

# ***Characteristics of Successful Programs in College Calculus Project: Findings from the Two-Year Colleges***

**Vilma Mesa<sup>1</sup>, Nina White<sup>1</sup>, Helen Burn<sup>2</sup>**

<sup>1</sup>University of Michigan - <sup>2</sup>Highline Community College

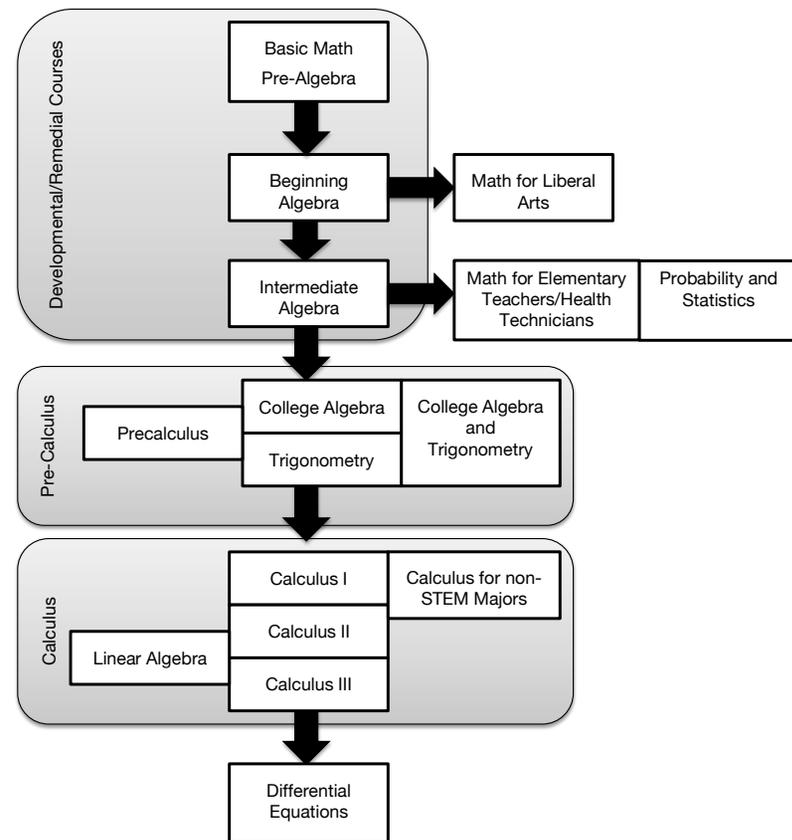
# The Two-Year Colleges Context

- 46% of students taking a mathematics class are doing so at a two-year college
- 42% of low-income students\*
- 55% with dependents\*
- 60% working full-time\*
- 44% Black/Hispanic\*

## Calculus I

- 2010 enrollment ~ 63K
- Average class size 20

\* First time enrollment.  
(Blair, Kirkman, Maxwell, 2013; NCES, 2011, NCES, 2011)



# Orienting Question

What are the features that participants identify as being directly associated with the success of their calculus program at the two-year institutions identified in the *CSPCC* as successful?

# Selected Two-Year Institutions

College	Size	Demographics	FT:PT	#Calc. I Sections/term	Class Size
South City College	<5000	Minority: 51% 18-24 y.o.: 22% Part time: 72%	7:10	2	30-35
Midwest Urban College	<10000	Minority: 62% 18-24 y.o.: 22% Part time: 67%	9:20	3 to 4	30
West Rural College	<3000	Minority: 61% 18-24 y.o.: 43% Part time: 58%	7:0	1	30 (52)
Southeast Suburban College	>10000	Minority: 26% 18-24 y.o.: 47% Part time: 58%	35:30	10	30

# Data

College	Interviews Instructors (Other)	Classroom Observations	Student Focus Groups
South City College	3 (6)	2	4, 43 students
Midwest Urban College	5 (8)	2	1, 26 students
West Rural College	1 (5)	1	1, 42 students
Southeast Suburban College	8 (9)	5	3, 39 students
<b>Total</b>	<b>17 (28)</b>	<b>10</b>	<b>9, 150 students</b>

