

## **AC 2009-529: ENTREPRENEURSHIP PROGRAM ASSESSMENT BY STUDENT OUTCOME**

**Hak Tam, University of California, Santa Barbara**

**Gary Hansen, University of California, Santa Barbara**

**Sally Blomstrom, Embry-Riddle Aeronautical University**

**Peter Robinson, Utah Valley University**

# ENTREPRENEURSHIP PROGRAM ASSESSMENT BY STUDENT OUTCOME

## Introduction

Harvard Business School offered the first course in entrepreneurship in 1947. Today most of the AACSB-accredited business schools offer programs in entrepreneurship<sup>1</sup>. With innovations emanating from the science and technology areas, entrepreneurship education has also migrated to engineering schools<sup>2-7</sup>. This seems to be a logical development. In fact, it has been reported that engineering entrepreneurship graduates have more new business start-ups than their business school counter-parts<sup>8</sup>.

Meanwhile, educators have voiced different opinions on what should be taught in entrepreneurship programs<sup>9-12</sup>. The modality of delivery and the objectives of entrepreneurship education is another area of lively discussion<sup>11-18</sup>. Learning style is a much covered field in education<sup>19</sup>. Matching teaching with learning style has also been addressed in the literature<sup>20</sup>. While it is important that there is substantive content in any educational program, perhaps the more interesting question for educators in this discipline is how to structure the curriculum and pedagogy to ignite or reinforce entrepreneurial attitudes. This might well be the most important attribute that an entrepreneurship educational program can instill in the students. Entrepreneurship education should cause students to think, feel, and act entrepreneurial; to eventually become entrepreneurs.

As we attempt to assess an entrepreneurship education program, we frame our research question around: Does entrepreneurship education make students more entrepreneurial? The operational parameter we chose to measure is entrepreneurial attitude. To inform practice, we also explored the respective contribution of curriculum, pedagogy, and instructional environment in facilitating changes in the students' entrepreneurial attitude. Educators in this field have tacit knowledge that instructional technique matters. We would like to introduce an assessment approach to make visible an important learning outcome unique to this discipline.

## Background of the study

This program assessment research is a collaboration between the School of Education and the Technology Management Program (TMP) embedded in the College of Engineering at a tier-one research university. While the institution is highly ranked and has many exemplary programs, it does not have a business school. The Technology Management Program which is designed to teach students how to commercialize technology becomes the de-facto program for students to learn about innovation, technology management and entrepreneurship. The courses are open to all enrolled upperclassmen which resulted in a multi-disciplinary student body. The curriculum and extra-curricular activities approach innovation and commercial feasibility using real-world data, supported by lecturers and mentors from the field. The faculty is primarily made up of adjunct professors and lecturers who have extensive business and venture experience. A mix of pedagogy is employed, including didactic instruction, guest speakers, entrepreneurship workshops, business plan competition, and internship in start-ups and technology enterprises.

To assess an education program, one can look at input parameters, process parameters or outcome parameters. Accreditation bodies historically have focused on input parameters and process parameters such as faculty qualification, faculty-to-student ratios, and institutional procedures. For K-12 education, the No Child Left Behind Act of 2001<sup>21</sup> underscored the new focus of measuring outcome parameters. The Secretary of Education, Margaret Spellings<sup>22</sup> also began to look for accountability in higher education in terms of outcomes. Therefore, we look out for meaningful outcome parameters in our study. While disciplines such as accounting or engineering have relatively well-defined content areas and criteria for learning outcomes, entrepreneurship education tends to be guided by institutional or program goals. Effectiveness of teaching and learning in entrepreneurship education is relatively hard to define and difficult to assess.

In this paper, we looked at an outcome parameter framed by the research question: Does entrepreneurship education makes students more entrepreneurial? Our main goal is to determine if this program indeed makes students more entrepreneurial. We also seek to identify what modalities and conditions of instruction contributed to the development of entrepreneurship attitudes, perhaps the singularly most important ingredient of entrepreneurship education. We think this is an important inquiry. Aside from skills and knowledge, success as an entrepreneur is also a function of many entrepreneurial characteristics. If we can measure whether education as a treatment process indeed makes students more entrepreneurial, this assessment technique could have very interesting implications to educators in entrepreneurship.

### Theoretical framework

The most extensive and current demographic data on entrepreneurs was reported by Reynolds, et al<sup>23</sup> through the Panel Study of Entrepreneurial Dynamics. Having contacted 64,622 households, 830 nascent entrepreneurs were followed over a two-year period. More than 120 scholars, 33 universities, and institutions such as the National Science Foundation and the Ewing Marion Kauffman Foundation were behind this effort. Factors such as race, age, gender, income, and level of education were profiled. While the demographic approach is important in the study of entrepreneurs, most of these factors are not attributes that can be modified with education.

