize accurate student self-assessment through adjusting competition rules or refining the self-assessment tool. Second, specific judging case studies should be developed for inclusion in judge training. Third, update student leadership training to include more active learning. Lastly, prepare a more comprehensive toolkit for capstone instructors that emphasizes value to students. These changes will be implemented over the final year of the study (Hack 2025 and Make 2026).

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Appendix

Table 8. Data Collection and Analysis Summary

Data Source / Tool	Description	When/Where is it collected	Analysis Status
Student Judging Application	Application Data, including capstone participation status (yes/no and what class), student project type (industry-sponsored challenge, low code/no code challenge, or student-initiated).	Collected as part of the judging sign-up process.	Data is being actively collected during each event and being analyzed simultaneously (ongoing).
	Student self-assessment in which a team assesses its performance based on the competition rubric.		Data has been analyzed from Hack and Make (2022-2024); data will be collected from Fall 25 and Spring 26 and thematically analyzed.
	Student 4-minute video presentation documenting their work over the last twenty-four hours.		Analysis is ongoing for new data collected in 2025; Data from Make and Hack (2022-2024) has been analyzed, and the findings have been presented in this paper.
Judges' Assessment	This consists of quantitative scores based on the rubric and qualitative feedback providing context for the scores.	Collected during each competition as part of the judging cycle.	Analysis is ongoing; data has been reviewed statistically for a single competition.
Judging Feedback	This consists of various basic demographic questions, Likert-style questions assessing interaction with the rubric, and requesting general feedback on judging.	Collected after each competition as part of quality control.	Analysis is ongoing; data has been reviewed statistically for a single competition by looking at a limited thematic analysis, which has been performed using ChatGPT to theme and sort the data.
Capstone Instructor Feedback	This consists of a qualitative survey asking the capstone instructors for feedback on outcomes.		Limited data has been collected due to the participation. As more courses participate, data will be analyzed.
Student-leader Qualitative Feedback	Students provided feedback on their experience with five EM leadership training models.	Collected as part of the course.	A preliminary review of the feedback has been conducted.