AC 2010-1282: MEASURING THE IMPACT OF ENTREPRENEURSHIP ACROSS THE CURRICULUM

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Measuring the Impact of Entrepreneurship Across the Curriculum

Abstract

No longer limited to business majors[1], interest in entrepreneurship now crosses many disciplines in universities. This is certainly the case in engineering programs, as society increasingly looks to small and medium sized firms for economic and employment growth. Engineering school interest is evident in a growing numbers of conferences, journals and funded projects. Engineering curricula are crowded, however, and leave little room for new courses. Beginning with the "writing across the curriculum" movement in the 1980's, the literature reveals that many disciplines have mounted "across the curriculum" movements. These include writing, mathematics, critical thinking, citizenship, ethics and other fields. Given crowded engineering curricula, an "across the curriculum" approach is a logical means to address the need to add entrepreneurial thinking without adding additional courses.

Measurement tools are a critical requirement to assess the efficacy or any curriculum intervention. This is especially true when dealing with a new and somewhat amorphous concept such as entrepreneurial thinking and mindset. In this paper, the authors describe Kettering University's efforts to measure faculty and student attitudes as we seek to infuse entrepreneurship across the curriculum. The paper discusses three specific measurement efforts. Our early efforts were formative and focused on student entrepreneurial mindset among engineering students studying entrepreneurship in a single course. Here we used measures of self-efficacy and locus of control as predictors of intention to start a business [2 3 4]. Our second (and current) efforts focus on a pilot project designed to motivate faculty to alter their courses to include one or more of eleven attributes generally accepted as core to entrepreneurial thinking and behavior[5]. Here we measured (both before and after participating in an eight week workshop) faculty member's (n=34) self-reported ability, willingness and perceived necessity of addressing eleven key attributes of entrepreneurial thinking [5] and behavior. We also measure student reactions to the resulting faculty initiatives in specific courses. Third, we address an upcoming summative effort to collect data on student entrepreneurial attitudes at the freshmen and senior level. The authors present empirical results from these efforts and discuss implications for further efforts in building entrepreneurship across the curriculum.

Authors' Note: The authors wish to acknowledge generous support for this research from the Kern Family Foundation

Introduction

No longer limited to business majors[1], interest in entrepreneurship now crosses many disciplines in universities. Interest in entrepreneurship and innovation among engineering degree programs is rapidly growing for a number of reasons. First, from a demand perspective, students

recognize the success of entrepreneurs, especially in the internet age, and are eager to learn about the subject. Second, donors have encouraged schools to offer entrepreneurial programs. Sources such as the Kaufman Foundation, and more recently for mid-western engineering schools, the Kern Foundation, have funded entrepreneurial programs. Finally, society in general is increasingly looking for small and medium sized firms for economic and employment growth. The days of large employers absorbing large number of graduates are largely over. Because of these factors, engineering school interest in entrepreneurship is evident in a growing numbers of conferences, journals and funded projects.

Against this backdrop, Kettering University began working to include entrepreneurship in its academic programs in 2006. Funded with a generous donation by the Kern foundation, we began following a "magnet" approach [1] wherein the Department of Business offered academic courses to students from all degree programs. We employed team teaching, however, pairing engineering faculty with business faculty. Further, we initiated co-curricular activities (such as a speaker series and entrepreneurial society) with engineering faculty leadership. After completing two rounds of funding, Kettering University had a flourishing entrepreneurial program that reached perhaps 100 of our 2,000 students (or about 5%).

After three years of efforts, we realized that to influence a broader array of students, we had to move from a "magnet" to a "radiant" model [1] wherein we teach entrepreneurship throughout all departments of the university. The challenge comes in reaching students in an engineering curriculum that is already crowded and has little or no room for new courses. When a general faculty survey in 2006 asked faculty if they believed entrepreneurship was an important topic for our students, there was general agreement. However, the challenge we discovered is to find points where faculty can and will insert entrepreneurship in the curriculum.