The other approach in studying entrepreneur is to identify the characteristics that differentiate entrepreneurs from non-entrepreneurs. This body of work mainly comes from two disciplines: psychology and business. Entrepreneurial characteristics such as need for achievement<sup>24-27</sup>, locus of control<sup>28-31</sup>, risk taking<sup>28-30 & 32</sup> values<sup>24, 31, 33 & 34</sup> and sacrifice<sup>35</sup> are some examples. Bolton and Thompson<sup>36</sup> contended that what is special about entrepreneurs is their repertoire. The entrepreneur is the inventor, the leader, while simultaneously demonstrating many other entrepreneurial characteristics. There is a constant interplay of talent, temperament and technique. Bolton and Thompson defines talent as creativity, opportunity-spotting, and courage, temperament in terms of urgency, risk-taking and ego drive, and technique such as planning, financial and personnel skills.

Peter Robinson's dissertation<sup>37</sup> was on the development of a quantitative instrument called the Entrepreneurial Attitude Orientation (EAO), designed with the intent of predicting

entrepreneurs based on their attitude. The four entrepreneurial attitudinal subscales used in the Robinson EAO instrument were achievement in business, innovation in business, perceived personal control and perceived self-esteem. In each subscale, the questions were constructed from three psychological perspectives - affect (i.e. the “I feel” questions), cognition (i.e. the “I think” questions) and behavior (i.e. the “I (act)” questions). After going through a sequence of item creation and selection, reliability testing and factor analysis, the instrument was validated with two sets of subjects. In one set, both the control and experimental group were students (students in school versus recent graduates who have founded businesses) while the other set was made up of business people (white-collar employees versus established entrepreneurs). Robinson later reduced the EAO from its original 91 items to a 75-item questionnaire<sup>38</sup>.

The EAO has been used in a number of other dissertations<sup>35, 39 & 40</sup> and research articles<sup>41-46</sup>. The limitation of the EAO model is that it does not include risk perception and opportunity recognition, two other well recognized characteristics of entrepreneurs. The advantage is that it is a validated instrument with sound theoretical underpinning and that it takes a multi-factor approach with four subscales.

## Method

Our inquiry seeks to determine whether the students become more entrepreneurial after taking these classes. We selected the EAO instrument<sup>38</sup> as our quantitative tool for several reasons. It was developed to predict entrepreneurship, which fits with our research question. It was tested on students, which fits our application of studying students as subjects. While using only four attitudinal subscales appeared to be limited, the notion of factor analysis is to identify the strongest factors so that the less informative ones can be eliminated. In an article on evaluation instrument, Rotem and Glasman<sup>47</sup> commented “*an evaluation instrument should be reliable, valid, efficient, and effective.*” We feel the use of the EAO in its entirety preserves the construct validity and provides a meaningful multi-variate approach to address our research question.

Aside from the EAO instrument, two other research techniques were used to triangulate the findings. One consisted of student responses collected at the end of the quarter and the other consisted of students interviews. These two qualitative methods complement the quantitative approach to confirm if indeed the students perceived that the classes have changed their entrepreneurial attitude.

Data was collected from the students enrolled in the entrepreneurship program during the spring 2008 quarter, after obtaining institutional internal review board approval to conduct the study. With the cooperation of course instructors from all nine classes offered during that term, students were asked to voluntarily participate in the study by answering a 75-item survey instrument at the beginning and at the end of the quarter. Informed consent was obtained from these students at the beginning of the quarter. The survey generally required less than 15-minutes to complete.

From a total program enrollment of 430 students, 197 responses were collected at the beginning of the quarter (46% response rate) and 100 at the end of the quarter two months later

(23% response rate). Since our instrument has 75 items representing four subscales, we set our missing-item limit at four. Responses with five or more missing items were eliminated. This reduced our pre-test sample to 186 and post test sample to 99. Ten cases were dropped from the pre-test due to incomplete results caused by time limitation in one class. Only one case was dropped in the post-test with a student arriving late in class who did not finish the survey.

