ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

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The Role of Mentors in Student Innovation Competitions and Programs

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The Role of Mentors in Student Innovation Competitions and Programs

Abstract

Many students in Science, Technology, Engineering, and Mathematics (STEM) fields seek to expand their technical knowledge, develop an innovative mindset, and build teamwork and communication skills. To respond to this need, many higher education institutions and foundations have broadened their co-curricular program offerings to include design challenges, hackathons, startup competitions, customer discovery labs, and pitch competitions that are designed to support and benefit student innovators. Faculty mentors are responsible for being available to students to answer questions, guide student thinking, and advise student teams to facilitate learning. For these students to gain crucial knowledge and at least be educationally successful in these programs, a mentor possessing key traits and using certain strategies is proven to be highly influential. While much research supports the importance and benefit of STEM students' participation in these programs, literature discussing the effective strategies for mentoring students participating in these programs remains limited. Exploring the best mentoring practices will provide insight into how to support and prepare students for innovation competitions and their upcoming careers as well as catalyze their entrepreneurial minds for future success. Based on a series of interviews with experienced mentors of innovation competitions and programs, this paper presents a set of best practices for mentoring student innovation teams.

Introduction

Innovation competitions and programs encourage students to think creatively and innovatively, solve complex problems, develop professional and technical skills, and improve communication and teamwork skills. Hackathons, pitch competitions, design challenges, startup competitions, and entrepreneurship programs can be considered innovation competitions and programs, which have been known to have many important benefits for undergraduate students within STEM fields. Upon participating, students are challenged to develop business ideas, think creatively, work collaboratively, and adhere to tight deadlines. They may experience increased confidence, a greater awareness of diversity, and an increased entrepreneurial spirit resulting from these programs. Due to the flexible nature of many design challenge ideas, students are also given the opportunity to expand their cultural knowledge to address global issues. McKenzie [1] proposes that participating in these programs has been linked to higher success rates, higher employment, higher profits and sales, and greater firm entry. Kwong et al. [2] note that they may also discover needs in their own community that they might be inspired to address. Students who learn about social entrepreneurship through different programs grow to engage themselves more deeply in social and civic matters while developing a broader global perspective.

Innovation competitions and programs may impact aspects of a student's academic, business, and personal development. Some students develop their program experiences to formulate a business venture. Other students participate in these programs to join a team, learn about modern technologies, or for pure enjoyment. These experiences for students play an influential role in forming an entrepreneurial ecosystem as students develop complex business ideas and create their own network of critical thinkers, problem-solvers, and entrepreneurial minds.

Providing student teams with proper resources to solve complex, open-ended problems and develop essential skills that will shape future innovators and critical thinkers are some of the many benefits of these programs [3]. While preparing for competitions, students are expected to collaborate, think innovatively, solve challenging problems, and be prepared to communicate their ideas properly. As student teams develop these crucial soft and practical skills, they are supported by faculty mentors, who assist them in navigating the complex challenges that arise when participating in these programs or competitions. Huster et al. [4] claim that students who are supported by mentors are more likely to participate and thrive in innovative environments and that mentoring can be considered the key to student success in these programs. These mentors play a vital role in student development and provide students with support, guidance, and advice as they navigate these competitions and programs.

This paper reviews interview data from experienced mentors to determine the best mentoring practices to support students within the entrepreneurial realm. The mentors were asked about their experiences guiding students through innovation competitions and programs. We analyzed what specific mentoring styles exist and which mentoring styles are more frequently used simultaneously in our interview data.

Literature Review

To accommodate students from different majors and backgrounds, faculty and staff mentors must be equipped to handle students' wide array of needs when participating in student innovation competitions and programs. Russel et al. [5] comment that competitions are often designed to attract students from a wide variety of disciplines, and these interdisciplinary experiences cannot be considered a one-size-fits-all type of curriculum.

