

In the Chat Pod...

Do you use informal indicators
(e.g. things other than graded assignments)
to gauge the effectiveness of your teaching
strategies?

Please share examples



Teaching, Learning, and Assessment Strategies for Math/QR Courses



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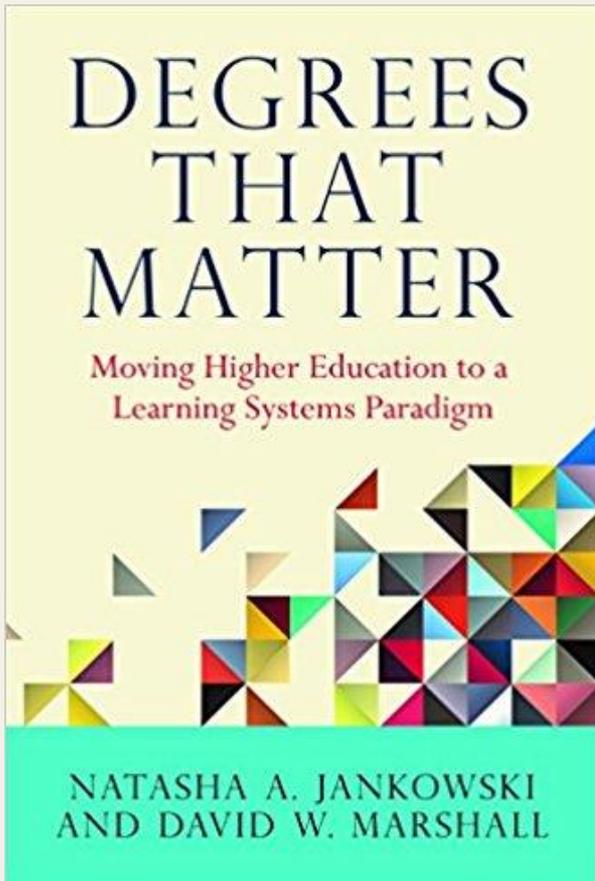
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Constructive Alignment



A constructively aligned course builds ‘links between course intended learning outcomes, teaching and learning activities, and assessment tasks so that [students] understand why they needed to take the course and how the course was related to other courses and even the programme goals’ (Wang, et al., 2013 p. 487).”

Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher education*, 32(3), 347-364.

Wang, X., Su, Y., Cheung, S., Wong, E., & Kwong, T. (2013). An exploration of Biggs’ constructive alignment in course design and its impact on students’ learning approaches. *Assessment & Evaluation in Higher Education*, 38(4), 477– 491.



Outcomes & Assignments

Intellectual Skills Undergraduate Learning Outcome

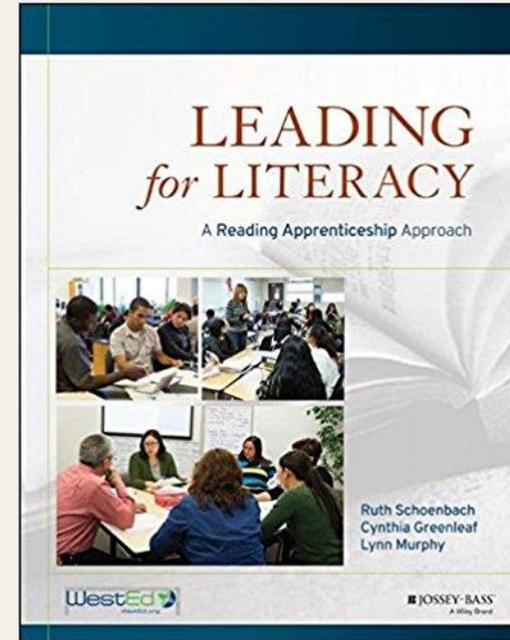
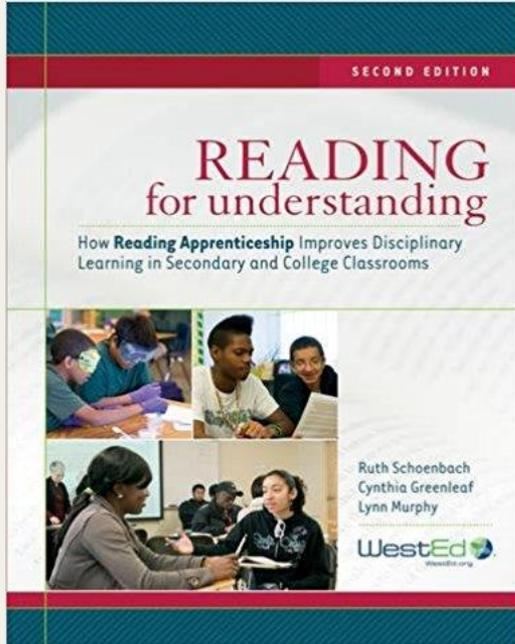
Document	Purpose
QR assignment guides	Helps instructors make intentional choices about what prompts to include -- or not include -- in assignments
QR rubric	For assignment prompts in guide, describes stages of proficiency development over 4-year undergraduate program
QR rubric guides	Illustrates terms and concepts used in rubric and describes degree-level proficiency for rubric components

