Portraying the Academic Experiences of Students in Engineering:

Students Perceptions of Their Educational Experiences and Career Aspirations in Engineering.

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Introduction

Academic Pathways Study

- Flat to declining enrollment, high attrition
- Continuous improvement of the learning environment
- Need to better understand students' experiences in engineering education
  - Student motivations to study engineering
  - Perceptions/experiences with school

Research Questions

- What motivates students to study engineering?
- How do students navigate their educational programs at UMN?

- Get input directly from students.
- Conduct exploratory, descriptive study
  - Questionnaire survey (quantitative)
  - Focus groups (qualitative)

Perspective on Learning

- Cognitive & Constructivist Learning Theories
- Elements of theories investigated:
  - Student motivations
  - Instructional system

Student Motivations **X** **Instructional System** **=** **Educational Outcomes**

Survey Findings

Motivations to study engineering

	Non-transfers Fall05	Non-transfers Spring06	Transfers Spring06
Social good	.65	.70	.66
Financial	.64	.63	.53 *
Mentor	.28	.28	.22
Family	.13	.13	.13

- No differences by gender or division
- Non-transfers rated financial reward higher than transfers
  $t_{(215)} = 2.360$, $p = .019$
- $0 \leq m \leq 1$ (normalized scores)

Focus Groups Findings

Motivations to study engineering

Major themes

- Personal interests in subject
  - Problem solving
  - Creating, designing
  - Learning how to learn
  - Logical and objective (math and science thinking)
  - Practical application of math and science
- Parental, mentor influence
- Social good
- Professional prestige
- Financial rewards

Focus Group Findings

Motivations to study engineering

- I always enjoyed **that challenge of the problem-solving part** where actually it's . . . more than just your opinion,

- I just think it's absolutely fascinating to be able **to find answers to problems in our world**.

- But I think it's something where you can -- when you create something, -- especially like new technology -- **you're helping people.**

Focus Group Findings

Motivations to study engineering

- And I think in the classes I've taken, there are some hard problems, and I'll get it like 50 percent right. But it's more the practice of trying to solve that problem, like sitting down, taking the time and **honing my problem solving skills**, that's the important part of the engineering degree.

- And I learned early on I get a lot less frustrated if I think about that I'm learning how to learn something, rather than learning the actual thing itself. So when I go to an employer, I'm not gonna use a lot of what I got in school, but **those four years I learned how to learn things**.

Focus Group Findings
Motivations to study engineering

- **I like it 'cause it's logical**. Like, I was frustrated . . . and the English and those classes, like, they're kind of fluffy like and subjective.
- I had someone made the comment to me, um, **you shouldn't sell yourself short -- by being anything else**.

Focus Group Findings
Motivations to study engineering

- well, **my dad's an electrical engineer** and, you know, I always -- I like my dad and I kind of want to be like him and I'll be an engineer. And then I had -- **my oldest brother is now a civil engineer**
- **Plus, it's good money**, so there's this huge incentive…as opposed to be a starving artist or something.

Survey Findings

Perceptions of Educational Experiences

- Women reported more difficulty coping with course pace and load. $t_{(158)} = 3.625$, $p < .001$

- Women reported higher levels of involvement in extra-curricular activities. $t_{(158)} = 2.311$, $p = .022$

- Transfer students reported higher levels of academic disengagement for liberal arts classes. $t_{(161)} = -2.351$, $p = .020$

- Transfer students reported lower levels of satisfaction with overall collegiate experiences. $t_{(214)} = 2.943$, $p = .004$

Focus Group Findings

Perceptions of Educational Experiences

Major themes

- Important institutional experiences
  - Satisfaction with classes
  - Satisfaction with faculty, TAs, advising
  - Grades (competition, weeding-out, the curve)

- Workload
  - Value of course content
  - Extracurricular activities

Focus Group Findings

Perceptions of Educational Experiences

- I don't understand what is going on in that class, for the life of me, but I'm doing wonderful in the class. **But I don't feel like I understand it**. So I don't like that feeling of I'm doing okay but I don't understand the concepts.

- It's **almost always competitive**. 'Cause it's always graded on a curve

- especially when it comes to tests because you have to beat the curve. You have to **-- it's not always how well do you know it; it's how well do you know it compared to other** people to get the good grades.

