



# **A Holistic Approach to Improving Undergraduate Performance in Gateway Computer Science Courses**

**Melanie J. Martin**  
**Computer Science Department**

# **New Mexico State University**



# The Context

- Recruit and retain students in CS
  - Underrepresented minorities
    - Native American
    - Hispanic, African American, Women, Others
- Pathways from High School to Graduate School
- Holistic, team-based approach
- Gateway courses

# The Gateway Courses

- CS 171, *Algorithmic Computation*:
  - First Course in CS Major
  - Students have diverse backgrounds and preparation levels
    - Required for some other majors (e.g.Math)
    - Some students have taken it up to 5 times
  - Students who fail tend to change their major

# The Gateway Courses

- Math/CS 278, *Discrete Mathematics for CS*:
  - New course in Spring 2003
    - Developed jointly by Mathematics and Computer Science Departments
    - Combines Math 279 (Intro to Finite Mathematics) and Math 330 (Discrete Mathematics)
    - Better alignment with ACM, IEEE-CS *Computing Curricula 2001*
    - Provide mathematical foundation to study theoretical computer science, while maintaining mathematical rigor
    - Taught alternately by Math and CS
  - Historically, many students who did well in CS 171 had difficulty passing Math 279 (Intro. to Finite Mathematics)
  - Students who fail tend to change their major

# Pathways: Spring 2003

- Focus Groups (Two for each course)
  - Listen to students
    - Support they want
    - Issues with the course
  - Provide supplemental material
    - Challenge
    - Reinforcement of course material
  - Identify potential “fast-track” students
- Web page with worksheets

# CS 171, Spring 2003

Grade	Focus Groups attended			Total
	0	1-2	>2	
A	9(4 ♀)	1(1 ♀)	3 (1 ♀)	13 (6 ♀)
B	7(3 ♀)	1	2 (1 ♀)	10 (4 ♀)
C	6 (1 ♀)	0	0	6 (1 ♀)
D	1	1	0	2
F	2	2(1 ♀)	0	4 (1 ♀)
W	6 (2 ♀)	0	0	6 (2 ♀)
Total	31(10♀)	5(2 ♀)	5 (2 ♀)	41(14♀)

Ethnicity	Focus Groups attended			Total
	0	1-2	>2	
African-Am.	0	0	1	1
Hispanic	9(3 ♀)	3(1♀)	1(1 ♀)	13 (5 ♀)
Native-Am.	0	2(1 ♀)	2(1 ♀)	4 (2 ♀)
White	21(7 ♀ )	0	1	22 (7 ♀)
Foreign	1	0	0	1
Total	31(10 ♀)	5(2 ♀)	5(2 ♀)	41 (14♀)