Particular needs mentors may address include assisting in team conflicts, teaching technical skills, providing support and motivation, conflict resolution, preparation for presentations, and development of other personal and academic skills. These mentors can have significant effects on the lives and careers of students: giving them guidance, confidence, and knowledge to develop a product or idea. For many undergraduate students, these competitions and programs are their first exposure to an entrepreneurial experience. They do not yet have the skills, abilities, or mindset to succeed. Mentors, therefore, can guide and support them as they navigate complex issues and develop an entrepreneurial mindset. Blank [6] shares research on how teams with certain levels of prior entrepreneurial experience survive based on whether they take advantage of the offered mentoring program. It was concluded that student teams who had low levels of previous entrepreneurial experience and did not take advantage of the mentoring program had lower survival rates. Conversely, Hu et al. [7] suggest that mentors can greatly affect their

students' long-term dedication and success. Negative mentor experiences are linked to depleted egos and decreased creativity and drive. Hall [8] adds that many collegiate-level students feel it is difficult to find someone trusted to talk to regarding their innovation process. Based on this data, it seems that some universities are not equipped to handle the unique needs of individual students, and some mentors do not foster meaningful connections with their mentees. Mentors consequently have a large effect on their students' long-term dedication and success, whether that experience is negative or positive.

Due to this concern of unsatisfying student-mentor relationships, many student innovation programs also incorporate peer mentoring. In addition to students benefiting from these programs, mentors may also build strong connections and develop their knowledge of entrepreneurial skills. Kubberød et al. [9] note that many innovation programs assign students to peer mentors to provide them with someone relatable. These mentors fulfill the roles of learning facilitator, supportive coach, and familiar role model, which can catalyze student entrepreneurial success. Additional results collected from interviews described by Elliot et al. [10] reveal that student mentors gain an increased awareness of entrepreneurial self-efficacy, diversity and gender issues, and a changed outlook on problem-solving and decision-making.

Despite positive outcomes from peer mentoring, there does seem to be a benefit to students interacting with older, more experienced mentors. Mentoring facilitated by experienced entrepreneurs appears to be directly correlated to student development and success in the entrepreneurial realm. These connections with mentors help students learn new skills and teach them the challenges and opportunities presented by the business world if they choose to pursue their idea outside of the program or competition. According to a study completed to analyze the effectiveness of older entrepreneurs supporting young entrepreneurs by Santini et al. [11], it has been noted that intergenerational mentoring is effective in supporting young entrepreneurs through their innovative endeavors and giving them helpful guidance. This mentoring may also foster meaningful conversations between mentor and student, improving dialogue about difficulties young entrepreneurs face and providing support to implement solutions and take risks from the more experienced entrepreneurs. Mentors do not only play a role in developing the fundamental skills and knowledge required to succeed in these competitions and beyond but also are connected to the formation of impressionable students' identities. Many of these projects are meaningful for students and allow them to engage with their unique ideas to serve their communities. Rigg and O'Dwyer [12] report that a close mentor relationship may shape aspects of student identity by stimulating their learning related to innovation, thus adding a deeper layer to their development of practical skills and fostering an entrepreneurial spirit. Holder [13] emphasizes the importance of creating individualized mentor relationships that grow closer over time and are supported by a caring nature and careful guidance. When trust and understanding are established, students can thrive personally and professionally while developing their innovative ideas.

Therefore, mentors must be properly trained and supported to handle their undergraduate students' fresh and malleable minds. There seems to be a delicate line between tough love and overly harsh criticism, and many express their discomfort with a harsh mentoring style. Proper approaches to mentoring remain an area with much uncertainty, but mentors seem to desire to foster meaningful relationships and stronger connections with their students. Interviews of

mentors conducted by Duval-Couetil et al. [14] about their experience with NSF I-Corps, a program that trains mentors, reveal that many are dissatisfied with the "boot camp" style of mentoring promoted in these trainings. They reported that the environment was too cutthroat to connect with students.

These desired deeper mentor connections may only be forged if the student can develop the necessary practical skills to succeed in the business world. Technical skills are a foundation for solving complex problems and developing an entrepreneurial mindset. Cuddihy et al. [15] comment on one program that led students on an 11-week journey to develop an idea and pitch for development funding, and many students identified an increase in knowledge on key innovation topics, including customer discovery, assessing markets, and intellectual property that improved their ability to move forward on their ventures.

While students can expand their knowledge of technical skills and terms through these programs, a disputed topic regarding entrepreneurial education is whether entrepreneurship can be taught or if it is a mindset only certain students possess. Students who are taught entrepreneurship and are given the proper resources to explore their innovative ideas are more likely to further develop an entrepreneurial mindset. Klinger and Schündeln [16] conduct research on a program teaching entrepreneurial skills to business students in Central America. They find that teaching entrepreneurship successfully promotes the creation of new business ventures and the expansion of existing business ventures.