In late 2008, we formulated a plan to teach entrepreneurship across the curriculum. Beginning with the "writing across the curriculum" movement in the 1980's, the literature reveals that many disciplines have mounted "across the curriculum" movements. These include writing, mathematics, critical thinking, citizenship, ethics and other fields. Such efforts are especially appropriate for topics such as entrepreneurship that are application oriented and inter-disciplinary in nature. Given crowded engineering curriculums, an "across the curriculum" approach seemed to be a logical means to address the need to add entrepreneurial thinking without adding additional required courses.

Measurement issues abound in any curriculum innovation. Critical and recurring questions we face include: "How can one measure entrepreneurial mindset? How will we know if our students are acquiring entrepreneurial thinking? How can we measure faculty members' willingness, ability and perceived necessity to teach entrepreneurial thinking?"

Measurement tools are a critical requirement to assess the efficacy or any curriculum intervention. This is especially true when dealing with a new and somewhat amorphous concept such as entrepreneurial thinking and mindset. In this paper, the authors describe Kettering University's efforts to measure faculty and student attitudes as we seek to infuse entrepreneurship across the curriculum. The paper discusses three specific phases in our measurement efforts. Our early efforts focused on student entrepreneurial mindset among

engineering students studying entrepreneurship in a single class. Here we used measures of self-efficacy and locus of control as predictors of intention to start a business [2 3 4]. Our second (and current) efforts focus on a pilot project designed to motivate faculty to alter their courses to include one or more of eleven attributes generally accepted as core to entrepreneurial thinking and behavior[5]. Here we measured (both before and after participating in an eight week workshop) faculty member's (n=34) self-reported ability, willingness and perceived necessity of addressing eleven key attributes of entrepreneurial thinking [5] and behavior. We also measure student reactions to resulting faculty initiatives in specific courses. Third, we address upcoming measurement initiatives. These include a longitudinal effort to collect data on student entrepreneurial attitudes at the freshmen and senior level. Further, we describe an upcoming effort to measure mental models from experienced entrepreneurs and compare these with our students. The authors present empirical results from these pilot efforts and discuss implications for further efforts in building entrepreneurship across the curriculum.

Early Efforts

Working with students (n=192) in our inaugural entrepreneurship course between 2006 and 2009, the authors measured three key concepts:

1. Entrepreneurial self efficacy (ESE) – a 22 item measure that speak to "the strength of an individual's belief that he or she is capable of successfully performing the roles and tasks of an entrepreneur"[3]
2. Locus of Control (LOC) - Locus of control refers to how individuals attribute the results of their lives to internal or external forces[4]. Timmons [6] and Diaz-Bretones [7] speak of the connection of LOC to the success of entrepreneurs.
3. Intention to start a business – a 5 item measure.

The results of this work are reported elsewhere [2]. Notably, we found a significant positive relationship between ESE and ITSB that is moderated by LOC. In addition, our pre- and post-measures revealed that students completing our course significantly increased their ESE, but actually experienced a slight decrease in ITSB.

Current Efforts

Currently, the authors are working to measure faculty attitudes in the entrepreneurship across the curriculum workshops (so far, n=34 participants with an additional sample of n=7 non-participants). In these workshops, we exposed faculty drawn from all departments on campus to entrepreneurship and are encouraged to implement change initiatives in their courses. Subsequently we measured student attitudes towards the change initiatives.

On the faculty side, we created an instrument (see Appendix A) that focuses on 11 core attributes of entrepreneurship noted by Timmons and Spinelli [5]. For each attribute the instrument measures faculty self-efficacy (do faculty feel able to teach key entrepreneurship attributes), faculty willingness to teach key entrepreneurial attributes and faculty belief in the necessity of teaching key entrepreneurship attributes to students. Preliminary results show increases from pre to post measures on all three dimensions. Appendix A shows this result for

self-efficacy as an example. Increases in the necessity and willingness dimensions are less pronounced, but this may be due to scale compression as many scores average very close to the maximum of 5. Furthermore, results show that faculty responses on ability, necessity and willingness from participants are significantly higher than non-participants.