[Link to guides & rubrics](#)



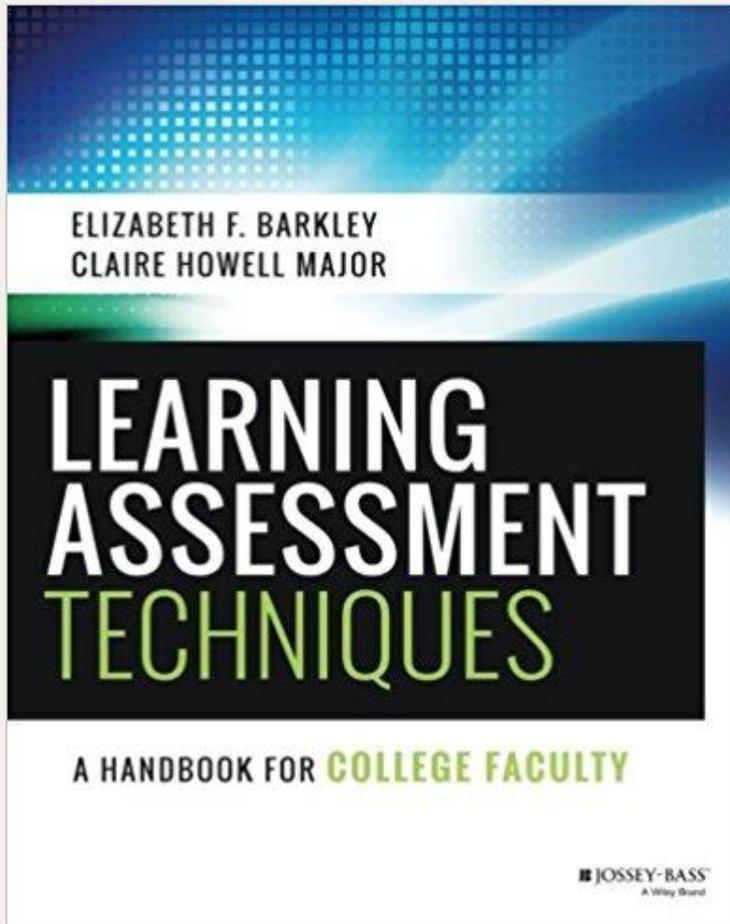
Pedagogy: Reading Apprenticeship

Embracing difficulty and confusion

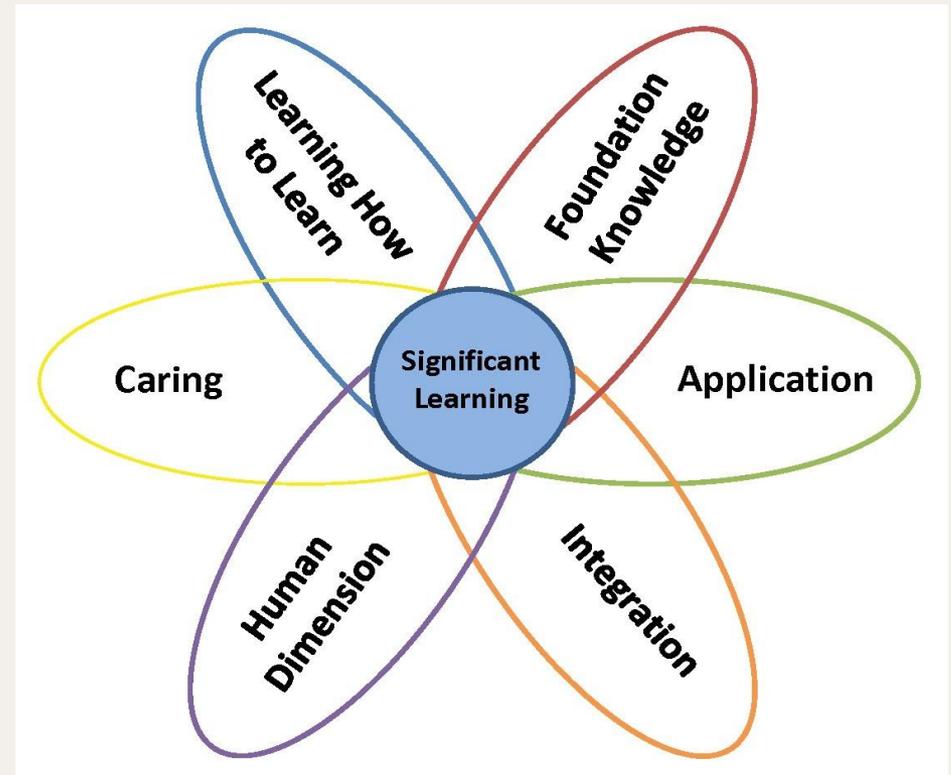


Learning Assessment Techniques

Monitoring student learning



Fink's Taxonomy of Significant Learning



POLL

Do you help students develop general strategies for engaging with difficult concepts and problems?

Please share examples in chat pod



Reading Apprenticeship (RA) Routines & Learning Assessment Techniques (LATs)

Appropriate for any level course, from first-semester to senior-level

Presenter	RA routines (metacognitive conversation)	LATs (Fink's taxonomy)
Jeffrey Wand	Think Aloud	Best Summary
Peri Shereen	Curriculum Embedded Reading Assessment (CERA)	Entry and Exit Tickets
Alison Lynch	Think Aloud Pair Problem Solving (TAPPS)	Peer Problem Review



Jeffrey Wand

Learning Assessment Technique: **Best Summary**

Reading Apprenticeship routine: **Think Aloud**

What's next?



Learning Assessment Technique (LAT)

“The Best Summary”

Students independently create a paragraph summarizing content from the week

Students get into groups and discuss their paragraphs

As a group, they make one paragraph and post it on a google spreadsheet



Learning Assessment Technique (LAT) “The Best Summary”

Groups assign points to every paragraph
(with the exception of their own)
according to a provided rubric

Paragraph with the most points is the
“Best Summary”