While describing an entrepreneurship program designed to promote innovation in rural areas, Galvão et al. [17] share the necessity of an entrepreneurial ecosystem: a network of mentors, financial support, and resources to jumpstart businesses and support entrepreneurs of all ages. Additionally, at the undergraduate level, students and mentors may benefit from having these resources readily accessible and in close proximity. A bridge between disciplines provides mentors and students with the resources to develop well-rounded innovations. This notion contributes to the idea of community, a network of entrepreneurial minds from different fields and backgrounds coming together to support and learn from each other. Goethner and Wyrwich [18] suggest that the emergence of entrepreneurial ideas in other fields, such as natural sciences and engineering ideas, are benefited by business faculty and resources close by to promote the generation of strong science and technology-based business ideas. Greenberg et al. [19] facilitate discourse among youth entrepreneurs regarding their experiences and emphasize the importance of community in both the entrepreneurial space and their physical environment. Many share their experiences as entrepreneurs of different races, classes, and genders.

This need for community and mentor support relates to the necessity of increased diversity among entrepreneurial programs. It can be assumed that prioritizing diversity is an important facet of increased entrepreneurial involvement, as it promotes student engagement and connection from all backgrounds. Weisz et al. [20] explore diversity within business plan competition teams and finds that teams with higher functional diversity levels perform better and that diversity plays a more prominent role in success than social capital at the initial stage of entrepreneurial team tasks.

Much research exists to support the benefits of student involvement in innovation competitions and programs, as well as their connection to diversity, individuality, and mentor-student relationships. Table 1 summarizes the attributes of mentoring practices mentioned in the above studies in the existing literature. Attributes include traits that foster relationships with students, such as being relatable and supportive to students, as well as more action-based qualities, such as encouraging students to participate and choosing diverse teams. Despite this preexisting knowledge, there is minimal research exploring the specific methods in which mentors enact their roles to foster student innovation and success, as well as connectedness and a sense of community.

Table 1. Summary of the findings in the literature.

Mentoring Practices	**Source**
Facilitating student success	[4]
Encouraging students to participate	[4, 7]
Helping students thrive	[4, 7]
Being relatable	[9]
Being a learning facilitator	[9]
Being a supportive coach	[9, 11, 13, 17]
Being a familiar role model	[9]
Being caring and creating trust	[13]
Having important conversations	[11]
Shaping student identity	[12]
Creating individualized relationships	[12, 13]
Avoiding “boot-camp” style mentoring	[14]
Having a network of mentors	[17, 19]
Choosing diverse mentors/teams from various backgrounds	[19, 20]

Research Methodology

This study used the interview method to gather responses from mentors from select universities across the Northeastern and Midwestern United States with experience in student innovation competitions and programs. The collected data has gone through preliminary rounds of qualitative data analysis, and initial conclusions have been drawn to collect a series of best mentoring practices.

The research process for this project involved three stages: (i) The consideration stage, where existing literature was reviewed and organized to determine a gap. A series of interview questions were then formulated to address these openings in literature; (ii) The data collection stage, where 30 mentors were interviewed, purposefully selected based on their experience involved with student innovation competitions and programs; (iii) The data analysis stage, where interviews were transcribed into text and analyzed using a bottom-up thematic analysis in NVIVO.

Interview candidates were selected based on several criteria: (i) They had experience in mentoring at least one team for an innovation competition or program; (ii) They were involved in STEM-related mentoring at a collegiate institution; (iii) They work currently or had worked in a program at a United States university with undergraduate students.

Most interviewees are from Pennsylvania colleges, including but not limited to Pennsylvania State University campuses, Lehigh University, Temple University, and the University of Pennsylvania. The interviewees' experience spread to further regions of the United States, with some from the Northeast (Cornell University), some from the South (Virginia Tech), and one as far as the Midwest (Purdue University). The selected mentors had experience mentoring at least one student team per year through an innovative program or competition.