# Math 278, Spring 2003

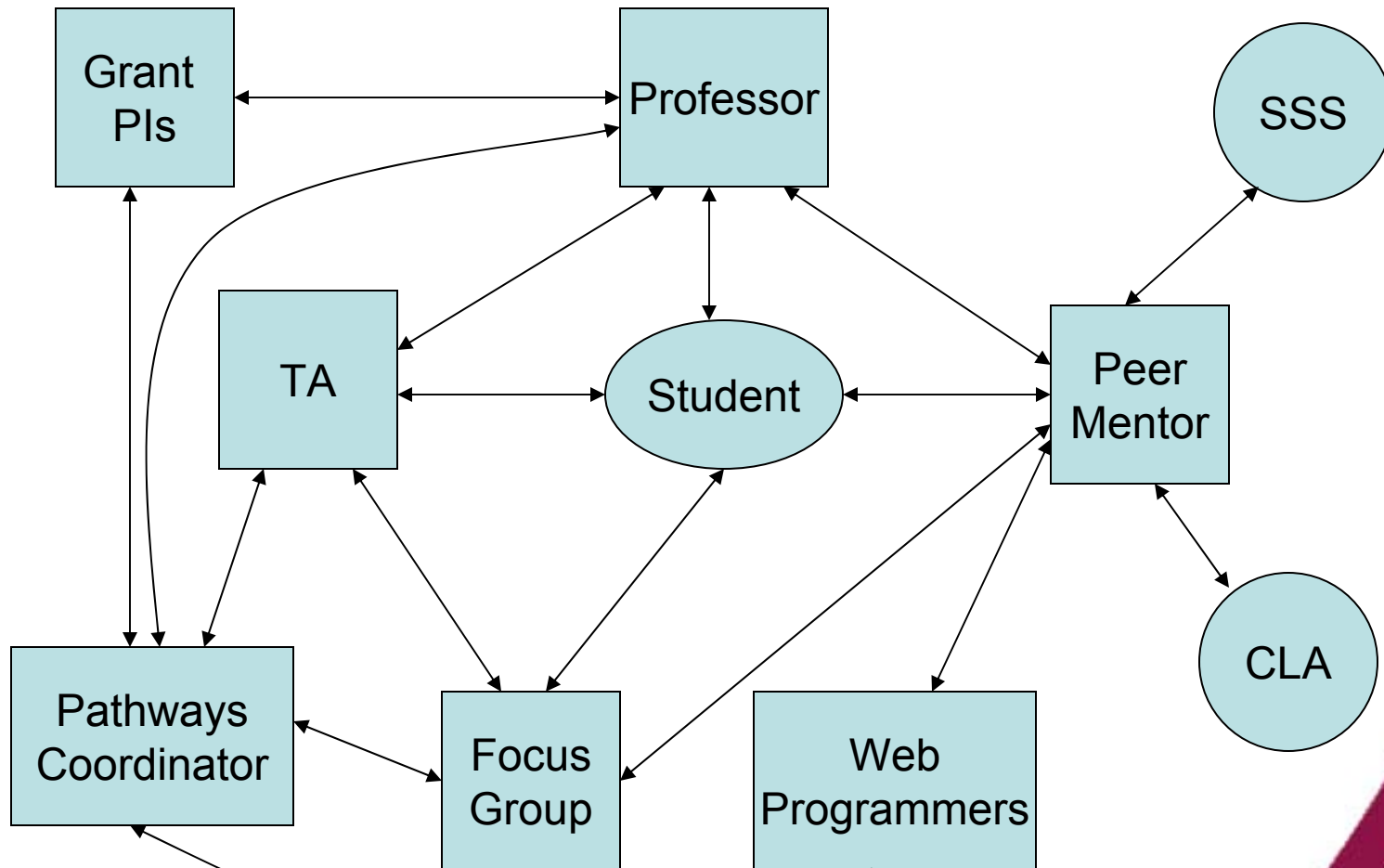
	Focus Groups attended			Total
	0	1-2	>2	
<b>Grade</b>	0	1-2	>2	
A+	0	0	2(1 ♀)	2 (1 ♀)
B	3	0	0	3
C	2 (1 ♀)	1	3(1 ♀)	6 (2 ♀)
D	3	1	0	4
F	7 (1 ♀)	2	1	10 (1 ♀)
W	5 (1 ♀)	0	0	5 (1 ♀)
Total	20(3 ♀)	4	6(2 ♀)	30(5 ♀)

	Focus Groups attended			Total
	0	1-2	>2	
<b>Ethnicity</b>	0	1-2	>2	
African-Am.	0	2	0	2
Hispanic	7	0	1	8
Native-Am.	3 (1 ♀)	1	0	4 (1 ♀)
White	10(2 ♀)	1	5(2 ♀)	16 (4 ♀)
Foreign	0	0	0	0
Total	20(3 ♀)	4	6(2 ♀)	30 (5 ♀)

# Pathways: Fall 2003

- “Support, Challenge and Opportunity”
- Focus Groups
- Peer Mentoring
- Web-based support
- Team approach
  - Holistic
  - Coordination
  - Communication

# The Pathways Team



# What we did differently in the Fall Focus Groups:

- Started Focus Groups first week of class
- Instructor regularly encouraged attendance
- Increased communication

