

Designing an Effective Corequisite Program

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What is Learning?

Learning is embedding new knowledge
in the rich soil
of what you already know

Marlieke van Kesteren at VU University Amsterdam



Outline

- 1 Structure of Corequisite Courses
- 2 Professional Development
- 3 Affective Domain
- 4 Pretests and Algebra Activities
- 5 Challenges
- 6 Next Steps
- 7 Student Feedback

New Corequisite Courses

Units are in parentheses

Fall 2018

Prestatistics (6 + 2)

Intermediate Algebra (5 + 3)

Spring 2019

Statistics (4 + 2)

Fall 2019

Trig (4 + 1)

Trig-Precalc (6 + 2)

Applied Calculus (5 + 1)

Placement



- Non-transferable courses
- Transferable courses

Embedded Counseling



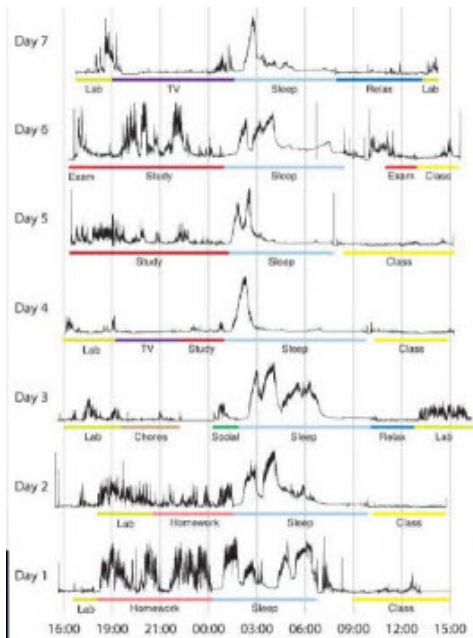
- Coordinating faculty and counselors
- 4 classroom visits
- Activities
- Outside class
- Communication between faculty and counselors during semester

A Typical Day



- Math activities
- Mini-lectures
- Affective domain activities

Why Group Work?



Embedded Tutoring



- Hiring
- Training

- In class
- Debriefs

Students' Evaluation of Tutors

- He doesn't tell you exactly what you did wrong. He lets you think about it and find out yourself, and I like that.
- He is very helpful and will elaborate on a problem if not done correctly. He always talks to us as students and as well as peers.

Students' Evaluation of Tutors

- The only problem with him is the language barrier so sometimes it's a bit confusing on both him and the students, but overall he gets the job done.
- Very intuitive and friendly.
- He's good. He's smart. Explained things better than the teacher.

Goal of Course

Have students **and faculty** embed new knowledge in the rich soil of what they already know



Professional Development



- Training faculty
- Bimonthly meetings
- Paid time
- Release time

Affective Domain



- Belonging
- Support groups
- “Grow your brain”
- Grit
- Reading apprenticeship
- How does math tie into your career?
- Three Rs (relationship, relevance, rigor)
- Counselors
- Seamless integration

Importance of Empathy

“High personal warmth with
high **active** demandingness”

Judith Kleinfeld (1972)

Goal of Course

Have students embed new knowledge in the rich soil of what they already know



Activities: As Many of the Following as Possible



- Students work collaboratively
- Address fundamental concepts
- Unfamiliar problems
- Address students' misconceptions

Activities: As Many of the Following as Possible



- Low floor high ceiling
- Single question
- Contextually rich
- Multiple solutions
- In-depth debates

Multiple Solutions

For which type of car, domestic or imported, has fuel efficiency improved the fastest? Explain.

Domestic		Imported	
Year	(miles per gallon)	Year	(miles per gallon)
2010	33.1	2007	32.2
2011	32.7	2009	33.8
2012	34.8	2011	33.7
2013	36.0	2013	36.6
2014	36.7	2014	36.0

Fuel Efficiency Rubric

Goals met are in red:

- Students work collaboratively
- Address fundamental concepts
- Unfamiliar problems
- Address students' misconceptions
- Low floor high ceiling
- Single question
- Contextually rich
- Multiple solutions
- In-depth debates

The Power of Debate

A person of which ethnicity is more likely to oppose the Death Penalty?