We also have begun to survey students in class sections exposed to entrepreneurial content on the extent of their exposure. Using a five-point scale that ranges from simple exposure to immersion, students evaluate their exposure to creativity, entrepreneurial attitude and entrepreneurial tasks. So far, n=311 students have participated in 14 different course sections. To date, student report greater exposure to creativity than attitudes and tasks. We anticipate presenting results that are more complete at the ASEE conference.

Future Efforts

In the future, we want to expand our work on student attitudes from formative measures in a single course to a summative measure across a student's university years. To this end, we are pursuing two efforts. First, we have already begun to measure student attitudes at both the freshmen and senior level using an instrument developed by Kingston University in the United Kingdom (http://business.kingston.ac.uk/researchgroup.php?pageid=27). The survey asks 36 questions of students in six categories (creativity, leadership, problem solving, project work, career control and financial risk) regarding their attitudes toward entrepreneurship.

As a baseline, one survey has been given to first year students (n=111) and one to senior students (n=89). Since we exposed none of these students to faculty innovations resulting from the workshop, we expected very little difference in their scores – and this is exactly what we observed. As we survey more students, we expect first year scores will remain constant while the gap between the two groups will increase, reflecting the impact of the faculty innovations during the tenure of the student at the university. Figure 1 depicts this hypothesized relationship:

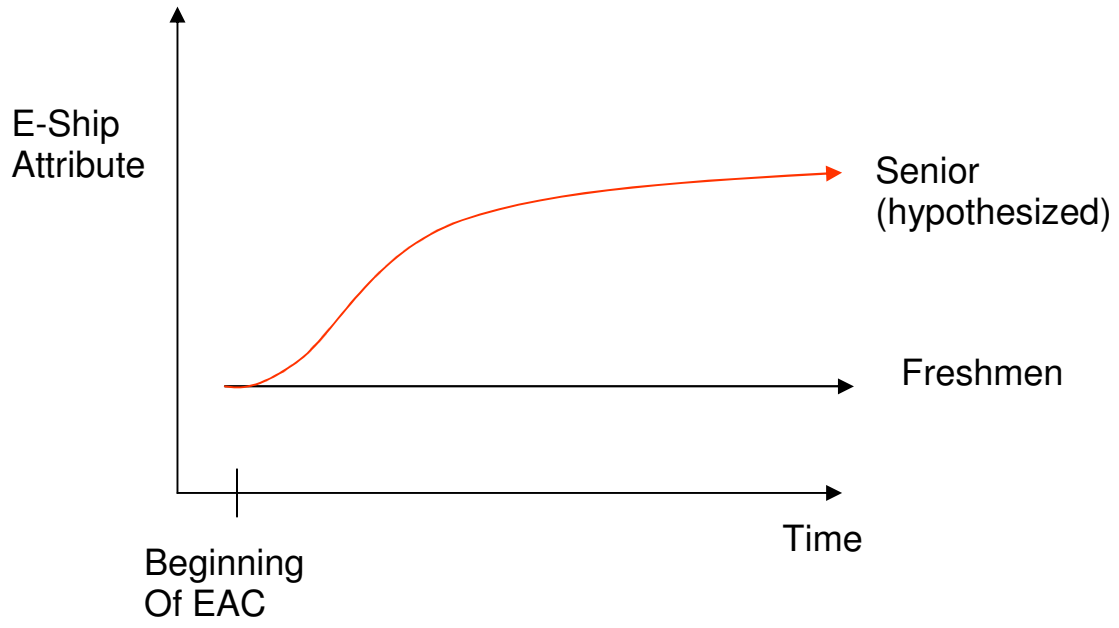

Figure 1 – Hypothesized Relationship

Second, we recognize the limitation of our efforts to date in measuring "entrepreneurial mindset". In a new effort, we are working to develop an improved "mental model" measure. We will start by studying a group of experienced entrepreneurs. Using recent research literature on mental models, we will use this information in the development of a new survey instrument to use with students.

