Creating a Catalog and Meta-Analysis of Freshman Programs for Engineering Students: Part 2: Learning Communities

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Abstract

Curriculum modification and the implementation of special programs are two primary ways to improve the freshman year experience for engineers. Following a SUCCEED-sponsored Freshman Engineering Programs Best Practices Conference held in Charlotte, NC, in May 2000, a catalog and meta-analysis of freshman programs for students in US engineering colleges is underway. This paper will briefly describe the larger project, which will study a variety of approaches to improving the success of freshman engineering students, and specifically report on the catalog and meta-analysis of summer bridge programs. The catalog will classify programs by their design options and the meta-analysis will review highlights of assessment results drawing generalizations where possible.

Introduction

Across the country, there is an extensive base of experience in the design and implementation of programs intended to improve the success of first-year engineering students. Significant resources have been spent to identify best practices in the education of first-year students (in general), including entire organizations and conferences.[1] It is safe to say that every institution that educates engineering students employs some strategy to introduce those students to the school and to engineering. Given the universal presence of some strategy for acclimating engineering students, published descriptions of these programs are less common than we might expect. Considerably fewer have published assessment data on their programs. As a result, many studies of such programs fall short of producing a true meta-analysis, which relies on finding a reasonable number of analyses.

The College Board's "Priming the Pump" study, which analyzed a wide variety of programs targeting minority success, faced this challenge—after beginning with a literature search and proceeding to brochures and word of mouth, the researchers eventually realized that nearly every campus had at least one program designed to foster minority student success. The study goes on to reduce the scope of the study by grouping programs by exemplars, archetypical programs with roots around the country, yet with some form of meaningful assessment.[2] Since most programs were not founded on a particular research model, they were classified by their features rather than by their research model.[3]

The SUCCEED Freshman Programs Catalog and Meta-Analysis Project

In two significant ways, this study takes another course. Programs that target underrepresented populations do not generally use a strategy deemed to be particularly effective, much less uniquely effective, for their target population, so these programs are not studied in isolation. Thus a study of a learning community for women students is discussed with other learning communities, where its focus on women students is revealed in the description of the population served by the program; this is appropriate because the strategies used in such programs would benefit any student. Since assessment data are sparse in the literature, at this stage the study is much more a catalog of programs than a meta-analysis, but the growth of the study should reveal the information needed to conduct a true meta-analysis. As a result, this study at this point is able to identify what appear to be a few broad conclusions and recommendations for further study. A shortcoming of the study at this point is that it cannot clearly identify best practices since, while there is a fair amount of information about the design of the programs, there is insufficient assessment data to clearly identify which programs and approaches have been the most successful.

Further, although we have clearly given preference to programs about which there is published assessment, we do not eliminate programs for a lack of published assessment for a number of reasons. It is likely that a number of programs use reasonable assessment procedures, yet by choice or by custom have not published the results of their assessment. Especially as university resources become more closely guarded, some level of program assessment is almost assured. We also do not eliminate programs due to their similarity to others under study--the ongoing study uses a snowball to continue expanding by word of mouth to include all the programs that can be identified in a category. Since we are focusing on engineering, programs that are specifically targeted to groups other than engineering students are not considered.

We use this strategy for one primary reason—because the sharing that must take place around the country for program coordinators to learn about the best practices of others requires the development of a community. Everett M. Rogers, a noted communications researcher, indicates that the dissemination of an innovation is more likely if certain conditions are met.[4] While ***relative advantage*** is among these (as would be proven by rigorous assessment), ***compatibility*** is also a significant factor—which is best determined by being able to select exactly which features are desirable for a particular institution.

Obviously, we should not and did not list all of these programs here, but a web-searchable database is ideal for accounting for such an expansive list, and will be created. Once activated, this database will be advertised to the engineering education community and its development will accelerate (and accuracy will be improved).

The rest of this paper will focus on the findings for one type of program included in the broader study, learning communities. These findings are revealed by patterns in the classification matrices as well as through a review of published information on the programs under study. Many of the findings refer to the classification tables, which are also included.