	African American	Caucasian	Other	Total
Favor	128	953	108	1189
Oppose	140	414	81	635
Total	268	1367	189	1824

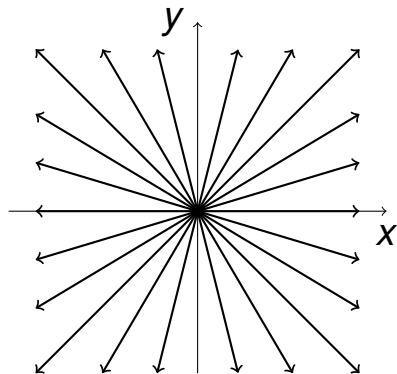
Death Penalty Rubric

Goals met are in red:

- Students work collaboratively
- Address fundamental concepts
- Unfamiliar problems
- Address students' misconceptions
- Low floor high ceiling
- Single question
- Contextually rich
- Multiple solutions
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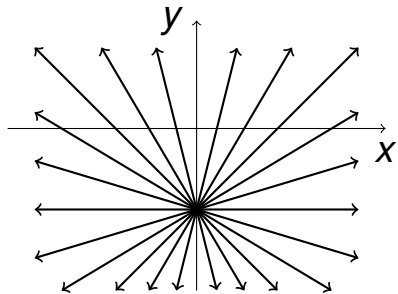
Experimentation

On a graphing calculator, graph a group of lines to make a starburst like the one below. List the equations of your lines.



Experimentation

On a graphing calculator, graph a group of lines to make a starburst like the one below. The intersection point is $(0, -3)$. List the equations of your lines.



Slope Experimentation Rubric

- Students work collaboratively
- Address fundamental concepts
- Unfamiliar problems
- Address students' misconceptions
- Low floor high ceiling
- Single question
- Contextually rich
- Multiple solutions
- In-depth debates

Groundbreaking Research

Design as many measures of consistency as you can to determine the more consistent basketball player for each player's first 20 games.

Game	<u>Points Scored in 2017–2018</u>	
	Stephen Curry	Kevin Durant
1	22	20
2	28	22
3	37	29
4	29	25

(There are actually 20 rows of data.)

Basketball Rubric

- Students work collaboratively
- Address fundamental concepts
- Unfamiliar problems
- Address students' misconceptions
- Low floor high ceiling
- Single question
- Contextually rich
- Multiple solutions
- In-depth debates

Who's More Consistent?

Curry: $s = 7.4$, IQR = 9, Range = 30

Durant: $s = 3.7$, IQR = 4, Range = 12

Multiple Solutions

Estimate when the total revenue from television, radio, and multimedia was equal to the revenue from telecommunication devices. What was that revenue?

Year	Revenue (billions of dollars)	
	Television, Radio, and Multimedia	Telecommunication Devices
2011	56.3	65.5
2012	52.0	69.8
2013	47.5	73.6
2014	45.5	77.2
2015	44.0	79.9

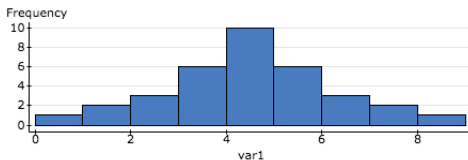
Media Rubric

- Students work collaboratively
- Address fundamental concepts
- Unfamiliar problems
- Address students' misconceptions
- Low floor high ceiling
- Single question
- Contextually rich
- Multiple solutions
- In-depth debates

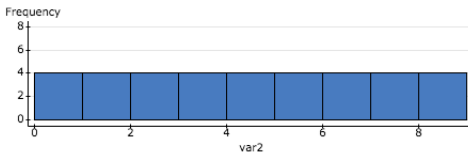
Power of Debate

Which distribution has the smallest standard deviation? The largest? **Explain.**

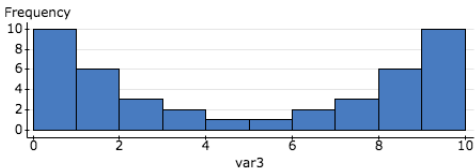
Dist 1:



Dist 2:



Dist 3:



Standard Deviation Rubric

- Students work collaboratively
- Address fundamental concepts
- Unfamiliar problems
- Address students' misconceptions
- Low floor high ceiling
- Single question
- Contextually rich
- Multiple solutions
- In-depth debates

Conceptual Development

1. A student tries to solve the equation

$$x^2 + 6x - 5 = 0:$$

$$x^2 + 6x - 5 = 0$$

$$x^2 + 6x = 5$$

$$x^2 + 6x + 9 = 5$$

$$(x + 3)^2 = 5$$

$$x + 3 = \pm\sqrt{5}$$

$$x = -3 \pm \sqrt{5}$$

Describe any errors. Then solve the equation correctly.