# What we did differently in the Fall Focus Groups:

- CS 171
  - Extra Credit Points
    - 3 per week
    - Equal to one lab
  - Focused on thinking through the lab assignments
- Math 278
  - Extra Credit Problems
    - Assigned in Focus Group
    - Collected in Focus Group
  - Focused on “homework-like” problems

# Pathways: Fall 2003

- Support Available to Students
  - Individual
    - 8 hours of office hours (Prof, TA, Mentor)
  - Small Groups
    - 2 hours (or more) Focus Groups
  - Web
    - Practice Area
    - Support Materials (Worksheets, Terminology Review)
    - News and Information

# Fall 2003 Web Page

**NMSU Computer Science Undergraduate Pathways Program**

**Math 301**

Home  
Math 301  
CS 171  
Staff  
Links  
Site Map  
FAQ

**Current Calendar**

Important dates:  
Final will be Dec. 4th  
Graded exams will be handed back at the regular final time:  
10:30 am, Dec. 11th

**Class News**

All homework solutions are now available

Review Session for Final:  
Wednesday, Dec. 3rd,  
5-7 pm, in SH 124

**Class Links**

Course syllabus  
Homeworks & Exams  
Course material  
Grades

**Focus Group Hours**

Wednesdays 6:00 to 7:00 pm  
Fridays 2:45 to 3:45 pm (in SH 166)

**Course Contact Information**

**Dr. Desh Ranjan** Professor (dranjan@cs.nmsu.edu)  
Office SH #159  
Phone # 646-4600  
Office hours:  
Tuesday and Thursday, 1:30-2:30 pm  
[View my profile](#)



# CS 171, Fall 2003

Grade	Focus Groups attended			Total
	0	1-2	>2	
A	9 (2 ♀)	4 (1 ♀)	5 (1 ♀)	18 (4 ♀)
B	5 (1 ♀)	1	1	7 (1 ♀)
C	2	0	0	2
D	0	0	1	1
F	9 (4 ♀)	0	1	9 (4 ♀)
W	2 (2 ♀)	0	0	2 (2 ♀)
Total	29(9 ♀)	5 (1 ♀)	8 (1 ♀)	42(11 ♀)

Ethnicity	Focus Groups attended			Total
	0	1-2	>2	
African-Am.	0	0	0	0
Hispanic	11(3 ♀)	4	3	18(3 ♀)
Native-Am.	2(2 ♀)	0	2 (1 ♀)	4 (3 ♀)
White	16(4 ♀)	1(1 ♀)	3	20(5 ♀)
Foreign	0	0	0	0
Total	29(9 ♀)	5(1 ♀)	8 (1 ♀)	42(11♀)

# Math 278, Fall 2003

Grade	Focus Groups attended			Total
	0	1-2	>2	
A	0	1	7 (1 ♀)	8 (1 ♀)
B	0	2	5 (2 ♀)	7 (2 ♀)
C	1	1	2	4
D	0	0	1 (1 ♀)	1 (1 ♀)
F	2 (1 ♀)	1	0	3 (1 ♀)
W	1	0	0	1
Total	4 (1 ♀)	5	15 (4 ♀)	24(5 ♀)

Ethnicity	Focus Groups attended			Total
	0	1-2	>2	
African-Am.	0	1	1(1 ♀)	2(1 ♀)
Hispanic	1	2	7(1 ♀)	11(1 ♀)
Native-Am.	1(1 ♀)	0	2(1 ♀)	3 (2 ♀)
White	2	1	2	5
Foreign	0	1	2(1 ♀)	3(1 ♀)
Total	4(1 ♀)	5	15(4 ♀)	24 (5 ♀)

# Conclusions:

## Percent of Students Receiving C or Better (grading standards maintained)

- CS 171
  - Spring 2003: **71%**
  - Fall 2003: **64%**
    - Three students who regularly attended focus groups did raise their grades
    - Unusually bi-polar class
- Math 278
  - Math 279, Spring 2000-Fall 2001: **52%**
  - Math 278, Spring 2003: **37%**
  - Math 278, Fall 2003: **79%**