Part 2: Learning communities

In seeking to ease the transition of college students into the institution, community, and engineering, fostering the development of learning communities is a strategy rooted in Vincent Tinto's studies of affiliation and its benefits for persistence. Learning communities are currently of significant interest, and, as a result, this phase of the project is restricted to communities formed exclusively of engineering students. Although all these programs seek to form a supportive community of engineering students, it is clear that a wide variety of approaches and results are represented in the sample discussed here. As with summer bridge programs (part 1 of this study), the range of strategies used to create learning communities suggests that the "type" of a program provides not nearly as much information as the classification of the strategies it uses.

Classification. The programs in the study have been classified in the tables in the appendix. Tables 1 through 9 classify a broad range of program characteristics that can be used to identify programs of interest for comparison studies and sharing of ideas. These tables contain the following characteristics:

1. Programs included in this sample, their institution (by web address), and references
2. Population served and other logistics
3. Approaches to engineering discovery
4. Approaches to success skills training
5. Approaches to self-discovery
6. Approaches to develop affiliation
7. Mentoring / learning resources
8. Academic areas included
9. Engineering topics

Table 1 also contains a reference number for each program to avoid listing the name of the program in each of the tables. Where the number of student participants was vague, further details of the target population are given in Table 2. Where the learning community included courses for credit, the total number of credits included is indicated in Table 2 as well.

Some assessment results are available. Clemson's FIRST CLASS program assessment of its first cohort showed that (controlling for student PGPA and gender), program students had slightly higher CGPAs and greater persistence to the second year than non-FIRST CLASS students. The Live and Learn Program at West Virginia University studied the 1996-97 cohort to find that retention rates for the L&L students were significantly higher than the rest of the freshman class and that the overall academic performance of the L&L group was "more uniform than the other freshmen, but not necessarily better."

Some communities keep students for their entire academic career. Since some programs such as Residential Initiative on the Study of the Environment (RISE) at Michigan State University maintain a living/learning community for four-years, it seems appropriate to maintain program duration as a classification variable. Similarly, the Residential Option for Science and Engineering Students (ROSES) at Michigan State University allows upperclass students to

return. An improvement in the retention rates for the AE department at Iowa State has been credited to the ABE Learning Community as well, due to the favorable feedback from surveys and focus groups. The CirCLES Program at the University of Texas, El Paso, is among the larger and more successful communities, credited with increased retention rates and improved student success. Extraordinarily positive assessment data from the Connections community is dampened by the small numbers in the community, but the observed trends are expected to continue.

Learning communities for women are much more common than communities for minorities. At first, it would seem that minority program coordinators have neglected one possible strategy that has the potential to improve the achievement of minority students. In part, this is due to arbitrary classifications, as mentioned above—many of the summer bridge programs studied in Part 1 use strategies to encourage affiliation and the development of community. The observation we can make from Table 2 is that programs specifically targeting women are much more common among formally constructed learning communities. A significant literature base shows that making a psychosocial connection is important for all students (as shown by Tinto), but is especially critical to the success of women and minorities. One obstacle to the further development of minority learning communities may be the negative appearance of segregation both in the classroom and in the residence hall.

Certain strategies are used only by a subset of programs, and certain strategies are popular. Success skill development in learning communities is clearly dominated by certain of the programs studied, as shown in Table 4. Similarly, very few programs use a wide variety of self-discovery approaches, whereas career profiling and advising components are quite popular (as Part 1 showed they were in summer bridge programs). Of the techniques used to develop affiliation, the use of a common residence, block scheduling, residence hall services, and social activities was common to many programs. As was the case with summer bridge programs, peer mentoring and tutoring programs were very common components.

The sciences are more prominent than engineering in learning communities. Engineering academic content appears less prominent in learning communities, but it is noted that some level of integration of fundamental science courses is commonly achieved through a learning community. This has the potential to help students become better integrators as they make stronger connections among these courses.

Conclusions

As with the study of bridge programs, the variety of approaches taken even in this relatively small sample of learning communities indicates that they should not be studied in isolation from other programs that aim at enhancing student success, but should be described by the components that comprise them. This also suggests that the designation of a program as a learning community can be identified with a few additional categories of classification—similar to those used by Gándara.[5]

There will be a significant advantage to studying programs by their components—this approach will more objectively allow the study of programs of different goals. It is clear from the sample

in this study and the related study of summer bridge programs that there is considerable variation among programs identified as the same type. As described in the summer bridge program study, plans to take the study in this direction are already underway. In implementing this new approach, the focus will shift to identifying a more complete set of information about a more exhaustive list of programs, but focusing on a more limited number of schools.