Of all these responses, 77 students completed both the pre-treatment and post-treatment surveys. 75 of them met our missing-item inclusion/exclusion criteria (17.5% of the population). Only 7 out of 75 responses have 1 missing item in the 75-item pre-test instrument and 5 out of 75 have 1 missing item in the post-test survey. This sample (n=75) formed the basis of our repeated-measure MANOVA comparison. The repeated-measure research design allows for assessing the treatment effect without the influence of group differences (between-group errors). Each subject serves as his or her own control. Since the instrument is quite complex with 75 items, and that the pre-test post-test interval was two months apart, we can reasonably assume that there is little learning effect of becoming familiar with the questionnaire which might have caused bias to the results. None of the 75 pairs of responses have more than 1 missing item. Missing values were replaced with the item group mean in our statistical compilations.

Overall treatment effect was tested using a repeated-measure MANOVA design as an omnibus test. It was performed for the four entrepreneurial subscales in a 2x4 pre-test post-test design. The null hypothesis is that there is no difference in the entrepreneurial attitudes before and after the treatment. The alternate hypothesis is that there is a difference.

To triangulate the findings using the EAO instrument, two other research methods were used. Attached to the post-test questionnaire was a set of four open-ended questions which queried whether the students felt the classes made them more entrepreneurial, in what way and what they attributed that to. 88 out of the 99 post-test participants responded (88.89% response rate). We also randomly selected students for interviews near the end of the term. Interviews occurred at the end of class and during the end of TMP events, and ranged from five minutes to twenty-five minutes, most typically lasting around twelve minutes. A total of 40 students were interviewed.

## Results

Data analysis was performed using SPSS 16.0. Reliability of the instrument was established by calculating the Cronbach alphas for each subscale. The alphas were then re-calculated with the weakest items taken out, resulting in a more succinct 69-item instrument. The alphas were above 0.7 except for the personal control subscale in the pre-test (Table 1). More items could have been taken out to further improve the alpha. However, this particular subscale has only 12 items to begin with. We judged that preserving the fidelity of the theoretical construct was a higher priority. Expectedly, the alphas are higher for the subscales with more items.

Table 1. Cronbach Alphas of Each Subscale at t1 and t2

Subscales	items	Cronbach alphas t1	items	Cronbach alphas t2	improve by removing
Achievement	23	0.714	22	<b>0.725</b>	question 57
Innovation	26	0.751	24	<b>0.794</b>	questions 41, 66
personal control	12	0.600	11	<b>0.664</b>	question 36
self-esteem	14	0.653	12	<b>0.750</b>	questions 53, 25
Total questions	75		69		

Subscales	items	Cronbach alphas t1	items	Cronbach alphas t2	improve by removing
Achievement	23	0.792	22	<b>0.819</b>	question 57
Innovation	26	0.718	24	<b>0.745</b>	questions 41, 66
personal control	12	0.674	11	<b>0.717</b>	question 36
Self-esteem	14	0.579	12	<b>0.712</b>	questions 53, 25
Total questions	75		69		

Factor analysis was not performed since we only included data from 75 students and this sample size is insufficient for performing factor analysis of a 69-item instrument. Since the instrument was grounded in theory and has been validated and examined in various studies, we see no reason to question the internal validity.

A screening t-test (Table 2) was performed. Significant changes were observed in the subscales of innovation and personal control, as well as the behavior factor.

Table 2. 2-tailed, pair-sample t-test (n=75)

	mean t1	std dev t1	mean t2	std dev t2	t	df	significance
Achievement	5.66	0.43	5.74	0.50	-1.351	74	0.181
Innovation	5.09	0.50	5.22	0.50	-2.477	74	0.016**
Personal control	5.06	0.68	5.22	0.70	-2.667	74	0.009**
Self-esteem	5.25	0.73	5.31	0.74	-0.808	74	0.422

To check for between-group difference at the beginning and at the end of the quarter, the pre-test and post-test subscales data were analyzed using General Linear Model in a repeated-measure MANOVA analysis (Table 3). A significant main effect was observed between the pre-test and post-test ( $p=0.044$ ). Typically, interaction effect is of great interest to researchers. For this study, the four subscales are different attributes without specific order or relational importance. All four subscales showed higher means at t2. Thus the main effect served as our main finding.

To determine the factors responsible for the overall difference, univariate tests were performed. The results were similar to what we found with the t-test. Of the four attitudinal subscales, innovation and personal control were responsible for the significant difference after making Bonferroni adjustments (i.e. multiply each of the significance value by 4 to account for under-estimating the individual Type 1 errors when all 4 subscales are considered together).