# Conclusions

- Results for Fall 2003 are promising for holistic team-based approach
- Some courses are better suited for this approach
  - Math 278 was very successful
  - CS 171 approach needs to be reconsidered
- Students who attend focus groups and seek help tend to do better, so we need to get them there

# Conclusions

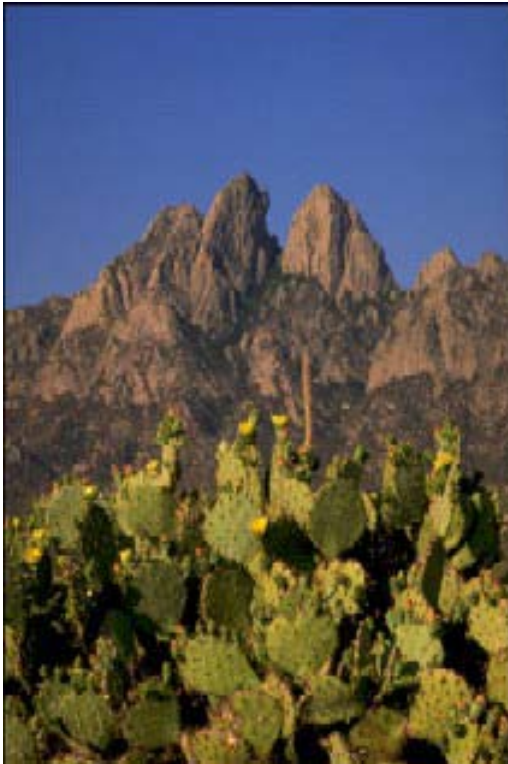
- Some Key Factors:
  - Timely consistent communication
  - Keeping students paced
    - Weekly assignments
    - Quick grading turnaround
    - News, assignments and solutions on web
  - Incentives to attend focus groups

# Conclusions

## Some Key Factors:

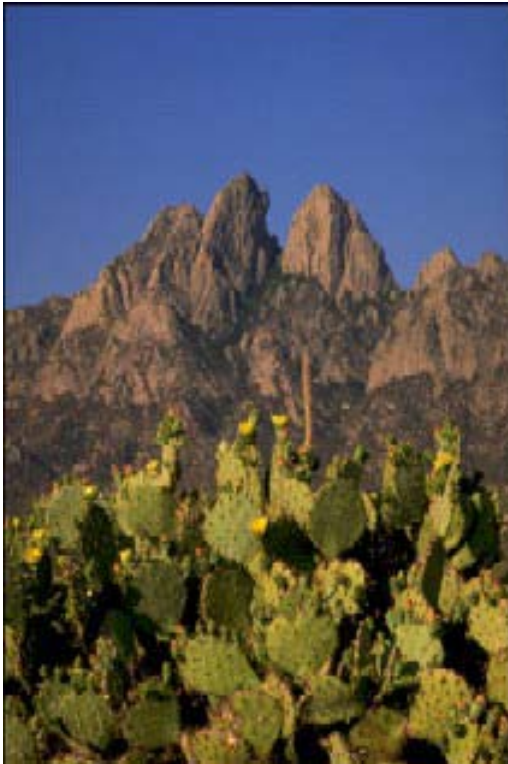
- Support a diversity of learning styles
  - Individual
  - Small group
  - Traditional Classroom
  - Web-based
- Recognize and address interconnected spheres where students function, including:
  - Academic
  - Cultural
  - Financial
  - Family
  - Work
  - Peers

# Acknowledgements



- National Science Foundation Minority Institution Infrastructure Grant (No EIA-0220590)
- 2003 Pathways Team Members
- Dr. Roger T. Hartley and Dr. Enrico Pontelli
- Dr. John Harding and Dr. Desh Ranjan, Hue McCoy and Dr. Esther Steiner

# Questions/Discussion



- Thank you for listening!!!