Documents: exams, syllabi, homework, quizzes, worksheets, college publications and reports, college/department websites

# Method

- Identification of *Facts and Features* at each case, by two researchers in the same case
- Member checking
- Identification of commonalities: facts and features that were common to three of the four cases, by all researchers
- Category reduction to identify themes, independently and then in collaboration
- High agreement in seven themes
- Confirmation with other data (e.g., observations)
- Testing with survey data

# Cross-Case Themes

THEME	
1. High quality instructors 2. Faculty autonomy and trust in the teaching of calculus	
3. Attention to placement 4. Supporting students academically and socially	
5. Transfer policies 6. Informal instructional support 7. Assessment and data collection	

# Cross-Case Themes

THEME	CATEGORY
<ol style="list-style-type: none"><li>1. High quality instructors</li><li>2. Faculty autonomy and trust in the teaching of calculus</li></ol>	INSTRUCTION
<ol style="list-style-type: none"><li>3. Attention to placement</li><li>4. Supporting students academically and socially</li></ol>	STUDENT SUPPORT
<ol style="list-style-type: none"><li>5. Transfer policies</li><li>6. Informal instructional support</li><li>7. Assessment and data collection</li></ol>	IMPROVEMENT EFFORTS

# Instruction

## High quality instructors

Knowledgeable, available, approachable

Have high expectations for developing conceptual understanding in addition to procedural competency/fluency

## Faculty autonomy; trust in their teaching

Instructors have latitude and freedom

No department-wide policies for instructional approaches or technology

Loose coordination (textbook, master/state syllabus)

# A 10-min Quiz

1. True or false. If true, explain why. If false, explain why or give an example to show it is false:

a. If  $\lim_{x \rightarrow a} f(x) = L$  then  $f(a) = L$ .

b. A rational function has at least one vertical asymptote.

c.  $\lim_{x \rightarrow 5^-} \sqrt{x-5} = 0$ .

d. The function  $f(x) = \begin{cases} \frac{x^2 - 6x + 5}{x - 5}, & x \neq 5 \\ 4 & , \quad x = 5 \end{cases}$  is discontinuous at  $x = 5$ .

2. Sketch the graph of a function that satisfies the following conditions:

$\lim_{x \rightarrow \infty} f(x) = 0$ ,  $f(0) = 0$ ,  $f(1) = 1$ , and  $f(-x) = -f(x)$  which means the

function is odd.

# Selected vs. not-Selected Institutions

	Selected (N= 91)	Not Selected (N=307)	Sig
Instructor <sup>a</sup>	5.10 (.754)	4.68 (.948)	***
Expectations and Environment <sup>b</sup>	5.27 (.703)	4.69 (.899)	***
Materials: exams, homework, good and fair	5.12 (1.01)	4.88 (1.01)	ns

- asked questions to determine if I understood what was being discussed; listened carefully to my questions and comments; allowed time for me to understand difficult ideas; helped me become a better problem solver; provided explanations that were understandable; was available to make appointments outside of office hours, if needed.
- made class interesting; presented more than one method for solving problems; encouraged students to enroll in Calculus II; acted as if I was capable of understanding the key ideas of calculus; made me feel comfortable in asking questions during class.

# Student Support

## Attention to Placement

Intentional processes for accurate placement

“Student oriented” placement policies

Confidence in “in-house” preparation courses (two sites)

## Academic and Social Support

Learning centers, office hours, advising

Extracurricular math competitions, clubs, study space

Study groups

## Transfer Policies

Supported by the states

Common course descriptions/articulation agreements

Instructors’ personal experience

# Selected vs. not-Selected Institutions

	Selected (N=90)	Not Selected (N=295)	Sig
Attended office hours, tutoring sessions, study groups outside of class	1.12 (.621)	1.18 (.655)	ns
Learning Center availability	.93 (.254)	.91 (.285)	ns
Use online tutoring	1.41 (.993)	1.81 (1.404)	*

One of the concerns with the center is that... **we're giving all the support to developmental students** and then some of the **college-level students feel they're left hanging in the lurch**. Dr. X serves one of his office hours in the center specifically here to help. We encourage Calculus students to walk in during that hour and he's here to help just Calculus students, because **most of our staff here... they weren't hired to help higher level and aren't qualified**.