Focus Group Findings

Perceptions of Educational Experiences

- I don't think it's a very good way to run an academic environment where everybody's failing all the time. But I've **heard the things like weeding out**. Like too many people take engineering and they've got to fail some people and –

- Well, I had a calc class that I actually -- like, I got my grade back and I failed. And then I -- I signed up for it again to go take it again. And I show up the first day, next semester and I was so pissed off that I was there and I went back and I looked and I had actually passed the class. **They had adjusted it about a month after the grades came out** because he obviously failed too many people. I ended up with a C.

Focus Group Findings

Perceptions of Educational Experiences

- ‘Cause **I’ve had great instructors**, and I’ve had instructors who seem like they could really care less when it came to actually presenting accurate information, or actually making an effort to make sure people understood things.

- I think **I learned a lot more at community college**. Really here, I’m going through the steps, but none of it’s sinking in, really.

Focus Group Findings

Perceptions of Educational Experiences

- …I have a class that's all group work, like that's all we do, and **it's amazing how much you're learning** just from interacting with the other people. That helps so much. Like doing it all on your own would be ridiculous.

- I feel bad whenever I go home or anywhere else on a weekend, 'cause that's like I just missed out on 25 hours I could spend in the lab. **I hate weekends, when I have to leave**.

Findings

Perceptions of Transfer Students

- Difficulty transferring in credits
- Meeting people
- Getting started

Discussion of Findings

Motivators of Learning

- Personal interest
- Student-student interaction
  - Group learning
  - Cooperative learning (study groups)
- Student-instructor interaction
  - Value of learning subjects
  - Value of advice
- Student-professional interactions
  - Internship/coops
  - Professional groups

Discussion of Findings

De-motivators of Learning

- Extreme difficulty
  - Perceived disconnect from real world
  - Weeding out vs. education
- Grading (the curve)
  - Not a measure of learning
  - Promotes competition over cooperation
- Poor levels of support
  - Advisement not helpful (especially lower division)
  - Value of interaction mixed (TAs, faculty, bureaucracy)

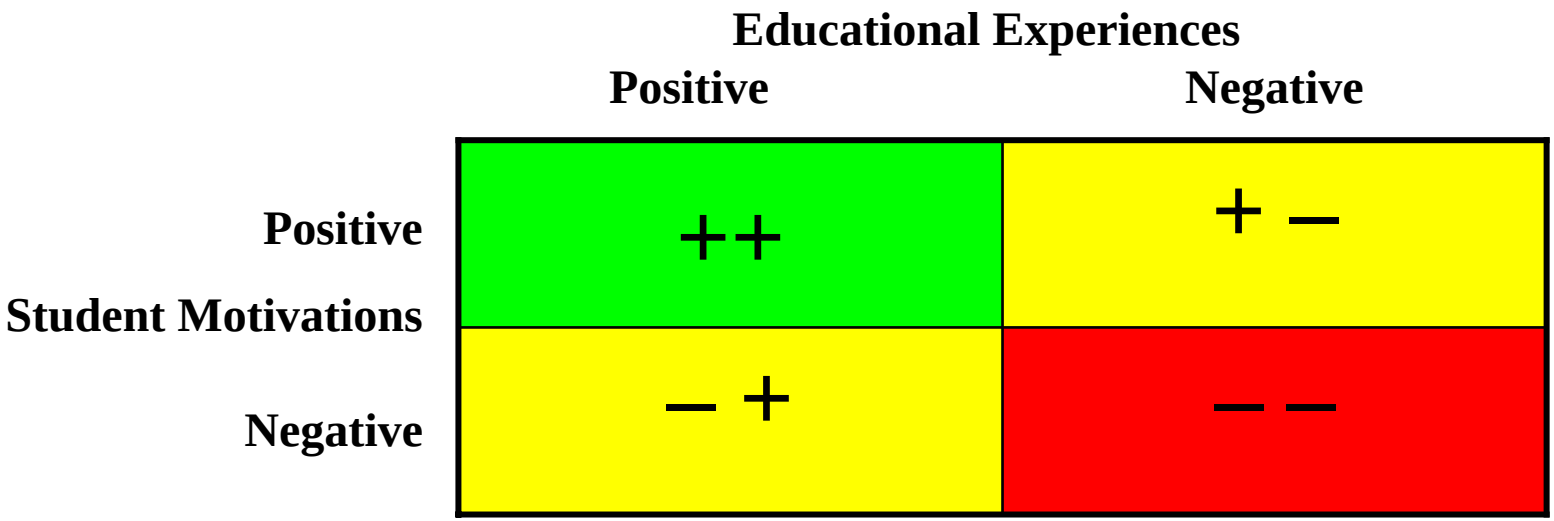
Discussion of Findings

Complex interactions

Student Motivation X **Instructional System** = **Educational Outcomes**

Discussion of Findings

Complex interactions



Discussion of Findings

Principles for Good Practice

- Encourage contact between faculty and students.
- Develop reciprocity and cooperation among students.
- Encourage active learning.
- Provide prompt feedback.
- Emphasize time on task.
- Communicate high expectations.
- Respect diverse talents and ways of learning.