Mental models allow people to understand and interpret phenomena, to draw inferences, to decide what actions to take, to control system execution, and make predictions [10]. The reason why we are interested in measuring shared mental model is that it can be a good performance indicator for our programs. The ultimate outcome sought from our entrepreneurial program is to create an entrepreneurial mindset among our students that contributes to innovation or new venture creation in their later careers. By measuring shared mental model between successful entrepreneurs and the students, we believe we can assess whether our program creates an entrepreneurial mindset among the students now rather than wait years to see what students actually do. Figure 2 below represents the expected shared mental model between successful entrepreneurs and the students in our program. As an indicator of our program's success, we expect to see student's mental models to become increasing similar to experienced entrepreneurs as the program proceeds.

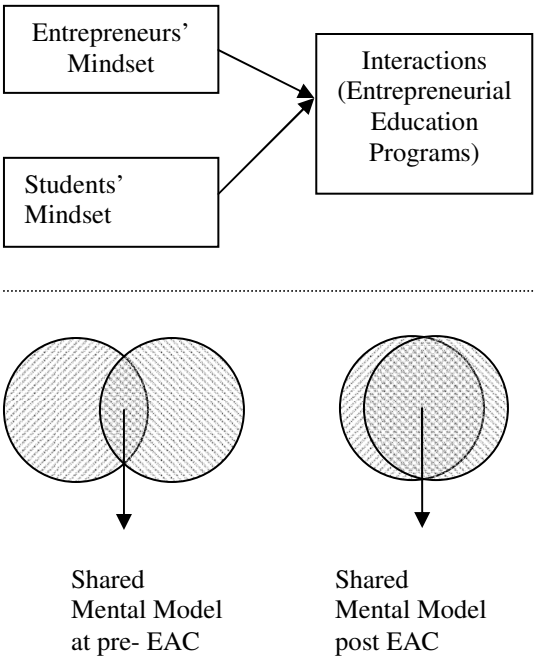

Figure 2. Shared Mental Model in Entrepreneurship Across the Curriculum

There are three available methods for developing shared mental models [11]: pair wise ratings, repertory grid technique and casual mapping. Each involves work with a small group of experts (experienced entrepreneurs in our case) prior to measuring students. We are currently working on this approach. At the ASEE conference, we will update attendees with our progress to date.

Conclusion

This paper outlines Kettering University's work in measuring the impact of entrepreneurial programs on student and faculty attitudes. Starting in 2006 with initial work on student self-efficacy studied in a single course, we have expanded our work in several directions. Currently, we are working to address faculty attitudes in our Entrepreneurship Across the Curriculum program and student perceptions of the extent of intervention made in courses. Future work includes a longitudinal study of entrepreneurial mindset across students' university years, and development of a new instrument to measure shared mental models of entrepreneurship. These efforts are essential as we implement curriculum changes designed to infuse entrepreneurship in our university.

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Appendix I

Self-Efficacy Pre-Measure
Entrepreneurship Across the Curriculum

Thank you for participating in this survey on self-efficacy to influence student innovation attributes. Your participation is voluntary, and we will treat all data collected in confidence. Please select the statement that best describes your feelings.

Last three digits of your employee number: _____ (This is only used for matching pre-and post measures. It will not be used to identify you otherwise).

Core Attributes – Below, we have listed eleven attributes that are generally accepted as core to entrepreneurial thinking and behavior. For each of items below, circle the answer that indicates your attitude toward each of these attributes in your students, and your willingness and ability to encourage these during your class.