# Improvement Efforts

## Instructional Support/Collegiality

Informally conducted on an ongoing basis

On-campus faculty development opportunities and funding →  
not widely used by math faculty

## Assessment and Data Collection

- Student learning outcomes (college & department)
- Student success (e.g. pass rates, graduation rates)
- Student success in transfer institutions

The colleges used the data mostly for reporting purposes

Faculty did not describe using the data for programmatic decisions

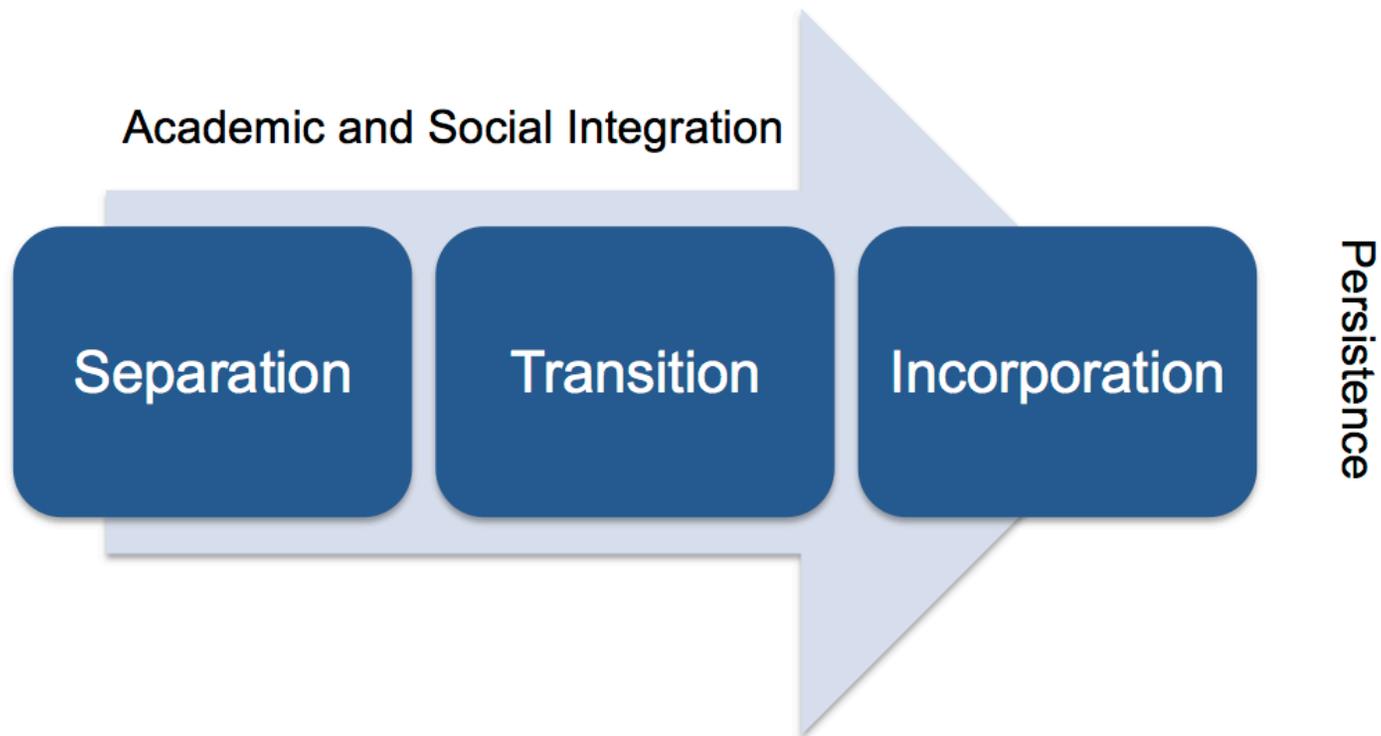
# Selected vs. not-Selected Institutions

	Selected (N=42)	Not Selected (N=307)	Sig
Encouraged faculty to pursue professional development	1.00 (.00)	.72 (.447)	***
Resources available for attending UG teaching conferences	1.00 (.00)	.53 (.499)	***
Recognition of teaching	.00 (.00)	.20 (.397)	***

There was no variation here...