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References

1. Baille, C., and Fitzgerald, G. (2000). Motivation and attrition in engineering students. *European Journal of Engineering Education, 25*(2), 145-155.
2. Seymour, E., and Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences.* Boulder, CO: Westview Press.
3. Sheppard, S., Atman, C., Stevens, R., Fleming, L., Streveler, R., Adams, R., and Barker, T. (2004). Studying the engineering student experience: Design of a Longitudinal Study. *2004 American Society for Engineering Education Annual Conference & Exposition.*
4. Astin, A. 1991. What really matters in general education: Provocative findings from a national study of student outcomes. Address presented at the Association of General and Liberal Studies meeting, Seattle, WA, October 18, 1991. Also, see *What matters in college: Four critical years revisited*., San Francisco: Jossey-Bass, 1993.
5. Astin, A. 1993. *What matters in college: Four critical years revisited.* San Francisco: Jossey-Bass.
6. Light, Richard J. 1992. *The Harvard assessment seminars: Second report*. Cambridge, MA: Harvard University.
7. Cross, K.P. (1993). On college teaching. *Journal of Engineering Education*, 9-14.
8. Pelz, D. and Andrews, F. (1966). Scientists in Organizations: Productive Climates for Research and Development. Ann Arbor: Institute for Social Research, University of Michigan.
9. Pelz, D. (1976). Environments for creative performance within universities. In Samuel Messick (Ed.), Individuality in learning, pp. 229-247. San Francisco: Jossey-Bass.
10. Pascarella, E. T. and Terenzini, P. T. (1991). How College Affects Students. San Francisco: Jossey-Bass.
11. Pascarella, E. T. and Terenzini, P. T. (2005). How College Affects Students: A Third Decade of Research. San Francisco: Jossey-Bass.
12. Kuh, G.D., Kinzie, J., Schuh, J.H., Whitt, and E.J. (2005) Student Success in College: Creating Conditions That Matter. San Francisco: Jossey-Bass.
13. Lemonick, M. D. (2006). Are we losing our edge? *Time, (Feb. 13),* 22-33.
14. Levine, J., and Wycokoff, J. (1991). Predicting persistence and success in baccalaureate engineering. *Education*, *111*(4), 461-468.
15. Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition, (2nd ed.).* Chicago: University of Chicago Press.
16. *University of Minnesota, Institute of Technology Mission.* Retrieved on January 15, 2007, http://www.it.umn.edu/about/mission.html
17. Eris, O., Chen, H., Bailey, T., Engerman, K., Loshbaugh, H. G., Griffin, A., Lichtenstein, G., and Cole, A. (2005). Development of the persistence in engineering (PIE) survey instrument. *2005 American Society for Engineering Education Annual Conference & Exposition.*
18. Chickering, A.W. and Gamson, Z.F. (1987). Seven principles for good practice in undergraduate education. *AAHE Bulletin*, March.
19. Savery, J. R. (1999). Enhancing Motivation and Learning through Collaboration and the Use of Problems. In S. Fallows and K. Ahmet (Eds.). *Inspiring students: Case studies in motivating the learner*. London: Kogan Page.
20. Johnson, D.W., Johnson, R.T., and Smith, K.A. 2007. The State Of Cooperative Learning In Postsecondary And Professional Settings. *Educational Psychology Review, 19(1)* (in press, online edition available)
21. Smith, K.A., Sheppard, S. D., Johnson, D.W., & Johnson, R.T. 2005. Pedagogies of engagement: Classroom-based practices. *Journal of Engineering Education* Special Issue on the State of the Art and Practice of Engineering Education Research, *94* (1), 87-102.
22. Bonwell, C. C. and Sutherland, T. E. (1996). The active learning continuum: Choosing activities to engage students in the classroom. In T. E. Sutherland and C. C. Bonwell (Eds.). *Using active learning in college classes: A range of options for faculty, 67.* San Francisco: Jossey-Bass.
23. Silverman, S. L. and Casazza, M. E. (2000). *Learning and development: Making connections to enhance teaching.* San Francisco: Jossey-Bass.
24. Shapiro, H. N. (2006). Promotion & tenure& the scholarship of teaching & learning. *Change, March/April*, 39-43.