

Challenges Experienced in Innovation Competitions and Programs from Student Perspectives

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Abstract

Innovation competitions and programs (ICPs) are acknowledged in existing literature as effective mechanisms for fostering innovation and entrepreneurship within universities, corporations, and beyond. ICPs, such as hackathons, design challenges, and pitch competitions, allow students to expand their knowledge beyond the classroom. They help students develop their creativity, foster an innovative mindset, and learn from their mistakes. Participating in these events also enables students to improve their collaborative skills in team settings. However, these programs can also present various obstacles that may negatively impact the student experience. These challenges can relate to funding, organization, team dynamics, outreach, accommodation, and more, impacting how these students perceive the impacts or benefits of ICPs. This paper considers students' challenges and negative experiences while participating in ICPs based on past experiences collected from student interviews. Analyzing students' reported challenges and negative experiences provides a guide to address concerns when developing future ICPs. Understanding the type of obstacles students face in these events may be the first step in making the necessary interventions for further improving the experiences of future participants and ensuring that ICPs add value to students across majors.

Introduction

In order to gain more hands-on experience, many students participate in co-curricular activities in Science, Technology, Engineering, and Mathematics (STEM) or business fields, which we refer to as innovation competitions and programs (ICPs). According to Schuster et al. [1], hackathons, design challenges, pitch competitions, and other similar programs offer students a chance to work on design, construction, and testing under tight deadlines and in multidisciplinary teams. This gives them a more authentic real-world experience beyond their regular coursework. Some of the benefits of participating in student competitions include experiencing teamwork and peer interactions, building innovative mindsets, networking opportunities with potential employers, and a means to test ideas in a risk-free environment [2]. Additionally, students ranked technical and problem-solving skills as the most valued learning outcomes from participating in ICPs [3]. According to Chi and Gursoy [4], solely excelling academically does not guarantee promising employment opportunities after graduation for students in today's age of globalization. Tran [5] finds that many graduates lack the specific skills needed to tackle challenges in real-world situations, especially with communication and teamwork. Participating in co-curricular activities can be one solution for developing these required skills.

Much of the existing literature displays these co-curricular programs in a positive light, emphasizing the many benefits offered to students. Students can gain confidence in their major and beyond through hands-on learning experiences that supplement classroom instruction.

Students who engage in these programs have found higher employment rates, higher success rates, larger profits and sales, and greater firm entry [6]. In addition, participating in innovation programs such as business plan competitions increases student discipline, industry knowledge, and business skills, which enables them to create new products and services [7].

Furthermore, these programs have the potential to not only positively impact students' academic performance but also offer them chances to enhance and refine essential skills vital for their future careers, such as presentation, communication, and teamwork abilities [8]. There are also benefits on the psychological level and that co-curricular activities provide a chance to develop initiative, identity work, and new social skills [9].

Despite their perceived benefits, ICPs can also bring challenges for students that impact their experience negatively. These challenges encompass aspects such as funding, organization, team dynamics, outreach, and accommodations, influencing students' perceptions of the impacts or benefits associated with ICPs. This study discusses the challenges and negative experiences encountered by students during their participation in ICPs, drawing upon insights gathered from past experiences in student interviews. Analyzing these kinds of challenges further allows for a broader understanding of the student ICP experience and offers the potential for better designing these programs and equipping students with the proper resources to maximize their benefits.

Literature Review

Terwiesch and Ulrich [10] emphasize that innovation competitions and programs (ICPs) are acknowledged as effective mechanisms for fostering innovation and entrepreneurship within universities, corporations, and beyond. Obradovic [11] reiterates that ICPs also encourage students to grow their creativity, build an innovative mindset, learn from trial and error, and improve their collaborative skills in team settings.