Table 1. Programs included in this sample, their institution, and references

Ref. #	Program	Institution (www._____.edu)	References
1	FIRST CLASS	Clemson	6
2	Connections	CSM	7
3	ABE	IaState	8
4	Project SUCCESS	IaState	9
5	RISE	MSU	10
6	ROSES	MSU	11
7	Engineering Focus Community	OSU	12
8	Women in Engineering	OSU	13
9	Ford Living-Learning Program	OSU	14
10	EASI House	PSU	15
11	SHOE	PSU	16
12	WISE House	PSU	17
13	FISE	PSU	18
14	Engr. LC	Purdue	19
15	IMPaCT program	Miami	20
16	WISE RP	Umich	21
17	Men of Engineering	Missouri	22
18	Women in Engineering	Missouri	23
19	Engineering LC	UNL	24
20	Circles of Learning for Entering Students (CircLES)	UTEP	25
21	Engineering Floor	Wyoming	26
22	WISE-RP	Wisc	27
23	Women in Engineering	VT	28
24	Math-Science-Engineering Hall	WSU	29
25	Live and Learn Program	WVU	30

Table 2. Population served and other logistics regarding programs in this sample

Ref. #	# Students	# Credits	Women's program	Minority program	Assessment available
1	~120				x
2	31				x
3	37	13			x
4	58	~21			x
5	60				x
6	200				x
7					
8			x		
9					
10	80				
11					
12	18		x		
13	160				
14	24				
15					
16	120		x		
17					
18			x		
19					
20					x
21	78				x
22	100+		x		
23			x	x	
24		9			
25	58				x

Table 3. Approaches to engineering discovery used in programs

Ref. #	Introduce disciplines	Industry tours	Alumni contact
1	x		
2	x		
3	x		
4	x	x	
5	x	x	
6			
7			
8	x		x
9	x	x	
10			
11			
12			
13			
14	x	x	
15			
16		x	
17	x		x
18	x		x
19	x		
20			
21	x		
22	x		
23	x	x	x
24	x		
25			

Table 4. Approaches to success skills training used in programs

Ref. #	Seminar	Computer skills	Team skills	Writing	Speaking	Studying	Test-taking	Diversity training	How to learn	Time management	Conflict resolution
1	x	x	x			x				x	
2	x			x	x	x					
3	x	x	x	x							
4	x	x	x								
5	x		x								
6	x		x			x	x		x	x	
7						x					
8						x					
9			x								
10											
11	x										
12											
13											
14	x	x									
15											
16	x					x					
17		x									
18		x									
19	x										
20	x		x	x	x	x					
21	x	x	x			x					
22	x								x		
23	x	x	x	x	x	x	x		x	x	x
24											
25	x										

Table 5. Approaches to self discovery used in programs

Ref. #	Personality typing	Thinking preferences	Learning preferences	Career profiling	Advising	Student portfolio	Orientation	Leadership / achieve-ment awards
1	x	x	x	x	x		x	
2					x			
3				x	x			
4				x	x			
5					x			
6				x	x			
7				x	x			x
8				x	x			
9				x	x		x	x
10								
11								
12				x				
13				x	x			
14								
15								
16				x				
17					x			
18					x			
19				x				
20	x	x			x		x	
21				x	x			
22					x			
23	x	x	x	x	x			
24					x			
25								

Table 6. Approaches to develop affiliation used in programs

Ref. #	Common residence	Block scheduling	Residence hall services	Campus citizenship	Links to K-12	Team competitions	Freshman conference	Social activities
1	x	x	x			x		x
2		x						x
3	x	x	x					x
4	x	x	x					x
5	x	x	x	x				x
6	x	x	x					x
7	x	x	x					x
8	x	x	x					x
9	x	x	x	x				x
10	x		x	x				x
11	x		x	x				x
12	x		x					x
13	x		x					x
14	x	x						
15								
16	x	x	x	x				x
17	x	x	x			x		x
18	x	x	x					x
19	x	x						
20		x						
21	x	x	x					x
22	x	x	x					x
23	x		x					x
24	x	x	x					
25	x	x	x					

Table 7. Mentoring / learning resources in programs

Ref. #	Peer mentoring	Tutoring	At-risk intervention	Vertical integration
1	x			
2				
3	x	x		
4	x			
5	x	x		
6	x	x		
7		x		
8	x	x		
9		x		
10	x	x		
11	x			
12				
13	x			
14				
15				
16	x	x		
17	x	x		
18	x	x		
19		x		
20	x	x		
21	x	x		
22	x			
23	x			
24		x		
25				