1. Commitment and determination

Necessary for student's development	(Unnecessary)	1 2 3 4 5 (Necessary)
My willingness to implement	(Unwilling)	1 2 3 4 5 (Willing)
My ability to implement	(Unsure)	1 2 3 4 5 (Very Sure)

2. Leadership

Necessary for student's development	(Unnecessary)	1 2 3 4 5 (Necessary)
My willingness to implement	(Unwilling)	1 2 3 4 5 (Willing)
My ability to implement	(Unsure)	1 2 3 4 5 (Very Sure)

3. Opportunity obsession – that is, the student's persistence in pursuing promising new ideas.

Necessary for student's development	(Unnecessary)	1 2 3 4 5 (Necessary)
My willingness to implement	(Unwilling)	1 2 3 4 5 (Willing)
My ability to implement	(Unsure)	1 2 3 4 5 (Very Sure)

4. Tolerance of risk:

Necessary for student's development	(Unnecessary)	1 2 3 4 5 (Necessary)
My willingness to implement	(Unwilling)	1 2 3 4 5 (Willing)
My ability to implement	(Unsure)	1 2 3 4 5 (Very Sure)

5. Tolerance of ambiguity:

Necessary for student's development	(Unnecessary)	1 2 3 4 5 (Necessary)
My willingness to implement	(Unwilling)	1 2 3 4 5 (Willing)
My ability to implement	(Unsure)	1 2 3 4 5 (Very Sure)

6. Tolerance of uncertainty:

Necessary for student's development	(Unnecessary)	1 2 3 4 5 (Necessary)
My willingness to implement	(Unwilling)	1 2 3 4 5 (Willing)
My ability to implement	(Unsure)	1 2 3 4 5 (Very Sure)

7. Creativity:

Necessary for student's development	(Unnecessary) 1 2 3 4 5 (Necessary)
My willingness to implement	(Unwilling) 1 2 3 4 5 (Willing)
My ability to implement	(Unsure) 1 2 3 4 5 (Very Sure)

8. Self-reliance:

Necessary for student's development	(Unnecessary) 1 2 3 4 5 (Necessary)
My willingness to implement	(Unwilling) 1 2 3 4 5 (Willing)
My ability to implement	(Unsure) 1 2 3 4 5 (Very Sure)

9. Adaptability:

Necessary for student's development	(Unnecessary) 1 2 3 4 5 (Necessary)
My willingness to implement	(Unwilling) 1 2 3 4 5 (Willing)
My ability to implement	(Unsure) 1 2 3 4 5 (Very Sure)

10. Motivation to excel:

Necessary for student's development	(Unnecessary) 1 2 3 4 5 (Necessary)
My willingness to implement	(Unwilling) 1 2 3 4 5 (Willing)
My ability to implement	(Unsure) 1 2 3 4 5 (Very Sure)

