

Building a Framework to Understand the Impact of Entrepreneurship Support Programs on the Formation of Engineers

Introduction

Entrepreneurship Support Programs (ESP) in engineering provide education, mentoring, and advising for emerging entrepreneurs and their ventures. The impact of ESPs on engineering students' professional formation and the acquisition of different attributes—such as creativity, risk-taking, empathy, and curiosity—is largely unknown. Though the social sciences have a strong and robust history of studying many of the attributes, such as creativity and problem-solving, typically associated with entrepreneurship, there has been little connection between this foundational research and the work of ESPs. A separate systematic review has shown that most published work in STEM entrepreneurship education is not theoretically grounded and does not follow standards of quality research approaches in the social sciences [1]. In an effort to bridge the gap between social scientists and engineering entrepreneurship practitioners, the authors are conducting a two-phase study. Phase 1 of the study involves conducting a Delphi study to identify the top entrepreneurial attributes of professionals and researchers who lead ESPs. Phase 2 of the study includes conducting workshops with social scientists who study the attributes and ESP leaders. The goal of the workshops is to identify assessment frameworks grounded in social science theory and literature that will guide the measurement of the attributes. This paper will focus on the results of the Delphi Study.

ESPs are one mechanism by which students can gain knowledge, skills, and capabilities for both students who aspire to be entrepreneurs as well as those who plan to work in industry settings. It should be noted that most ESP programs focus on the development of an entrepreneurship mindset. While the term entrepreneurial mindset does not have an agreed-upon, unified definition, most programs define it either as 1) a manner in which individuals solve problems or design products, utilizing an approach that can bring economic value to a venture, their employers, or society or 2) a set of differing characteristics or attributes that individuals would need in order to be successful in a variety of settings (either in an entrepreneurial or broader context) [13]. This study focuses on the identifying the attributes that are developed through the activities offered by the ESP. Byers, Sheppard, & Weilerstein (2013) state, "Entrepreneurship education teaches engineering students in all disciplines the knowledge, tools, and attitudes that are required to identify opportunities and bring them to life. Students who take part in entrepreneurship programs as undergraduates gain

insights not available from traditional engineering education, such as understanding and designing for end users ('empathy'), working in and managing interdisciplinary teams, communicating effectively, thinking critically, understanding business basics, and solving open-ended problems [14]." Phase 1 of the research study focused on identifying entrepreneurial attributes that entrepreneurship practitioners and researchers perceive as important for students to be successful in entrepreneurship, as professionals, and working in inclusive environments. Phase 1 utilized a Delphi technique to allow for both exploratory and confirmatory processes.

Methodology

The Delphi technique is a common research technique used to achieve consensus among experts [2]. Unlike focus groups where people gather to arrive at a consensus, the Delphi technique considers each participant as an autonomous individual and consensus is achieved through a series of questionnaires [3]. The first step in the Delphi process is to develop a panel. Panel members are considered to be experts in the field and have a vested interest in contributing to answering the research question. Panel members may or may not know each other. Panel members' primary involvement is through the completion of questionnaires. Panel members have access to the overall results of each questionnaire. However, participants do not have access to individual questionnaire responses. This approach allows for a true group consensus rather than any single individual influencing the overall consensus making. The second step is to develop a series of iterative questionnaires. Responses from each round of the questionnaire informs the choices presented in the subsequent questionnaire.

Delphi Panel

The selection criteria required participants to have conducted research in entrepreneurship education or have been an administrator of an entrepreneurship program. The study invitation was sent to seventy-three individuals who lead or have led an ESP, have conducted research in entrepreneurship education, or act as administrators of relevant entrepreneurship programs. Thirty-five individuals expressed an initial interest in the study. Ultimately, 14 people participated in the study. All individuals who participated in the study were experts in the field of engineering entrepreneurship education. While there is variation in the number of panelists who participate in a Delphi study, generally 12 panelists is considered to be a sufficient sample size [4,5,6]. Furthermore, Delphi techniques rely more on informed expert consensus rather than statistical power [7].

Delphi Questionnaires

There are no firm recommendations on the number of rounds required for a Delphi study; it is up to the researchers on the desired level of consensus to be reached and

the degree of convergence among the panelists [8,9]. This study comprised three rounds- brainstorming, narrowing, and ranking. Each phase of the Delphi Study asked participants to think about three different sets of attributes: 1) entrepreneurial attributes that they thought were important in the development of an entrepreneur, 2) attributes in becoming a successful professional, and 3) attributes in working in an inclusive workspace. The surveys intentionally did not provide any definitional resources or guidance around the attributes. The researchers did not want to influence the respondents in any way and wanted the responses to be informed by participant expertise and experience. In the brainstorming phase (Round 1), participants were sent an online questionnaire and were asked to brainstorm as many attributes as they could think of. The results of the brainstorming questionnaire were consolidated and used to develop the narrowing questionnaire (Round 2). The narrowing questionnaire asked participants to narrow the attributes to the top 10 key attributes. The results from the narrowing questionnaire were then used to develop a ranking questionnaire (Round 3). Ranking questionnaire asked participants to rank the items on a scale of importance with 1 being the most important to 10 being the least important for each set of attributes. The results of the round 3 questionnaire were analyzed to identify the attributes that were ranked the highest among a majority of the participants. As there was group consensus on the key attributes, a subsequent ranking questionnaire was not administered.