When the 30 interviewed mentors were asked how many student innovation teams they mentor per year, 30% responded with "about one," 30% with "2 to 3," and 40% with "more than 5." Of the 30 mentors, about 13% had "less than 2," 20% had "3 to 5," and 57% had "over 6" years of experience mentoring student innovation teams. The study aimed for a balanced gender interviewee pool: 57% male and 43% female. Most interviewees were faculty with various engineering, education, and entrepreneurship backgrounds.

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. Questions touched on several areas, including personal mentor experience, motivation and practices as a mentor, structure of innovative programs, impacts and challenges of student innovation programs and competitions, and suggestions to improve the student experience. For the rest of the paper, we will focus 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 for students involved in innovation competitions and programs.

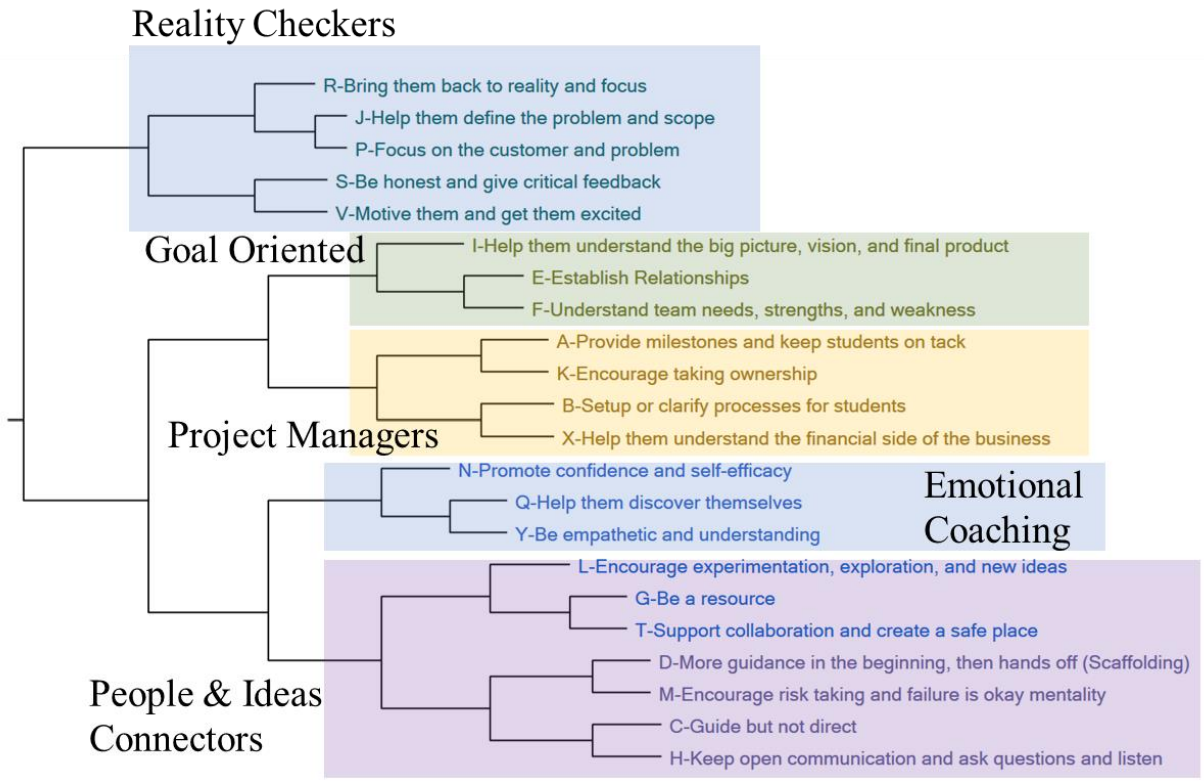
Findings in the Bottom-Up Thematic Analysis

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. These identified concepts were merged into the final codes during a consensus-building session. Figure 1 summarizes the final codes identified for the question: "What are some of your best mentoring practices?" Finally, three research team members reviewed all 30 transcripts independently and marked whether the codes existed in the transcripts or not. On average, multiple coders agreed on 78.6% of the codings, indicating a substantial agreement among the three coders.