Table 3. Repeated-measure statistics (n=75)

Factors	Mean	Standard Deviation		
Achievement t1	5.66	0.43		
Achievement t2	5.74	0.50		
Innovation t1	5.09	0.50		
Innovation t2	5.22	0.50		
Personal Control t1	5.06	0.68		
Personal Control t2	5.22	0.70		
Self-esteem t1	5.25	0.73		
Self-esteem t2	5.31	0.74		
	Wilks'			
	Lambda	Significance	Partial Eta Squared	Power
MANOVA	0.873	0.044	0.127	1.000
Contrast	Significance	Partial Eta Squared	Power	
Achievement	0.123	0.032	0.337	
Innovation	0.010	0.087	0.744	
Personal Control	0.009	0.088	0.749	
Self-esteem	0.400	0.010	0.133	

Attached to the post-test survey is a set of open ended questions which began with the question: Does taking the TMP course(s) change your attitude toward entrepreneurship? 88 students responded while 11 did not answer any questions. 73 out of the 88 responses were yes (82.95%), punctuated with emotive remarks such as “*absolutely*”, “*it makes me even more interested*”, “*very much so*”, “*a lot more excited about starting business*” and “*motivates me*”. Four responses were tentative. They used words such as “*a bit*”, “*not sure*”, “*a little bit*” and “*maybe*”. Thirteen answered no, of which four indicated that they were quite entrepreneurial to begin with so the courses do not change their attitudes per se. Together, only about 10% did not experience a positive effective. The central tendency clearly supports the findings using the EAO.

The third approach in our inquiry involved interviews with the students at the end of the quarter. A total of forty students were interviewed. The responses were particularly rich and contextual. The classes have made a strong impact on many of them. Being armed with real world skills and knowledge, they are ready to go out and swim with the sharks. Some remarks were particularly informative:

*“I caught the entrepreneurial bug from taking the first one (TMP class).”*

*“Yes, this is like catalyst. What TMP program did to me was to tell me it's OK to be an entrepreneur. The parents would like you to get a job, get a salary to pay off the loan and stuff. TMP program puts so much behind you. It's OK to be entrepreneur. It's OK to innovate and implement your own ideas. Legitimacy-it's legitimate to be an entrepreneur”*

*“For the ones who are entrepreneurial, the TMP gives them a medium to express their ideas. For those, the program is a great way to see if they can be one, really want to be one.”*

*“I have strong beliefs in the technology management program. I’ve already seen a lot coming out of it.”*

*“It gives me a little oomph to try new venture now that I’ve known more about it. Previously it never crossed my mind.”*

*“I was always entrepreneurial minded but not knowing how to go about doing it. After taking these classes I have more skills that would help me. Yeah, I’m more entrepreneurial minded now”*

*“I definitely have idea to form company before this. I always dreamed of having my own company. My father is an entrepreneur. When I was really young me and my brother will paint curbs, sell candy bars, whatever it was. Being in school here as a Business Econ student, I don’t think I got any insight as to how to start a business. I found out about the TMP. From this I felt I have gained more knowledge about starting a business than all my other years in college. I can actually apply what I learned from TMP and start a company.”*

*“I hope to start a business and retire at 40 so I always think about doing my own thing. Now I feel more confident in my ability.”*

*“These courses give you info you can’t get from B-Econ and Engineering classes. I got a lot out of the courses; the closest thing you can get without going through the experience yourself.”*

*“I didn’t consider myself to be entrepreneurial but I changed. In other classes you learn theory, never application. TMP gives me the tool belt to go out and do it.”*

*“I was not entrepreneurial before, maybe just a little bit. Now it opens up the door.”*

*“I became more confident with my ability. It probably was there before the classes. It solidifies with the classes.”*

*“The course has given me more ambition”*

*“It changed my attitude, definitely. I knew I would be able to start my own business, kind of reinforced the proposition.”*

*“Before the TMP classes, I have a personal draw towards starting my own company. After the classes, it feels closer to reality”.*

*“I’m interested in looking for a job with a start-up”*

*“Since I was 5, 6 years old I was always looking for opportunities. The classes make me look at more opportunities. It works out great.”*

*“I would consider myself entrepreneurial. I already own my business…it’s crucial to learn how to do it.*

*“TMP opens my eyes, make me look at things differently. Maybe it does make me more entrepreneurial. I’m always trying to find a market for an idea of mine.”*

*“More entrepreneurial? Of course. That’s why I want to dig deeper into it.”*

*“More entrepreneurial? Most definitely. I know what it takes to become one, the way business is done, how to market, focus on technology.”*

*“These classes open your perspective. The professors allow us to see real world experience rather than just theory.”*

*“I’m definitely interested in doing something that I put my own intuition to it.”*

To further explore how the instructional technique and the learning environment inside and outside the classroom were responsible for causing the change, we asked the students to

elaborate during the interviews. What appeared to stand out was their hands-on involvement with business through the class projects.