Analysis

As the Round 1 questionnaire included only open ended questions, thematic analysis was conducted with the text data to identify attributes for each of the questions. A total of 25 key attributes, across all three questions, were identified through the thematic analysis and used in the Round 2 survey. Attributes that were selected by 50% or more of the participants as one of the 10 key attributes (Round 2 survey) were selected for the ranking questionnaire (Round 3). Attributes that were ranked as one of the top 5 attributes by 75% or more participants were identified as the key attributes. The levels agreement that has been used in each phase of this study has been considered appropriate in previous Delphi Studies [2, 10, 11, 12].

Results

Problem solving, critical thinking, motivation, team player, empathy, and open-mindedness were the top attributes identified through the Delphi Study. Table 1 shows the ranking by attribute.

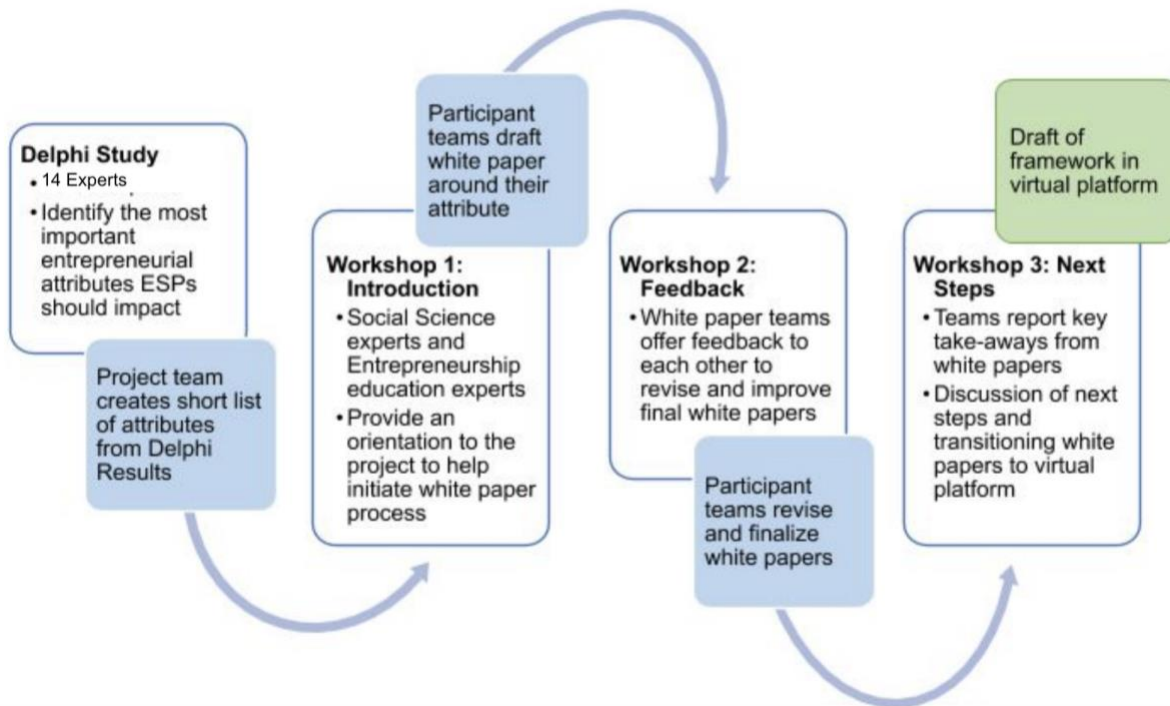
Table 1 Key entrepreneurial attributes

Attributes	% Respondents who ranked the attributes as a key attribute
Problem solving	83%
Empathy	83%
Open- mindedness	83%
Critical thinking	75%
Motivation	75%
Team player	75%

Next Steps:

Results from the delphi study were used to design phase 2 of the study. Phase 2 is the implementation of an interdisciplinary workshop series where social scientists who study the attributes identified in the Delphi study are paired with entrepreneurship educators/researchers. This Phase was launched in February of 2023 and will continue through the summer of 2023. In the workshop series, each pair of social scientists and entrepreneurship educators will explore a construct from an assessment and measurement perspective within the context of entrepreneurship education. The constructs being included were based on the results of the Delphi study, focusing on problem solving, empathy, critical thinking, motivation, and team player. Unfortunately, because we did not find a social scientist who had expertise in open-mindedness, only five constructs are currently being explored. Each team will write a whitepaper including considerations and guidance for how this construct can be defined, included in ESP programming, and assessed. Each whitepaper will provide a roadmap (grounded in social science theory and literature) on how to measure the impact of the ESP on entrepreneurial attributes on student engineers. Figure 1 illustrates the progression from the Delphi Study to the workshop series. The whitepapers will then be disseminated through a website and workshops provided through [a national organization-anonymized for paper review].

Figure 1 Delphi Study and Workshop Series



Acknowledgements:

The authors acknowledge the National Science Foundation (Award Number: 2220329) for providing funding for this project. Any opinions and findings expressed in this material are of the authors and do not necessarily reflect the views of the NSF.

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