First, we identified common mentoring styles by clustering the codes based on how frequently they appeared together in the transcripts. Figure 1 presents a horizontal dendrogram where the codes that frequently appeared are clustered together on the same branch, and different codes are

further apart. The first mentoring style focused on giving students honest and critical feedback (Reality Checkers). The mentors in this group mentioned students' being "*overconfident*" about their solutions at times and helping students "*understand their assumptions and evaluate whether or not those assumptions are accurate and valid*." Another group of mentors emphasized supporting students in terms of project management (Project Managers). However, these mentors did not see their roles as "*to micromanage students*," but rather guide them through the process so that *"they are not losing track or losing steam*." Mentors made clear that *"it was student responsibility, student burden, and students drive the work."* Therefore, they emphasized "*making the students take the ownership in the project is important.*" 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. These mentors indicated the importance of understanding "*the student's profile, what they are interested in, and their strengths and weaknesses"* through "*establishing a relationship"* and *"listening to them carefully."* Mentors suggested they could advise and guide students better once they understand their mentees' backgrounds and expectations.

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



Another emerging mentoring style involved a focus on providing students with emotional support (Emotional Coaching). The mentors utilizing this style emphasized the importance of exposing students to different situations "*to give them confidence."* Mentors also suggested that students had a lot on their plates, and therefore it is important to be understanding and "*to find the path of least resistance and try to empathize with them."* Since student competitions may

require considerable time and effort, Emotional Coaching is important for retaining students in these programs and ensuring that they complete the program successfully.

The remaining codes appeared closely under two concepts, although they were conceptually different. We put them under the same cluster because they frequently appeared together. In this group, mentors indicated that they encouraged students to explore innovative ideas and to be open to experimentation and taking risks. However, this encouragement went beyond simply suggesting students try new ideas. In this capacity, mentors saw their role as supporting students "*to navigate*" complex systems of resources available in higher education and "*try to help demystify*" them while students explore innovative ideas. We call this mentoring group "People & Ideas Connectors" because they saw one of their mentoring roles as being a resource for students. Helping students be aware of and connect to tangible and intangible resources in higher education innovation ecosystems is an essential mentoring role for student innovation teams to be successful.

Conclusions

Since mentors play a key role in the experiences that students have in innovation competitions and programs, a comprehensive set of proven practices would be beneficial to mentors engaged in guiding STEM students. This paper first reviews different mentoring practices existing in literature. Then, it analyzes interview data to determine a set of best mentoring practices by identifying the distinctive styles of mentoring and the connection between certain practices mentioned simultaneously. Therefore, this paper adds to the existing literature by exploring how mentors can best support students participating in innovation competitions and programs through a set of best mentoring practices. Our initial data analysis reveals that the mentors we interviewed are classified as having the following mentoring types: (i) Reality Connectors; (ii) Project Managers; (iii) Goal Oriented; (iv) Emotional Coaching; (v) People & Ideas Connectors. Our results showed that mentors care about students' emotions during the programs. They first tried to understand students' backgrounds and needs and adjusted their mentoring styles to advise them in the best possible ways. It seems that mentors who guide students as opposed to directing or micromanaging them find the most success. Mentors should act as a resource for students to support their technical development, as well as their emotional development. Further analysis of the interview data will be on our future research agenda.

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References

[1] D. McKenzie, "Identifying and Spurring High-Growth Entrepreneurship: Experimental Evidence from a Business Plan Competition," *American Economic Review*, vol. 107, pp. 2278-2307, 2017.

[2] C. C. Y. Kwong, P. Thompson, and C. W. M. Cheung, "The Effectiveness of Social Business Plan Competitions in Developing Social and Civic Awareness and Participation," *Academy of Management Learning & Education,* vol. 11, pp. 324-348, 2012/09/01 2012.

[3] S. Kulturel-Konak, "Overview of Student Innovation Competitions and Their Roles in Stem Education," in *2021 Fall ASEE Middle Atlantic Section Meeting*, 2021, pp. 1-6.

[4] K. Huster, C. Petrillo, G. O'Malley, D. Glassman, J. Rush, and J. Wasserheit, "Global Social Entrepreneurship Competitions: Incubators for Innovations in Global Health?," *Journal of Management Education,* vol. 41, pp. 249-271, 2017/04/01 2016.