Although ICPs can potentially improve student experience, it is important to acknowledge the additional challenges and setbacks that students may face while engaging in them. These programs may be challenging to design, as little empirical research exists when designing experiential learning programs about how various learning instructions directly impact learning outcomes [12]. Due to this ambiguity surrounding the best methods for designing and executing these programs, students may experience setbacks during their time in the program. It is important to understand and mitigate these setbacks, as setbacks may have detrimental effects on the learning process, especially if the student teams are unable to properly work towards the project goal due to negative emotions produced by the setback. These setbacks have the potential to limit student attention, as well as hinder their innovative and creative thinking [13].

Challenges

Student challenges can present themselves in various forms within ICPs. Politis and Gabrielsson [14] report difficulties acquiring the necessary resources to meet expectations for a successful project. Cannon and Edmondson [15] mention interpersonal challenges arising from team members holding differing or incompatible views. Moreover, the study by Singh et al. [16]

suggests that entrepreneurial failure can be devastating for aspiring entrepreneurs, with many needing to grieve the venture or failed portion of the process. Considering the emotional implications of aspiring student innovators facing unexpected challenges or failures while engaged in these programs is important. Student challenges can relate to outreach, funding, organization, team dynamics, accommodation, and more, impacting how these students perceive the impacts or benefits of ICPs.

Time Constraints

A significant challenge experienced by students in these ICPs is the difficulty of managing their time effectively. Given the nature of ICPs with their defined goals, deadlines, and limited time, students may struggle with either prioritizing their classwork or competition efforts. Some students might be willing to sacrifice a good grade in a course for the valuable experience gained from participating in the project, and others might choose to put in less time and effort in the ICP to avoid jeopardizing their GPA, thus making it less likely they will gain the skills or benefits that come with participating [1]. Although Schuster et al. [1] also suggest that good project planning and advising can help resolve this issue, it can be challenging to maintain students' focus on both aspects and create a good balance between the two.

Lack of Accommodations and Outreach

Based on research conducted by Dang and Nguyen-Viet [17], one of the crucial factors motivating students to participate in co-curricular activities is their perceived behavioral control. This means that students are more likely to engage in extracurricular activities if they feel that they possess the necessary skills and have sufficient resources such as time and finances. This further emphasizes the need for ICP organizers to design ICPs that are suitable for their potential members. Needs typically vary across separate groups of students, so it is important to consider how befitting they are for each group. For example, short-term ICPs work best for students with limited time. Another challenge that students encounter is the lack of outreach. Students across a wide range of majors were not well informed about innovation competitions, exhibitions, and training programs (ICETs) and reported low awareness of them. Furthermore, students responded to an open-ended question about why they decided not to participate in ICETs with statements such as not knowing they existed or not hearing about them until now [18].

Team Dynamics

When examining the cultural constructs within a successful student design competition team, Foor et al. [19] encounter that the team's culture confines an inclusive educational community to only students who possess the assertiveness to integrate themselves into the group while disregarding other aspects of student life. New members strive to copy this culture of dedication by observing the behaviors of senior members, thus repeating the cycle. Their study further finds that participation becomes difficult for married, parenting, commuting, or financially independent students due to their level of commitment.

Diversity

In a study by Walden et al. [20], the cultures of the Student Experiential Learning Engineering Competition Teams (SELECT) from a particular university are being examined. The study has found that these teams have an uneven distribution of representation, with a lower number of female or minority students. This uneven distribution does not accurately reflect the demographics of the College of Engineering, which the students attend. It was also noted that although these teams recruit at college-wide events, they are still predominantly comprised of white male students who already have pre-established friendships or connections.

Opportunities for Growth

Rauter et al. [21] have found that there is potential for team learning despite these setbacks. Shepherd et al. [22] emphasize this point by highlighting the importance of directing attention and resources to the setbacks of project team members to maintain the group's cohesion and morale while encountering challenges during the design process.

This paper, herein, considers students' challenges and negative experiences while participating in ICPs based on past experiences collected from student interviews. Analyzing students' reported challenges and negative experiences provides a guide to address concerns when developing future ICPs. Understanding the type of obstacles students face in these events may be the first step in making the necessary interventions for further improving the experiences of future participants and ensuring that ICPs add value to students across majors.