In one popular class, the students teamed up to participate in a quarter-long business decision simulation project. Every week there were business scenarios requiring them to make decisions on R&D investment, capacity and production decisions, advertising and sales force build-up, pricing and inventory planning and so on. They had to make decisions as a group and their choices interacted with other teams' decisions which subsequently resulted in changes in each teams' company performance and their stock prices. The teams had to debate their ideas and come to some consensus on the strategy. They learned team skills as well as business skills.

In another course, they were required to form teams to prepare a business feasibility analysis on a business. They came up with products and related business models and performed an analysis of the value proposition, market segment, value chain structure, revenue generation and margins, position in value network and competitive strategy. Again they learned to function in multi-disciplinary teams and submerged themselves in real-world business data collection and analysis.

The faculty with abundant real-world experience was also a significant contributor. The students viewed them as role models and sources of advice and inspiration. They were also intrigued by the guest speakers, the trials and tribulations they went through and the mistakes they made. They heard how the difficult decisions were made and the consequences. When asked which component was more effective in causing their entrepreneurial attitude to change, the projects seemed to be the popular choice. However, the general opinion was that all these ingredients worked well together. The students expressed their views as follows:

*"The group projects are the most rewarding aspects. Good professors are number two and the guest speakers are really close behind like two-and-a-half."*

*"I like the projects. We have to figure out what product to produce, how to make it, how to market it all in two weeks...at the end we have to prepare a 25 page document and really flush it out. How are you going to make money with this? Pricing? What's the pro-forma gonna look like."*

*"I have a brilliant instructor for my Entrepreneurship class! He puts things in layman's terms so someone like me with zero business background can understand. The course makes us think about creating something new, something that hasn't been invented yet. The class assignments are graded really roughly so you have to take it seriously. They force you to get the juice flowing."*

*"It's the combination of all of these. I've never been exposed to so many guest speakers! We had 2-3 in the finance class, almost weekly in the entrepreneurship class, 4 or 5 in the lecture series. Probably I've listened to thirty or so in one year. I have done projects in my biotech classes but nothing like this!"*

*"A lot has to do with the teachers themselves and the people they bring in. They are so passionate and have so much knowledge they want to convey to you. Today I get to ask an expert a direct question that applies to my business instead of reading about the theory. In business, you want to get expert advice as much as you can. You can't keep testing theory or your business will go down."*

*“Almost all the classes have team work; that’s what it’s like in the real world. Yes, I intentionally team up with different people each time.”*

*“The mentors are not shy in beating you up - don’t know the market, didn’t do sensitivity analysis, on and on. After a while you realize investors focus on the market. We tend to focus just on the product.”*

*“Learn from a PhD or an entrepreneur? I want to be taught by someone who made the mistakes and knows how to do it. In my marketing class we have to go out and interview people for market research, nothing like what you do in Engineering.”*

*“Having all these together is really effective. If one is not in the picture, the rest would not be as effective as they are.”*

*“I benefit more from working with my team then sitting in a class listening to lectures.”*

*“The first class I took he made us go out and sell something. It gets you to see what works and what doesn’t work. Guest speakers are also great, you hear from the ones who have done it, not hear from the professor about someone who has done it. Marketing was taught by someone who has worked at Proctor and Gamble, not reading about the marketing finesse of Proctor and Gamble.”*

This part of the inquiry was designed to find out what worked and what didn’t worked. While the students have shown tremendous appreciation for the education, they also noted some misses.

*“They shouldn’t focus so much on venture capital. VCs don’t invest in students. They should focus on angel investors.”*

*“The courses don’t tie together. TMP is not linear. There are many overlaps and also many gaps.”*

#### Educational importance of the study

In many disciplines, effectiveness in teaching and learning is assessed via content uptake of the students. This may be measured using psychometrics or evaluating student products using certain rubrics. In disciplines where the ‘correct answer’ is less precise, the rubric approach tends to also pay attention to production process as well as outcome. In our discipline of entrepreneurship education, not only is there no precise ‘correct answer’ to many management and business opportunity questions, content uptake does not necessarily reflect the overall preparedness of these students to become entrepreneurs. Entrepreneurial attitude orientation appears to be an outcome parameter that complements content uptake for assessing entrepreneurship education. This study provided empirical evidence that entrepreneurship can be learned, both substantively and attitudinally.

The student interviews revealed how the combination of projects, practitioner instructor and submersion with real-world business issues through the guest speakers together is an effective means to enhance their entrepreneurial attitude. They feel they have gained the relevant, practical skills and knowledge to begin their entrepreneurial journey.