Table 8. Academic areas included in programs

Ref. #	Dimensions	Units	Measure-ment	Algorithms / Programming	Graphical solutions	Plotting	Open-ended problem solving	Well-defined problem solving	Statistics	Ethics
1								x		
2										x
3								x		
4								x		
5										x
6										x
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20								x		x
21										
22										
23										
24										
25										

Table 9. Engineering topics included in programs

Ref. #	Multidisciplinary engineering	Math	Physics	Chemistry	History of Technology	Liberal education	Service learning
1	x	x	x	x		x	
2	x	x	x	x	x	x	
3	x						
4		x	x	x			
5	x						x
6	x						
7	x						
8	x						
9	x						x
10							
11							
12							
13							
14		x	x	x			
15							
16	x	x		x			
17	x	x	x	x			
18	x	x	x	x			
19	x	x		x			
20		x					
21	x	x		x			
22	x			x			
23	x						x
24	x			x		x	
25		x		x			

1 National Resource Center for The First-Year Experience & Students In Transition, http://www.sc.edu/fye/
2 Gándara, P., and J. Maxwell-Jolly, *Priming the Pump, Strategies for Increasing the Achievement of Underrepresented Minority Undergraduates*, http://www.collegeboard.org/research/html/PrimingThePump.pdf , item number 987257, The College Board, New York, December 1999, chapter 4.
3 Gándara and Maxwell-Jolly, p. 30.
4 Rogers, E.M., *The Diffusion of Innovation*, 4th Ed., New York: Free Press, 1995.

5 Gándara and Maxwell-Jolly, p. 38.
6 http://www.ces.clemson.edu/firstclass/
7 Olds, B.M., and R.L. Miller, "Connections: A Longitudinal Study of an Integrated Freshman Program," *Proc. Amer. Soc. Engr. Ed. 2001*, Session 2330.
8 Mickelson, S.K., Harms, P.C., and Brumm, T.J., Building Community for First- and Second-year Students in the Agricultural and Biosystems Engineering Department at Iowa State University, Session 2608, ASEE 2001
9 Jacobson, D. and Licklider, B., Freshman Year Learning Communities in a Computer Engineering Program, Iowa State University, Session T2B, FIE 2000
10 Appreciative Inquiry on the RISE Program, Dempsey, Estrada, Fear and Kim
11 Zmich, R.T. and Wolfe, T.F., The ROSES Program at Michigan State University: History and Assessment, Session 1653, ASEE 2001
12 http://www.osuhousing.com/LLC/llc-fcom-eng-ps.html
13 http://www.osuhousing.com/LLC/llc-engwmn-ps.html
14 http://www.osuhousing.com/LLC/llc-ford-ps.html
15 http://www.clubs.psu.edu/EASI/welcome.htm
16 http://www.clubs.psu.edu/shoe/index.html
17 http://www.psu.edu/dept/wise/
18 http://www.engr.psu.edu/wep/prospective/housing.htm
19 http://fairway.ecn.purdue.edu/FrE/new/special/lc
20 http://www.miami.edu/UMH/CDA/UMH_Main/1,1770,8-1;2757-3,00.html
21 http://www.umich.edu/~wiserp
22 http://prospectivestudents.missouri/edu/~reslfwww/hallsandcommunities/menengineer.html
23 http://prospectivestudents.missouri.edu/~reslfwww/hallsandcommunities/womenengineer.html
24 http://www.unl.edu/learncom/engineer.html
25 Della-Piana, C.K., Arenaz, P., Fisher, W. and Flores, B.C., CircLES: A Comprehensive First-Year Program for Entering Engineering and Science Students, University of Texas, El Paso, Session 1237, ASEE 2001
26 Steadman, S. and Whitman, D. Residential Innovations for Engineering Students, University of Wyoming, Session 3453, ASEE 2001.
27 http://www.housing.wisc.edu/wise/
28 http://www.rdp.vt.edu/themehousing/welc.html
29 http://www.cea.wsu.edu/student/support.htm
30 Cooley, W.L., Prucz, M., Live and Learn Program for Recruitment/Retention, West Virginia University, Session T1F, FIE 1997

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