Methodology

This paper utilized a qualitative research procedure where interview data was collected and later analyzed via inductive thematic analysis. A research team consisting of project consultants and research students collaborated to create a set of interview questions. A panel of students then validated these questions to remove bias and achieve project goals. Additionally, pilot interviews were conducted to validate the questions and evaluate the interview process.

In order to recruit interviewees, a screener survey was administered, asking demographic and short Likert scale questions about respondent perceptions of ICPs. The survey link was delivered to students at three Northeastern universities in engineering and entrepreneurship fields. Interviewees were invited from the list of respondents who participated in ICPs, ensuring that the sample represented as many student groups and diverse interviewees as possible.

Interviewee Demographics

The team conducted interviews remotely over Zoom with 36 students, with questions covering various topics, including diversity within ICPs, skills learned, challenges faced, student experiences, perceptions of networking, and others. 50% of respondents identified as male and 50% identified as female. 36% of interviewees indicated they were part of the "White" ethnic group. 36% of interviewees indicated they were members of an "Asian" ethnic group. 6% of students indicated they were part of both the "White" and "Asian" ethnic groups. The remaining

interviewees denoted other ethnic groups, including 6% of students selecting “Black,” 6% of students selecting “Hispanic,” and 2.5% of students selecting “Middle Eastern or North African.” 7.5% of students chose not to disclose their ethnic information. The majority of respondents (82%) were actively earning their undergraduate degree, with 12% being first-year students, 34% being second-year students, 24% being third-year students, and 12% being fourth-year students. The remaining 18% of interviewees had already received either a Bachelor’s, Master’s, or Doctorate degree. The areas of study represented in the pool of interviewees varied, with 66% being Engineering & Sciences students, 10% being Hospitality Management students, 7% being Liberal Arts students, 3% being Arts and Architecture students, 7% being Agriculture students, and 7% being students with other majors. Interviewees were also asked about their intimacy with ICPs in general, where 32% of students reported a moderate level of familiarity. 26% of respondents reported being “Extremely familiar” or “Very familiar,” and 42% of respondents reported being “Not familiar at all” or “Slightly familiar with ICPs.

Data Collection

Interviewers received uniform training on interview skills and the objectives of the study. The interviews were conducted over Zoom, independently, and at predetermined times. Interviews lasted from 20 to 40 minutes, and all interviewees provided informed consent for their interview to be recorded. Upon completion, the recorded interviews were automatically transcribed into text and later reviewed by team members for accuracy. The upcoming analysis will concentrate on our interviewees’ responses to the following question: What was the least positive experience of the innovation competitions and programs you participated in?

Findings and Discussions

During the initial phase of the analysis, three members of the research team carefully examined the transcript of each student’s response and individually identified important concepts and codes that were relevant to the research question. In this stage, the team members employed an inductive coding approach, which involved extracting codes directly from the data without attempting to fit them into pre-existing concepts or theories. This approach allowed for themes to emerge organically from the data itself. After that, the team members held a meeting to share and discuss the codes they had generated independently and agreed on a common set of codes, using a consensus-building approach. Later, three team members independently coded the transcripts using the common codes agreed upon in the previous stage, and these codes were combined to create the final themes. To calculate the inter-rating agreement among the independent coders, the Fleiss Kappa function in R, a programming language for statistical computing and data visualization, was used. The resulting Kappa value of 0.578 ($z=23.2$, $p=0.0$) indicates a statistically significant moderate to high agreement among the raters. In the subsequent phase, two research team members analyzed the codes and transcripts, using a consensus approach to group related codes into broader themes of concepts, as presented in Table 1. The challenges expressed by student participants are expressed by the following themes: Team Dynamics, Communication Challenges, Logistical Challenges, Time Management, Frustration/Stress, and Gender Discrimination.