The American Psychology Association (1997) described a framework for a learner-centered environment<sup>48</sup>. It addressed a number of cognitive and meta-cognitive factors, motivational and affective factors, developmental and social factors:

1. Nature of the learning process.

*The learning of complex subject matter is most effective when it is an intentional process of constructing meaning from information and experience.*

2. Goals of the learning process.

*The successful learner, over time and with support and instructional guidance, can create meaningful, coherent representations of knowledge.*

3. Construction of knowledge.

*The successful learner can link new information with existing knowledge in meaningful ways.*

4. Strategic thinking.

*The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals.*

5. Thinking about thinking.

*Higher order strategies for selecting and monitoring mental operations facilitate creative and critical thinking.*

6. Context of learning.

*Learning is influenced by environmental factors, including culture, technology, and instructional practices.*

7. Motivational and emotional influences on learning.

*What and how much is learned is influenced by the motivation. Motivation to learn, in turn, is influenced by the individual's emotional states, beliefs, interests and goals, and habits of thinking.*

8. Intrinsic motivation to learn.

*The learner's creativity, higher order thinking, and natural curiosity all contribute to motivation to learn. Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control.*

9. Effects of motivation on effort.

*Acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without learners' motivation to learn, the willingness to exert this effort is unlikely without coercion.*

10. Developmental influences on learning.

*As individuals develop, there are different opportunities and constraints for learning. Learning is most effective when differential development within and across physical, intellectual, emotional, and social domains is taken into account.*

11. Social influences on learning.

*Learning is influenced by social interactions, interpersonal relations, and communication with others.*

The comments from the students echoed many of these principles. For example, through the business feasibility project students constructed meaning from information and experiences (item 1), created meaningful, coherent representations of knowledge (item 2), linked new information with existing knowledge in meaningful ways (item 3), created and used a repertoire of thinking and reasoning strategies to achieve complex learning goals (item 4), motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control (item 8), without learners' motivation to learn, the

willingness to exert this effort is unlikely without coercion (item 9). Their comments on being in interdisciplinary teams addressed the points on learning is most effective when differential development within and across physical, intellectual, emotional, and social domains is taken into account (item 10) and Learning is influenced by social interactions, interpersonal relations, and communication with others (item 11).

Educators in the TMP program appeared to have created an effective learner-centered environment as defined by the APA.

#### Limitation of this study and opportunity for future research

The findings in this study is highly contextual to the particular set of students, their motivation and interest, the set of instructors, speakers and their personal styles. While we have demonstrated that entrepreneurship can be taught and we have created an effective assessment framework, it is hard to extrapolate the findings to other institutional settings or even at the same institution when the student profile, educator profile or instructional profile changes.

In our data analysis, we also compared the pre-test and post-test results of the 69-items using the three psychological factors of cognition, affect, and behavior. We also found significant difference using repeated-measure MANOVA. Follow-up univariate tests revealed that the behavior factor was responsible for the significant difference. Since our theoretical framework was not built up with these factors and the instrument was not validated accordingly, there is no pretext for making inferences along this direction. However, the qualitative data appeared to support a behavioral difference when many students indicated they are ready to take action. This could be a very interesting research area to add to the knowledge in entrepreneurship education.

The EAO instrument was developed in 1989. Since that time abbreviated versions of the EAO have been tried and some researchers have expanded the instrument to test additional entrepreneurial characteristics. It would be beneficial to review this body of work and update the instrument with additional subscales around the educational assessment objective.

A common issue in research is that most studies utilize a unique instrument to address their specific research question. The lack of a standard methodology makes it difficult to compare research and findings in the same field. The EAO is a well-designed multivariate instrument for measuring the students' entrepreneurial attitude. We would like to update and enhance the instrument, and collect data broadly across disciplines. From which we can set up a normative score and explore if it can be used to identify students with entrepreneurial inclination and correlate that to future success in entrepreneurship programs (e.g. the SAT is normalized to a mean score of 500, with one standard deviation points at 400 and 600. SAT was validated for predicting students' first year success in college). That might be an additional tool for the programs to identify and attract students to the field. We are also interested in taking this method to the business setting to investigate its usefulness in the business domain that the original instrument was also validated for. Caution must be taken, however, in the proper validation against the intended scope of application. Research is only as good as the data. The data is only as good as the method. The method is only as good as the theoretical grounding.