[5] R. Russell, M. Atchison, and R. Brooks, "Business Plan Competitions in Tertiary Institutions: Encouraging Entrepreneurship Education," *Journal of Higher Education Policy and Management,* vol. 30, pp. 123-138, 2008/05/01 2008.

[6] T. H. Blank, "When Incubator Resources Are Crucial: Survival Chances of Student Startups Operating in an Academic Incubator," *The Journal of Technology Transfer,* vol. 46, pp. 1845-1868, 2021.

[7] Z. Hu, J. Li, and H. K. Kwan, "The Effects of Negative Mentoring Experiences on Mentor Creativity: The Roles of Mentor Ego Depletion and Traditionality," *Human Resource Management,* vol. 61, pp. 39-54, 2022/01/01 2022.

[8] R. Hall, "Students as Partners in University Innovation and Entrepreneurship," *Education + Training,* vol. 63, pp. 1114-1137, 2021.

[9] E. Kubberød, S. M. Fosstenløkken, and P. O. Erstad, "Peer Mentoring in Entrepreneurship Education: Towards a Role Typology," *Education + Training,* vol. 60, pp. 1026-1040, 2018.

[10] C. Elliott, C. Mavriplis, and H. Anis, "An Entrepreneurship Education and Peer Mentoring Program for Women in Stem: Mentors' Experiences and Perceptions of Entrepreneurial Self-Efficacy and Intent," *International Entrepreneurship and Management Journal,* vol. 16, pp. 43-67, 2020/03/01 2020.

[11] S. Santini, B. Baschiera, and M. Socci, "Older Adult Entrepreneurs as Mentors of Young People Neither in Employment nor Education and Training (Neets). Evidences from Multi-Country Intergenerational Learning Program," *Educational Gerontology,* vol. 46, pp. 97-116, 2020/03/03 2020.

[12] C. Rigg and B. O'Dwyer, "Becoming an Entrepreneur: Researching the Role of Mentors in Identity Construction," *Education + Training,* vol. 54, pp. 319-329, 2012.

[13] A. A. Holder, "Sustaining a Legacy in Stem, the Prof. Tara Prasad Dasgupta Way: The Role of a Mentor in Our Lives," *Inorganica Chimica Acta,* vol. 521, p. 120304, 2021/06/01/ 2021.

[14] N. Duval-Couetil, A. Huang-Saad, and M. Wheadon, "Training Faculty in Entrepreneurship and Innovation: An Evaluation of the National Science Foundation Innovation-Corps™ Program," *Entrepreneurship Education and Pedagogy,* vol. 4, pp. 583-608, 2021/10/01 2020.

[15] M. J. Cuddihy, J. M. Servoss, D. C. Olson, B. J. Martin, C. Vemuri, K. A. Eagle, *et al.*, "A Program to Drive Innovation and Entrepreneurship in Academic Cardiovascular Center

Incorporating Clinical Team and Patient Codesign," *Journal of Clinical and Translational Science,* vol. 5, p. e89, 2021.

[16] B. Klinger and M. Schündeln, "Can Entrepreneurial Activity Be Taught? Quasi-Experimental Evidence from Central America," *World Development,* vol. 39, pp. 1592-1610, 2011/09/01/ 2011.

[17] A. R. Galvão, C. Mascarenhas, C. S. Marques, V. Braga, and M. Ferreira, "Mentoring Entrepreneurship in a Rural Territory–a Qualitative Exploration of an Entrepreneurship Program for Rural Areas," *Journal of Rural Studies,* vol. 78, pp. 314-324, 2020.

[18] M. Goethner and M. Wyrwich, "Cross-Faculty Proximity and Academic Entrepreneurship: The Role of Business Schools," *The Journal of Technology Transfer,* vol. 45, pp. 1016-1062, 2020.

[19] D. Greenberg, A. Calabrese Barton, E. Tan, and L. Archer, "Redefining Entrepreneurialism in the Maker Movement: A Critical Youth Approach," *Journal of the Learning Sciences,* vol. 29, pp. 471-510, 2020/10/19 2020.

[20] N. Weisz, R. S. Vassolo, L. Mesquita, and A. C. Cooper, "Diversity and Social Capital of Nascent Entrepreneurial Teams in Business Plan Competitions," *Management Research: Journal of the Iberoamerican Academy of Management,* vol. 8, pp. 39-63, 2010.