

Using a Situational Leadership Framework to Understand the Role of Mentors in Cultivating Innovative Thinking Skills in STEM Education

Abstract

Like many faculty, we have organized student innovation competitions and programs (ICPs) and coached many student teams for various competitions; therefore, we have observed first-hand how transformational the experience has been for our students. ICPs allow students to quickly test their skills and knowledge, push them beyond their comfort zones, encourage them to take risks, and provide a safe place to try and fail, as failures can be seen as a critical part of the learning process [1]. Despite their invaluable learning benefits, existing literature lacks a theoretical body of knowledge on the influence of ICPs on the educational experience. Our goal is to explore transformations in students' mindsets toward innovation through perspectives and data from students who formerly participated in ICPs, mentors who coach students through ICPs, and ICP organizers who create these opportunities for students. This paper will focus on the essential practices of mentors.

Methodology

This study used the interview method to gather responses from thirty mentors from select universities across the Northeastern and Midwestern United States with experience in student ICPs. The collected data has gone through preliminary rounds of qualitative data analyses, and initial conclusions have been drawn to garner a series of best mentoring practices. Interview questions touched on several areas, including personal mentor experience, motivation and practices as a mentor, structure of innovative programs, impacts and challenges of student ICPs, and suggestions to improve the student experience. Interviews were conducted remotely via video conferencing by two research team members, who were trained with uniform interview objectives and skills. Interviews were conducted independently at scheduled times and varied from 20-40 minutes in length. The complete recordings of the interviewee responses to these questions were transcribed into text and underwent an initial coding of analysis. We then focused on analyzing our interviewed mentors' responses to the following question: What are some of your best mentoring practices? The responses to this question were analyzed and developed to create a set of best mentoring practices.

We used a bottom-up approach (inductive coding) to analyze the interview transcripts. First, each research team member was assigned to a random subset of the transcripts, and at least two research team members reviewed each transcript. Then, the research team members independently identified core concepts emerging in their assigned transcripts, and these identified concepts were merged into the final codes during a consensus-building session.

Finally, three research team members reviewed all 30 transcripts independently and marked whether the codes existed in the transcripts or not (leading to a 78.6% agreement on the codings).

Findings

We identified common mentoring styles by clustering the codes based on how frequently they appeared together in the transcripts. The mentoring practices could fall under four categories—Reality checks, goal orientation, project management, and people connectors. The interview results indicate that because ICPs require students to transform an idea into a compelling solution to a pressing problem, mentors need to use a varied set of contextually dependent practices.

First, we identified common mentoring styles (themes) by clustering the codes based on how frequently they appeared together in the transcripts. Figure 1 presents a horizontal dendrogram where the frequently appearing codes are clustered together on the same branch, and different codes are further apart. There happened to be five styles emerged from our mentor interviews. The first mentoring style focused on giving students honest and critical feedback (*Reality Checkers*). Another group of mentors emphasized supporting students in terms of project management (*Project Managers*). The Project Managers cluster was closely related to themes about supporting students to understand the big picture and have a clear vision of their final products. We call this group *Goal Oriented*. Mentors suggested they could advise and guide students better once they understand their mentees' backgrounds and expectations. Another emerging mentoring style involved a focus on providing students with emotional support, i.e., *Emotional Coaching*. Since student competitions may require considerable time and effort, Emotional Coaching is important for retaining students in these programs and ensuring they complete the program successfully. The remaining codes appeared closely under two concepts, although they were conceptually different, i.e., "*People & Ideas Connectors*." Helping students be aware of and connect to resources in innovation ecosystems is an essential mentoring role for student innovation teams to be successful.

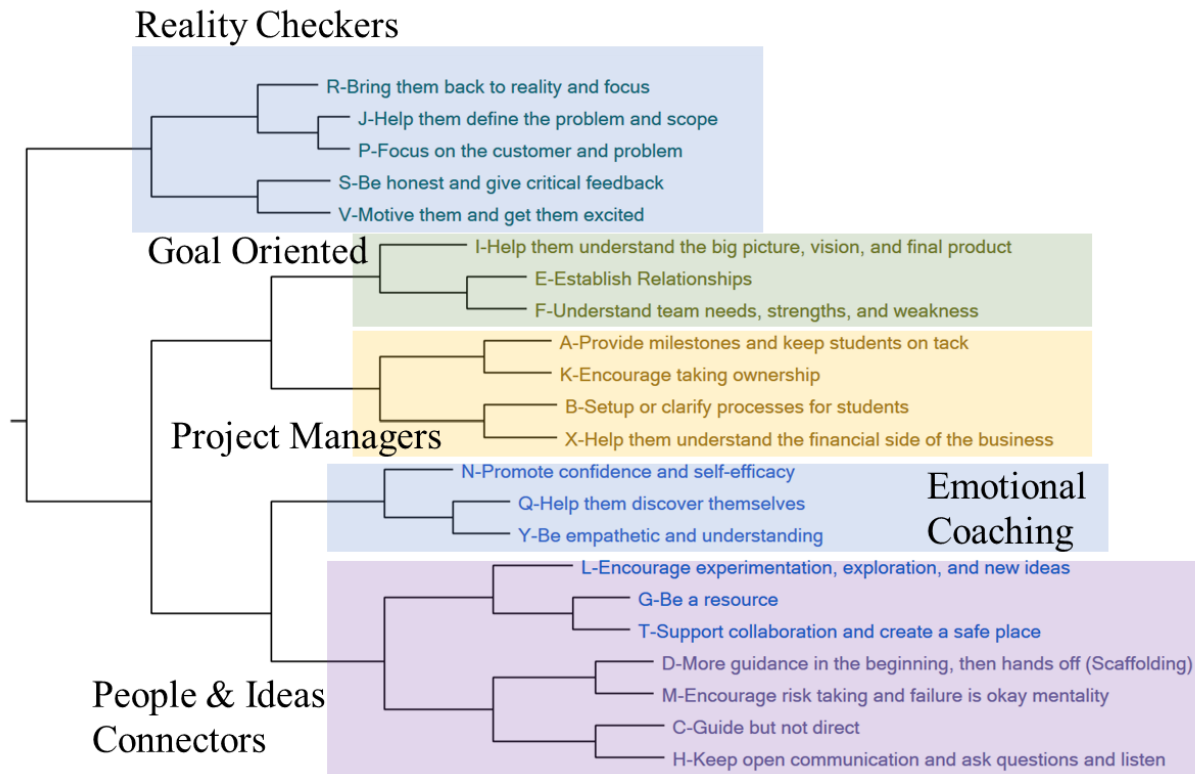


Figure 1. Cluster analysis of the emergent codes and themes.

ICPs also provide an opportunity for students to receive intense mentoring on high-pressure problem-solving. ICPs, by design, provide students an opportunity to learn through mentor relationships and program activities to become self-directed thinkers. Using a situational leadership framework ([2], [3]), we will explore the critical mentoring practices gained through the ICP process --directive practices (project management and goal-oriented) and supportive practices (emotional coaching, people connectors, reality checkers). We will discuss how the situational leadership lens makes explicit the tacit learning that is gained through the mentor-mentee relationship. Since mentoring involves mentees self-regulating behavior, attitudes, and emotions [4] and applying their knowledge in different contexts [5], we will show that the situational leadership lens provides a framework that connects the context to the behavior. The situational leadership lens will also be shown to provide a mental model to understand why a directive or supportive practice is appropriate for a particular context. Finally, it will be shown that mentees can use the mental model beyond STEM innovation and have a framework to use in their professional careers.

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