## References

1. Katz, Jerome A. (2003). The chronology and intellectual trajectory of American entrepreneurship education 1876-1999. *Journal of Business Venturing*, 18, 283-300
2. Niku, S. (1999). Integration of Entrepreneurship-TEAM concept into design classes, *29th Annual Frontiers in Education Conference*. 1, 11A6/25-11A6/27
3. Carlson, S. R. (1994) Entrepreneurship education for the multiple cognitive-developmental levels of third graders: Differential impacts of three experience-based programs. University of California, Los Angeles.
4. Barbe, D., Magids, S. and Thorton, K. (2003). Holistic approach for technology entrepreneurship education in engineering. *33<sup>rd</sup> Annual Frontier in Education*, 1, T2D 1-6.
5. Ohland, M., Frillman, S., Zhang, G. and Miller, T. (2004). NC State's engineering entrepreneurship program in the context of US entrepreneurship programs. Education that Works: The NCIIA 8<sup>th</sup> Annual Meeting, 155-163.
6. Kleppe, J. A. and Looney, M .S. (1996). "A Special Class on Innovation and Entrepreneurship," *Babson College - Kauffman Foundation Entrepreneurship Conference*, Seattle, WA.
7. Kleppe, J., Wang, E. (1997). Teaching invention, innovation & entrepreneurship in engineering. *Journal of Engineering Education*, 2001
8. Bailey, Jeff (2003). Can you teach someone how to grow a business? *Wall Street Journal online* <http://www.collegejournal.com/mbacenter/newstrends/20030819-bailey.html>, retrieved January 16, 2008
9. Rabbior, Gary (1990). Elements of a successful entrepreneurship/economics/education program. In *Entrepreneurship Education Current Developments, Future Directions*. Calvin A. Kent (Ed.) Quorum Books Westport, CT
10. Erkkila, K. (2000). Entrepreneurial education Mapping the debates in the United States, the United Kingdom and Finland. Garland Publishing. Inc. New York, NY
11. Solomon, G.T., Duffy, S. and Tarabishy, A., 2002. The state of entrepreneurship education in the United States: a national survey and analysis. *International Journal of Entrepreneurship Education*. (1), 1: 65-86.
12. Kuratko, D. (2004). Entrepreneurship education in the 21<sup>st</sup> century: From legitimization to leadership. USASBE National Conference
13. Klatt, L.A. (1988). A study of small business/entrepreneurial education in colleges and universities. *The Journal of Private Enterprise*. 4: 103-108.
14. Solomon, G.T. & Fernald, L.W., Jr. (1991). Trends in small business management and entrepreneurship education in the United States. *Entrepreneurship Theory and Practice*. 15: 25-39.
15. Gartner, W. and Vesper, K. (1994). Experiments in entrepreneurship education: Success and failures. *Journal of Business Venturing*. 9 (3), 179-181.
16. Hynes, B. (1996). Entrepreneurship education and training - introducing entrepreneurship into non-business disciplines. *Journal of European Industrial Training*, 20(8), 10-17.
17. Gibb, A. (2002). In pursuit of a new 'enterprise' and 'entrepreneurship' paradigm for learning creative destruction, new values, new ways of doing things and new combination of knowledge. *International Journal of Management Reviews*. 4 (3), 233-269.
18. Myrah, K. K. & Currie, R. R. (2006). Examining undergraduate entrepreneurship education. *Journal of Small Business and Entrepreneurship* 19(3), 233-254.
19. Kolb, A. Y. and Kolb, D.A. (2005). Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education. *Academy of Management Learning & Education*, 2005, Vol. 4, No. 2, 193-212.
20. Dunn, R. (1984). Learning style: State of the science. *Theory into Practice*. 23 (1), 10-19.
21. Public Law 107-110 (2002). <http://www.ed.gov/policy/elsec/leg/esea02/107-110.pdf> retrieved on February 2, 2009.
22. United States Department of Education (2006). A test of leadership charting the future of U.S. higher education. A report of the Commission appointed by Secretary of Education Margaret Spellings. Retrieved August 14, 2008, from <http://www.ed.gov/about/bdscomm/list/hiedfuture/reports/final-report.pdf>

