

INTRODUCTION

Engineering entrepreneurship education research has yet to be fully developed despite the wide adoption of entrepreneurship into engineering programs. This is partially due to the fact that the engineering faculty and practitioners leading these programs have limited exposure to education evidence-based research, theories, and methodologies.

The purpose of this review is to help newcomers to engineering entrepreneurship education identify major themes and theoretical constructs being pursued in entrepreneurship education by documenting the current state of research, identifying the most commonly used theories and variables, and proposing steps for employing rigorous research designs grounded in theory.

RESEARCH QUESTIONS

1. What sources are most prolific in reporting entrepreneurship education findings?
2. What are the major research focus areas?
3. What are the study characteristics?
4. How does research in engineering entrepreneurship compare to the field at large?

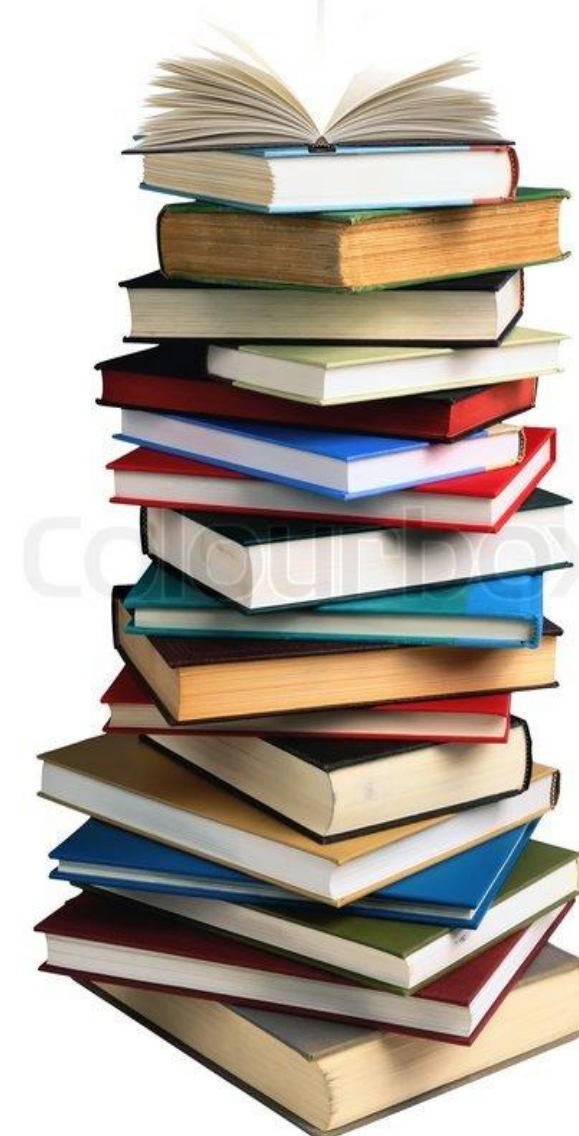
METHODS

Two literature databases, Scopus® and Proquest were searched for entrepreneurship education research literature. The same search criteria were used for both databases on September 3, 2015, ("*entrepreneurship education*" OR "*entrepreneurial education*") AND ("*measurement*" OR "*instrument*" OR "*assessment*") in the general search block for all fields. The initial literature search resulted in a total of 3,123 citations (including duplicates across the two databases) representing a wide variety of publication sources. The analysis identified 282 duplicate entries between the Scopus and Proquest searches. Duplicates were extracted, yielding a final dataset of 2,841 unique papers. A total of 2,365 citations were excluded from the literature review according to the criteria presented in Table 1, resulting in a total 476 papers to be coded for study design, theory, variables measured, instruments, and validity/reliability.

METHODS CONTINUED

Table 1: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none"> • International and domestic journals and conferences proceedings • Study participants must be entrepreneurs or faculty, students, and administrators in higher education • Studies must be focused on training entrepreneurs, entrepreneurial characteristics, or participant perceptions of entrepreneurship • Studies should focus on micro-entrepreneurial environments such as start-ups or entrepreneurship training programs 	<ul style="list-style-type: none"> • Literature reviews • Book reviews • Any articles that do not have the word entrepreneurship or any of its variations in the abstract or in the keywords. • Studies with participants that do not fall within the context of higher education or entrepreneurs, including, K-12, rural communities, peasants, veterans, tourism/hospitality industry, and apparel, textile and fashion industry. • Studies regarding public policy or the macro-economic environment such as entrepreneurial efforts of a country. • Studies focused on small business, unless entrepreneurship is specifically cited as relevant to the publication. • Papers describing anecdotal results or offering program descriptions. • Papers specifically describing a learning tool used in entrepreneurship education. • Papers that do not collect data from human subjects. • Studies that evaluate business incubators. • Studies that used case study methodology. • Studies that did not specifically delineate a research methodology section. • Include empirical data collected from human subjects.



