

**article:1078****The Effect of an Entrepreneurship Program on GPA and Retention**

The Engineering Entrepreneurs program puts engineering freshmen, sophomores, juniors, and seniors together in entrepreneurship project teams. This Journal of Engineering Education article describes the creation of this North Carolina State University program and assessments of that program that triangulate on its success.

A wide variety of benefits are attributed both to entrepreneurship programs and to vertical integration, though research on the benefit of each is scant. An April 2000 paper in JEE by Giralt, et al., describes a vertically integrated program at Tarragona that was also designed in the early 90's[i], but no published information from that work was available during the development of the program being studied. Through the NSF SUCCEED Coalition, Tom Miller was able to keep updated on the progress of vertical integration experiments at Virginia Tech [ii],[iii]. The focus of the literature review in the JEE article is on entrepreneurship programs, because we believed that was the primary audience of the paper—particularly because the article is an expansion of a manuscript presented at the 2004 National Collegiate Inventors and Innovators Alliance Conference. The article describes basic design of the program so that readers may understand what students experience. Faculty wishing to recreate the program would need to check supporting references or contact the authors for more details.

Six original program goals are enumerated, and the article describes in detail the approaches used to assess the program. Two goals would lead to improved retention in engineering, assessed by comparing the percentage of program participants remaining in engineering to the percentage normally expected. Another of the goals would lead to improved academic performance, assessed by comparing the GPA of program participants to the GPA normally expected. The other three goals are experiential—improving certain student skills by providing students opportunities to practice those skills (measured using surveys and interviews). These questions are important in engineering education, particularly because entrepreneurship programs merge different perspectives, integrating engineering and business education.

Retention statistics determined from student records data obtained from the University registrar during formative assessment were very positive, but could not guarantee long-term success. Later, after enough time had passed for a longitudinal study of retention, student records were taken from the SUCCEED longitudinal database, compiled to put student records from the NSF SUCCEED Coalition partner institutions into a common format. In studies of student records at a single institution such as this, there is no statistical advantage to using the multi-institutional database. There is a significant logistical advantage however—the SUCCEED longitudinal

database was compiled specifically to study engineering student success, particularly related to SUCCEED pilot programs, so it could be used without making a special request for data and without obtaining independent IRB approval for the study. This kind of research is known as ex-post-facto (Latin for “after the fact”) since both the effect (retention improvement) and the alleged cause (program participation) have already occurred and must be studied in retrospect.

The longitudinal study showed a significant improvement in retention in engineering and in academic performance (GPA) compared in matched pairs to students with similar predictive characteristics (gender, ethnicity, matriculation year, engineering major, and SAT scores). There are many reasons that one group of students might outperform another. The matching approach eliminates the variance in certain variables. If there is no variance in certain variables, those cannot be the cause of any measured differences. This approach helps narrow down the possible cause of the observed differences. We are still left with a selection bias—that only students who sign up for the program participate in it. This bias is very difficult to eliminate. Only in experimental research is the degree of control sufficient to establish cause-effect relationships, but true experimental research is rarely possible in educational settings.

Results from the formative assessment were used to establish a causal link between program participation and the retention and performance outcomes. Survey data linked participation to the decision to remain in engineering. Survey data also linked participation to improvements in attitudes and skills that are known to influence retention—confidence, learning, teamwork, leadership, understanding the context of the experience—establishing a chain of reasoning that supports the hypothesis that observed improvements in retention and academic performance are caused by participation in the program. The article also describes minor changes in program design resulted from formative assessment.

The article concludes with anecdotal information that does not come from formal assessment of the program: instructor observations regarding the career paths of program participants, the commercial success measured by the sales of video tapes of lectures that are part of the program, the endowment of the program by a former participant, and media coverage.

Vertical integration creates the opportunity for the development of informal mentoring relationships between freshmen and more advanced students. Informal mentoring has been shown to be more effective than formal relationships.[iv] In this way, a community of learning may be created. Further research is needed to identify the dynamics of vertically integration in academic settings. While the assessment triangulates on the conclusion that the Engineering Entrepreneurs Program is the cause of the improvement in retention, performance, and certain skills and attitudes, further study would be required to find out what part of this program is most

important. The use of different instructors during the time period of study suggests the benefit is not caused by an instructor effect and the duration of the study suggests the benefit is not due to a novelty effect. Yet, it is impossible to separate the effect of the entrepreneurship education and the integration of students from different academic levels.

[i] Giralt, F., Herrero J., Grau, F. X., Alabart, J. R., and Medir, M., "Two Way Integration of Engineering Education through a Design Project," *Journal of Engineering Education*, Vol. 89, No. 2, 2000, pp. 219-229.

[ii] Marchman, J.F. III, "Multinational, Multidisciplinary, Vertically Integrated Team Experience in Aircraft Design," *International Journal of Engineering Education*, Vol. 14, No. 5, pp. 328-334, 1998.

[iii] Ferrari, Leonard, "Virtual Corporations," <http://www.vc.vt.edu/>, 1997.

[iv] Chao, G.T., P.M. Walz, and P.D. Gardner, "Formal and informal mentorships: A comparison on mentoring functions and contrast with nonmentored counterparts," *Personnel Psychology*, 45(3), 1992, pp. 619-636.

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