11. Courage:

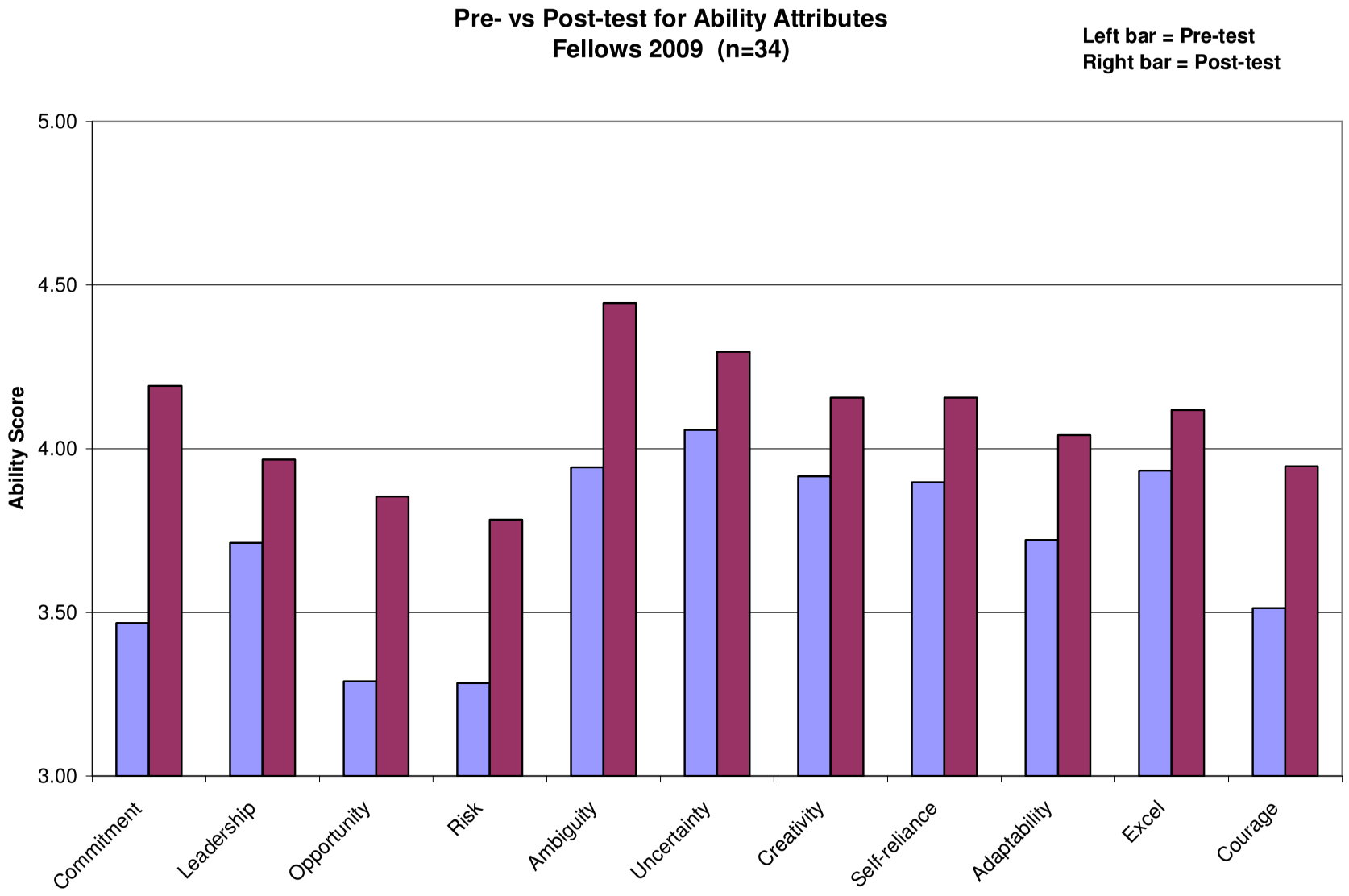
Necessary for student's development	(Unnecessary) 1 2 3 4 5 (Necessary)
My willingness to implement	(Unwilling) 1 2 3 4 5 (Willing)
My ability to implement	(Unsure) 1 2 3 4 5 (Very Sure)

Part 2 – Tell us about yourself (optional)

Your Department Is	☐ **Business**	☐ **Chemistry**	☐ **Computer Science**	☐ **Electrical/ Comp Eng**	☐ **Industrial/ Manuf Eng**	☐ **Liberal Studies**
	☐ **Math**	☐ **Mech Eng**	☐ **Physics**			
Gender	☐ **Male**	☐ **Female**				
Age	☐ **18-30**	☐ **31-40**	☐ **41-50**	☐ **51-60**	☐ **61-70**	☐ **71+**
Length of service at Kettering (years)	☐ **0-2**	☐ **3-5**	☐ **6-10**	☐ **11-20**	☐ **21-30**	☐ **31+**
Years of full-time teaching experience (years)	☐ **0-2**	☐ **3-5**	☐ **6-10**	☐ **11-20**	☐ **21-30**	☐ **31+**

12. I grew up in a family where many family members or family friends are entrepreneurs.

Strongly Disagree Disagree Neutral Agree Strongly Agree


Pre- vs Post-test for Ability Attributes
Fellows 2009 (n=34)
Left bar = Pre-test
Right bar = Post-test
Ability Score
5.00
4.50
4.00
3.50
3.00
Commitment
Leadership
Opportunity
Risk
Ambiguity
Uncertainty
Creativity
Self-reliance
Adaptability
Excel
Courage