FINDINGS

- Europe produces the largest percentage of entrepreneurship education empirical studies (34%), followed by the U.S., Asia (20%) and Africa (10%).
- The majority of entrepreneurship education studies were characterization studies (72%) and most studies utilized quantitative methods (85%, Table 3)

Table 2: Journals that Represent Placement of 50% of all Empirical Studies for this Literature Review

Publication Title	# Citations
Education & Training	48
ICSB World Conference Proceedings	28
International Journal of Entrepreneurial Behaviour & Research	24
Journal of Small Business and Enterprise Development	23
International Entrepreneurship and Management Journal	19
ASEE Annual Conference and Exposition, Conference Proceedings	19
African Journal of Business Management	16
Journal of Business and Entrepreneurship	15
Journal of Small Business Management	10
Journal of Entrepreneurship Education	8
International Journal of Management Education	8
Entrepreneurship Theory and Practice	7
Journal of Small Business and Entrepreneurship	6
Journal of European Industrial Training	6

FINDINGS CONTINUED

Table 3. Descriptive Statistics of Entrepreneurship Education Empirical Studies

Characteristics	Entrepreneurship Assessment Studies (N=476)	Engineering Specific Studies (N=27)
TYPE OF STUDY		
Intervention	132 (28%)	13 (48%)
Characterization	344 (72%)	14 (52%)
SUBJECTS		
Undergraduates	270 (57%)	21 (78%)
Graduate Students	84 (18%)	1 (4%)
Undergraduate Alumni	19 (4%)	2 (7%)
Graduate Alumni	10 (2%)	---
Faculty	40 (8%)	4 (15%)
Entrepreneurs	133 (28%)	4 (15%)
DISCIPLINES		
Business	271 (57%)	8 (30%)
Engineering	75 (16%)	22 (81%)
Multidisciplinary	166 (35%)	5 (19%)
BASIC MEASURES		
Age	281 (59%)	12 (44%)
Gender	335 (70%)	13 (48%)
Ethnicity/Race	55 (12%)	5 (19%)
Parent's Education	9 (2%)	2 (7%)
THEORIES/PROTOCOLS/MEASURES		
Theoretical Framework	50 (11%)	1 (4%)
Referenced Theory	238 (50%)	6 (22%)
Qualitative Methods	110 (23%)	9 (33%)
Quantitative Methods	403 (85%)	20 (74%)
Use of Existing Scale	263 (55%)	10 (37%)
Attempted Validity/Reliability Testing	311 (65%)	11 (41%)

Table 4. Variables Most Commonly Present in Analyzed Studies

Variable Type	Examples or details	Frequency
AFFECTIVE VARIABLES (n=393)		
Perceptions	Perceptions of new venture opportunities; perceived behavioral control	142 (36%)
Attitude	Entrepreneurial attitude; attitude towards failure	101 (26%)
Self-efficacy/Self-esteem	Entrepreneurial self-efficacy	71 (18%)
Entrepreneurial Orientation	Includes proactiveness, risk taking	64 (16%)
Motivation	Motivation to open a business	46 (12%)
Creativity	Creativity; creation process	42 (11%)
Beliefs	Behavioral beliefs; locus of control	31 (8%)
Entrepreneurial mindset	State of mind drawing people toward innovation, creation, and opportunity.	17 (4%)
BEHAVIORAL VARIABLES (n=286)		
Entrepreneurial intentions	Future plans to engage in entrepreneurial activity	113 (40%)
Behaviors	Entrepreneurial activities (present or past)	57 (20%)
Work Experience	Generic work experience	33 (12%)
Plans/Goals	Entrepreneurial career aspirations	27 (9%)
COGNITIVE VARIABLES (n=72)		
Skills	Business competencies	32 (44%)
Knowledge	Financial literacy	15 (21%)
Communication	Speaking skills	5 (7%)

- Behavioral and cognitive variables were much less common than affective variables.
- Only 263 of the 476 publications (55%) utilized an existing instrument (qualitative or quantitative) for their studies.

Table 5. Scales Used in Reviewed Studies

Paper/Scale	Focus
AFFECTIVE SCALES	
Chen et al (1998)	Entrepreneurial Self-Efficacy
Zhao et al. (2005)	Self-efficacy
Robinson et al. (1991)	Entrepreneurial Attitude
Koh (1996)	Psychological Characteristics
Jackson (1976)	JPI: Personality Trait
BEHAVIORAL SCALES	
Linan and Chen (2009)	Entrepreneurial Intent
Krueger et al (2000)	Entrepreneurial Intentions
Thompson (2009)	Entrepreneurial Intent
Kolvereid, 1996	Employee Choice Intention
Bateman and Crant (1993)	Proactive Behavior

DISCUSSION

- While many studies analyzed in this review reference theories, very few clearly articulated the theoretical framework being used to design a research approach and carry out data analyses
- Behavior – perhaps the most oft-cited outcome of entrepreneurship education – was the least often studied of the three categories (affect, behavior, and cognition)
- Reliability and validity of scales merits further attention in empirical work

CONCLUSIONS

While there has been growth in entrepreneurship education research, results have shown little cross-fertilization across disciplines. Empirical studies are in the minority and the majority focus on affective, rather than cognitive or behavioral, outcomes. Engineering faculty interested in conducting their own studies can use this review to more effectively meet the community's call for more rigorous research grounded in theory and established research methodologies.

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