Table 1. The themes and codes provided are summarized in a table:

Themes	Codes	Explanation
Team Dynamics	Experiencing unequally distributed work; Making difficult leadership decisions; Navigating team dynamics; Experiencing uncommitted team members	Challenges and issues experienced around teamwork, leadership, team relationships, dynamics, and member commitment/participation
Communication Challenges	Experiencing miscommunications; Having a noncommunicative mentor	Ineffective communication experiences such as miscommunications, insufficient information sharing
Logistical Challenges	Experiencing travel difficulty; Navigating a disorganized event	Logistical issues faced, such as with travel, event/activity organization
Time Management	Handling time constraints; Managing busy schedules	Difficulties around managing busy schedules and finding enough time
Frustration/Stress	Experiencing negative judge feedback; Feeling frustrated when not seeing results; Feeling stressed; Handling some inefficiency	Negative experiences tied to frustration, stress, inefficiency, and pressure
Gender Discrimination	Experiencing gender discrimination	Specific discriminatory situations faced based on gender

Figure 1 presents a concept graph illustrating the strength of the interconnections between the emerging themes. On this graph, the size of the nodes represents how frequently the themes occurred, while the thickness of the lines represents how often the students mentioned two themes together. “Team Dynamics” is at the center of the concept graph, indicating it is a core theme or a frequently mentioned topic during the interviews. “Team Dynamics” connects directly to all other nodes, indicating its significant role in student challenges and frustrations related to ICPs.

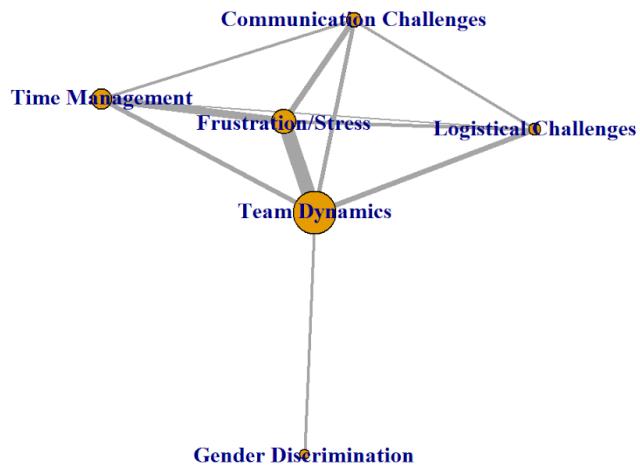


Figure 1. The strength of the interconnections between the emerging themes

The Team Dynamics theme concerns students encountering challenges surrounding leadership struggles, group dynamics, commitment and participation of group members, and teamwork. The following excerpts from interviewees illustrate this particular theme:

“... There can be like some people who don’t pick up what they’re supposed to do. And there’s one person on my team last fall who was like that, like very much do it at the last minute kind of thing...”

“... Our projects are very much student-led,... students decide what’s going on (which is great), but it does mean if you have people in your group who aren’t working, it becomes on you to hold them accountable...”

The theme of Communication Challenges highlights student difficulties with ineffective communication, whether misunderstandings with group members or dealing with an uncommunicative mentor. The following quotes from the interviewees emphasize this particular theme:

“... There wasn’t enough mentorship so we were stuck a lot throughout the process... That was the main issue, so more support in terms of mentorship in our particular field would have been useful...”

“... So that’s kind of always been one of the bigger challenges is just communicating who’s researching what and who’s working on what part of the report that we have to generate....”

The Logistical Challenges theme covers issues involving ICPs themselves, traveling to the event, and other logistics, including disorganized events, poor planning, and travel issues. The following excerpts emphasize this theme:

“... It was really disorganized... It was like the day before they sent an email. It’s like, okay, you’re gonna be doing it at this time in this building. Good luck. No dress code, no who’s going to be there, the details were just very vague...”