23. Reynolds, P. D., Carter, N. M., Gartner, W. B., Greene, P. G. & Cox, L. W. (2002). The entrepreneur next door characteristics of individuals starting companies in America. Ewing Marion Kauffman Foundation. Retrieved February 12, 2008.
24. Komives, J. L. (1972). A preliminary study of the personal values of high technology entrepreneurs. In A. C. Cooper & J. L. Komives (Eds.), *Technical entrepreneurship: A Symposium Milwaukee: Center for Venture Management*, 231-242.
25. McClelland, D.C. (1965), Need achievement and entrepreneurship: a longitudinal study. *Journal of Personality and Social Psychology*, 1.
26. McClelland, D., Winter, D.G. (1969), *Motivating Economic Achievement*, The Free Press, New York, NY.
27. Hansemark, O. (2003). Need for achievement, locus of control and the prediction of business start-ups: A longitudinal study. *Journal of Economical Psychology*. 24(3), 301-319.
28. Brockhaus, R. H. (1980). Risk taking propensity of entrepreneurs. *The Academy of Management Journal*, 23(3), 509-520
29. Brockhaus, R.H. and Nord, W.R. (1979). An exploration of factors affecting the entrepreneurial decision: personal characteristic vs. environmental conditions. *Proceedings, Academy of Management*, 364-8.
30. Liles, P.R. (1974). Who are the entrepreneurs? *MSU Business topics*. 2, 5-14
31. Hull, D.L., Bosley, J.J., & Udell, G.G. (1982). Renewing the hunt for the heffalump: Identifying potential entrepreneurs by personality characteristics. *Journal of Business Management*, 20(2), 11-19.
32. Palmer, M. (1971). The application of psychological testing to entrepreneurial potential. *California Management Review*, 13(3), 32-39.
33. DeCarlo, J. F. & Lyons, P. R. (1979). A comparison of selected personal characteristics of minority and non-minority female entrepreneurs. *Journal of Small Business Management*, 17, 22-29.
34. Hornaday, J. & Aboud, J. (1971). Characteristics of successful entrepreneurs. *Personnel Psychology*, 24, 141-153.
35. Roberts, L. P. (1998). Home-based entrepreneurs, non-home-based entrepreneurs and white-collar, non-management workers: A comparative study of attitudes toward achievement, personal control, self-esteem, innovation and business growth. Doctoral Dissertation, The University of Calgary: Calgary, Alberta.
36. Bolton, B. & Thompson, J. (2000). *Entrepreneurs: Talent, temperament, technique*. Butterworth-Heinemann: Woburn, Massachusetts.
37. Robinson, P. B. (1987). Prediction of Entrepreneurship Based on an Attitude Consistency Model. Doctoral Dissertation, Brigham Young University: Provo, Utah.
38. Robinson, P. B., Stimpson, D. V., Huefner, J., and Hunt, H. K., (1991). An attitude approach to the prediction of entrepreneurship. *Entrepreneurship: Theory and Practice*, 15 (4), 13 - 31.
39. Askim, M. K. (1999). The role of attributional explanatory style in the perceived outcomes of entrepreneurial venture failures. Doctoral Dissertation, Purdue University: West Lafayette, Indiana.
40. Christensen, M. A. (1995). The identification of business starters using attitude measurements. University of Calgary, AAT MM93876.
41. Hoge, B. (1995). Entrepreneurial attitudes: A future-oriented approach to the prediction of entrepreneurship? In Bygrave, W. et al (Eds.), *Frontier of Entrepreneurship Research*, Babson Park, MA: Babson College, 562-563.
42. Huefner, J., Hunt, H. K. & Robinson, P. B. (1996) Comparison of four scales predicting entrepreneurship. *Academy of Entrepreneurship Journal*, 1(2), 56-80.
43. Kassicheh, S. K., Radosevich, R. & Umbarger, J. (1996). A comparative study of entrepreneurship incidence among inventors in national laboratories. *Entrepreneurship: Theory and Practice*, 20(3), 33-49.
44. Shaver, K., Gartner, W., Gatewood, E. & Vos, L. (1996). Psychological factors in success at getting into business In Reynolds, P. et al. (Eds.) *Frontiers of Entrepreneurship Research*, Babson Park, MA: Babson College, 77-87.
45. Mccline, R. L., Bhat, S. & Baj, P. (2000). Opportunity recognition: An exploratory investigation of a component of the entrepreneurial process. *Entrepreneurship: Theory and Practice*, 25(2), 81-94.
46. Mento, E. R. & Friedrich, C. (2007). Is entrepreneurial education at South African university successful? An empirical example. *Industry & Higher Education*, 21(3), 221-232.
47. Rotem, A. and Glasman, N. (1979). On the effectiveness of students' evaluative feedback to university instructors. *Review of Educational Research*: 49 (3), 497-511.
48. American Psychological Association (1997). Learner-centered psychological principles: Framework for school redesign and reform. <http://www.dpi.bnu.edu.cn/apa/ed/lcp.html> retrieved Feb 2, 2009.