# Understanding Three Themes: Models of Academic and Social Integration

Academic and social integration influence students' choice to depart from college  
(Kuh et al, 2008; Tinto, 1975, 1988)



# Mixed Results in the Two-Year Context

However:

1. Community college faculty are key:
  - Validating students as learners (Rendon, 2006)
  - Encouraging out-of-class interaction
2. Classrooms are the main point of contact with the institution (Hagedorn, 2000)
3. Institutional features—placement and transfer policies—are more relevant (Hagedorn et al., 2000)

# Understanding Our Themes

- **Placement** as a first step in the integration process. Institutions and instructors
  - Make sure the student is where he or she needs to be—student oriented placement
  - Encourage students to take the preparatory courses **in the college** → creates common experiences, fosters use of rigorous language, sets-up expectations → creates a community ready for Calculus

# Understanding Our Themes

- The **teacher** in the classroom facilitates students':
  - Direct contact with knowledgeable and caring faculty
  - Learning of academic expectations
  - Interaction with other students
- **Study groups:**
  - Take advantage of the space available in learning centers

# Implications—Research

Reconceive and localize definitions of success:

- Develop a system of criteria for indicators of success at the program, department or institution level that capitalizes on the data collected (Briggs et al., 2003)
- Consider other aspects of success explored in the literature
  - “involvement” (Astin, 1984)
  - “validation” (Rendon, 2006)
  - “engagement” (Kuh, 2008)
  - learning

# Implications—Practice

- Reconceive the goal of placement: finding the (appropriate) class that will provide a space for social and academic integration within the culture of doing calculus
- Maintain and promote activities that target calculus students: clubs and competitions

# References

- Astin, A. W. (1984). Student involvement: A developmental theory for higher education. *Journal of College Student Personnel, 25*, 297-308.
- Blair, R., Kirkman, E. E., & Maxwell, J. W. (2013). *Statistical abstract of undergraduate programs in the mathematical sciences in the United States. Fall 2010 CBMS Survey*. Washington D.C.: American Mathematical Society
- Briggs, C. L., Stark, J., & Rowland-Poplowski, J. (2003). How do we know a "continuous planning" academic program when we see one? *Journal of Higher Education, 74*(4), 361-385.
- Kuh, G. D. (2008). *High impact educational practices: What they are, who has access to them, and why they matter*. Washington, D.C.: American Association of Colleges & Universities.
- National Center for Education Statistics, & Institute of Education Sciences. (2012). *Digest of education statistics: 2011*. ([http://nces.ed.gov/programs/digest/d12/tables/dt12\\_279.asp](http://nces.ed.gov/programs/digest/d12/tables/dt12_279.asp)). Washington, D.C.
- Rendon, L. (2006). *Reconceptualizing success for underserved students in higher education*. Response paper for NPEC National Post-secondary Education Cooperative. NPEC National Post-secondary Education Cooperative. Retrieved from [http://nces.ed.gov/npec/pdf/resp\\_Rendon.pdf](http://nces.ed.gov/npec/pdf/resp_Rendon.pdf)
- Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research, 45*(1), 89-125.
- Tinto, V. (1988). Stages of student departure: Reflections on the longitudinal character of student leaving. *The Journal of Higher Education, 59*(4), 438-455.

Vilma Mesa, [vmesa@umich.edu](mailto:vmesa@umich.edu)

Nina White, [whitenj@umich.edu](mailto:whitenj@umich.edu)

Helen Burn, [hburn@highline.edu](mailto:hburn@highline.edu)