“... And for negative experience... Our luggage got lost in Morocco, so we had to wear the same clothes for five days. So yeah. Definitely not positive...”

The Time Management theme involves difficulty managing and balancing students’ busy schedules and handling the tight time constraints of ICPs. The following interviewee excerpts demonstrate this theme:

“... I’m a student. I also work three jobs. So managing all of that time plus making it on time to attend these competitions... So making those meetings, actually working on the pitch deck, having constant communication with your mentor, the competition organizers and your team. It’s really hard to balance that....”

“... Time constraint is always a thing because we do this on the side as a club and it’s not really a class. So we obviously want to put our classwork first. So just coming down to time, when do you have the ability to work on everything, then obviously scheduling meetings as a group....”

The Frustration/Stress theme handles students feeling overwhelmed by the challenges or commitments presented during ICPs, as well as their frustration when experiencing setbacks.

This can also include handling inefficiency or frustration when receiving harsh criticism from ICP judges. The following excerpts from interviewees highlight this theme:

“... Frustrations when you’re working on something for a long time... to work on something for hours and hours and hours and for it to just be thrown away. I was a little sad...”

“... This person was actually like a judge for the competition... he told me he thought that I had a terrible business idea... so it was very disappointing...”

Finally, the Gender Discrimination theme handles students witnessing or experiencing some form of gender discrimination or identifying a lack of diverse participants. The following excerpts emphasize this theme from the perspective of interviewees:

“... I think it was just that the diversity was not the best as it could be, but everything else was good.....”

“... Probably my least positive experience was dealing with some man on a particular team that I was on that didn’t have really a lot of respect for female engineers on the team...”

Many of the themes were mentioned concurrently, which provides a framework for impacting the overall student experience in a positive way by improving one theme. With team dynamics being mentioned frequently and emerging as a core theme, ICPs organizers should offer more support in not only team formation but also team culture building. Additional oversight from faculty and mentors to improve team bonding may lead to the prevention of facing the obstacles of having uncommitted team members or unequally distributed work. Providing team-building workshops and support may, in turn, impact other interconnected themes, such as Frustration/Stress and Communication Challenges. Offering support in making a timeline and having mentors check in to keep projects on track may improve challenges associated with time constraints (Time Management theme), which could have direct impacts on Frustration/Stress and Communication Challenges as well.

Gender Discrimination is another challenge that may be mitigated with more faculty and mentor moderation. By monitoring teams more closely, one can not only promote more team-building activities but also encourage a culture of inclusion by implementing a “zero tolerance” policy and readily addressing instances of gender discrimination among team members. Another suggestion could be to establish a DEI training workshop for ICP members to complete to understand the importance of fostering an environment where all students can grow and thrive.

Conclusion

While it can feel natural to emphasize the many perceived benefits and positive experiences encountered by students who engage in ICPs, further analyzing their negative experiences and challenges is essential to capture the student experience truly. It is crucial to recognize and address these challenges to prevent them from creating a hostile learning experience for students. Synthesizing interview data produced several key ideas related to negative experiences and challenges faced by students participating in ICPs, which can be grouped into the following themes: Team Dynamics, Communication Challenges, Logistical Challenges, Time Management, Frustration/Stress, and Gender Discrimination. These insights guide proper ways to tailor the ICP

experience to address concerns, mitigate difficulties, and ultimately improve the student experience.

Understanding the nuances of the student ICP experience more closely and the best strategies to improve them remain areas to be further explored. Analyzing all sides of the student experience, including negative feedback, ensures the best design and execution of ICPs to facilitate a positive student learning experience properly. Investigating the different strategies that can be used to mitigate these challenges and linking student needs with the actual designing of ICPs remains part of our future research agenda. Starting the improvement process with students by understanding their challenges and taking steps to mitigate negative experiences is key to improving ICPs. Bridging the gap will make ICPs an integral part of STEM education, both in and out of the classroom.

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