Conceptual Development

2. A student tries to solve the equation $4x^2 - 8x = 12$:

$$4x^2 - 8x = 12$$

$$4x^2 - 8x + 16 = 12 + 16$$

$$(2x - 4)^2 = 28$$

$$2x - 4 = \pm\sqrt{28}$$

$$2x - 4 = \pm 2\sqrt{7}$$

$$2x = 4 \pm 2\sqrt{7}$$

$$x = 2 \pm \sqrt{7}$$

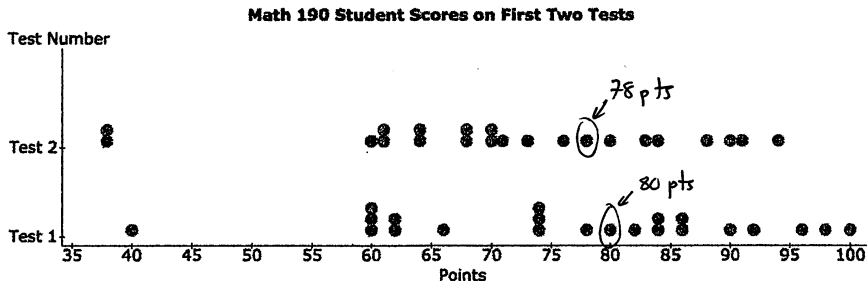
Describe any errors. Then solve the equation correctly.

Completing the Square Rubric

- Students work collaboratively
- Address fundamental concepts
- Unfamiliar problems
- Address students' misconceptions
- Low floor high ceiling
- Single question
- Contextually rich
- Multiple solutions
- In-depth debates

Multiple Solutions

The scores from Test 1 and Test 2 for our class are described by the following two dotplots. A student in our class earned 80 points on Test 1 and 78 points on Test 2. The student thinks that he or she did worse on Test 2. What would you tell the student?



Tests 1 and 2 Rubric

- Students work collaboratively
- Address fundamental concepts
- Unfamiliar problems
- Address students' misconceptions
- Low floor high ceiling
- Single question
- Contextually rich
- Multiple solutions
- In-depth debates

Symbolic Intensive Work

$$1 \quad \frac{3}{5} + \frac{7}{2}$$

$$2 \quad \frac{b}{2} + \frac{b}{3}$$

$$3 \quad \frac{x-2}{4x} + \frac{x+3}{6x}$$

$$4 \quad \frac{5}{x-3} + \frac{2}{x+4}$$

$$5 \quad \frac{w}{(w+3)(w-5)} + \frac{4}{(w-2)(w-5)}$$

$$6 \quad \frac{3}{x^2 + 3x + 2} + \frac{2}{x^2 + 7x + 6}$$

$$7 \quad \frac{x+1}{x^2 - 16} + \frac{x-2}{2x-8}$$

$$8 \quad \frac{a+1}{10a^2 + 13a - 3} + \frac{a-2}{2a^2 - 5a - 12}$$

Rational Expressions Rubric

- Students work collaboratively
- Address fundamental concepts
- Unfamiliar problems
- Address students' misconceptions
- Low floor high ceiling
- Single question
- Contextually rich
- Multiple solutions
- In-depth debates

Challenges



- Students
- Tutors

- Faculty
- Counselors

Next Steps



- Training faculty
- Designing activities
- Bimonthly meetings
- Hiring faculty

Ultimate Goal



Strong vision and commitment shared by all:

- Students
- Faculty
- Embedded tutors
- All counselors
- Dean of counseling
- Dean of math/science
- Vice president of instruction
- President

Student Feedback



- The worksheets are helpful. They help me learn a lot more about the topics.
- I believe group work does and doesn't work. It does work if my partners are talking and interacting with me. However it doesn't when there is no communication.

Student Feedback



- The group work is by far the best way to learn and understand the content. With such a long class period, it is almost essential.
- Group work has been able to provide me with a different perspective on how to solve the problem and gives me an easy option to ask for help.

For More Information



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