Group Number and Members	Group 1 (Nicholas, Carrie, Jesse)	Group 2 (Members: Sandra, Derrick, Isela, Irene, Miriam)	Group 3 (Members: Zac, James, Ryan, Clancey, Tracey)	Group 4 (Jordi Marquez, Ty Sanchez, David Cota, Parke)
	<p>This week, we went over complimentary equations. Determining how to solve generally and initially second order linear differential equations. We also went over the three possible cases, where the determinant of the complimentary equation is positive, zero, or negative.</p>	<p>We learned how to solve linear homogeneous differential equations with constant coefficients (Second order equations) where a does not equal 0. We had to solve the characteristic equation to find the characteristic roots. If the roots were less than 0, we use Euler's formula where alpha is a real number and beta is imaginary.</p>	<p>This week, we covered real, repeated real, and imaginary characteristic roots, which aided us in solving second order linear differential equations with constant coefficients. The first step is taking the discriminant of the quadratic equation formed by a, b, and c in the differential equation, and then solving accordingly. In real characteristic roots, r is computed through the quadratic equation (or by factoring). From there, r1 and r2 are plugged into the formula $y=c_1e^{r_1t} + c_2e^{r_2t}$ in order to give solutions to the differential equation. These solutions are typically linearly independent and serve as a basis for solutions to the differential equation. In the case of having imaginary roots, it is necessary to use the equation $y=c_1e^{at}\cos(\beta t) + c_2e^{at}\sin(\beta t)$ according to Euler's equation.</p>	<p>This week we just learned a equations. Using the charac the quadratic equations. Ther can obtain. When the discr has 2 repeated real root, wh real root, and if it less than 2 numbers.</p>
<p>Best summary of Week 11: Now it is time to rank each others paragraph. A successful summary for week 11 should include the following concepts: 1) The Characteristic Equation 2) How roots of the characteristic equation coorespond to solutions to the differential equation 3) How linear algebra plays a role in the solutions to the differential equation. For every other group, give up to two points for each concept they include in their paragraph (1pt for including it) (2pts for including and giving a clear explanation of it) then add up the points you give and place it in the row below under the cooredponding group</p>				
Group 1's Rankings of the other groups	Don't score yourself		3	6
Group 2's Rankings of the other groups		3 Don't score yourself		6
Group 3's Rankings of the other groups		3	3 Don't score yourself	
Group 4's Rankings of the other groups		2	3	6 Don't score yourself
Jeffrey's Ranking of all the groups		3	3	6
Average Ranking		2.75	3	6



“The Best Summary” Successes

Students were engaged, using vocabulary from the content

In post-activity reflection, students said it:

- cleared up some misconceptions
- helped them focus on the bigger ideas



“The Best Summary” Challenges

Students:

- were very nervous having their paragraphs projected on the screen
- wanted more time
- were unsure of where to start



Reading Apprenticeship Activity

Modeling “Think Aloud”

Chose an excerpt from the course book

Read the excerpt aloud to the class coupled with any thoughts running through my head

As students listened to my think aloud they compiled a list of reading strategies



Reading Apprenticeship Activity

Modeling “Think Aloud”

Students shared strategies/observations in groups

Compiled a class list of reading strategies

Posted list on LMS



Think aloud: 2/8/18

PEMDAS

Activity 6

Add & Subtract Rational Expressions

Polynomials
Polynomials

Statements without
"="

Warm Up Exercises

Simplify the following. Show your work.

need
to make
denominators
the same

A) $\frac{2}{5} + \frac{3}{8} = \frac{2 \cdot 8}{5 \cdot 8} + \frac{3 \cdot 5}{8 \cdot 5}$ B) $\frac{5}{11} + \frac{1}{9}$

$= \frac{16}{40} + \frac{15}{40}$

$= \frac{16+15}{40} = \boxed{\frac{31}{40}}$

C) $\frac{a}{b} + \frac{c}{d}$

D) $\frac{a}{b} - \frac{c}{d} = \frac{a \cdot d}{b \cdot d} - \frac{c \cdot b}{d \cdot b}$

$= \frac{ad}{bd} - \frac{cb}{bd}$

$= \underline{ad - cb}$



bd

Adding & Subtracting Rational Expressions

The Lowest Common Denominator

Just like with numerical fractions, we need to find the lowest common denominator when adding or subtracting rational expressions. Taking the product of all factors of the denominators without repeating forms our LCD.

Example:

Find the LCD of $\frac{3}{x^2 - 4}$ & $\frac{5}{2x - 4}$.

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

We know that the factors of $x^2 - 4$ are $x + 2$ and $x - 2$. So, the LCD is the product of all of these without repeating. In this case, the LCD is $2(x - 2)(x + 2)$.

Note: didn't add an extra factor of $(x-2)$.

Adding and Subtracting

Remember, adding and subtracting rational expressions is just like adding and subtracting numerical fractions. Make sure you have a common denominator and add/subtract the numerators!



Reading Strategies:

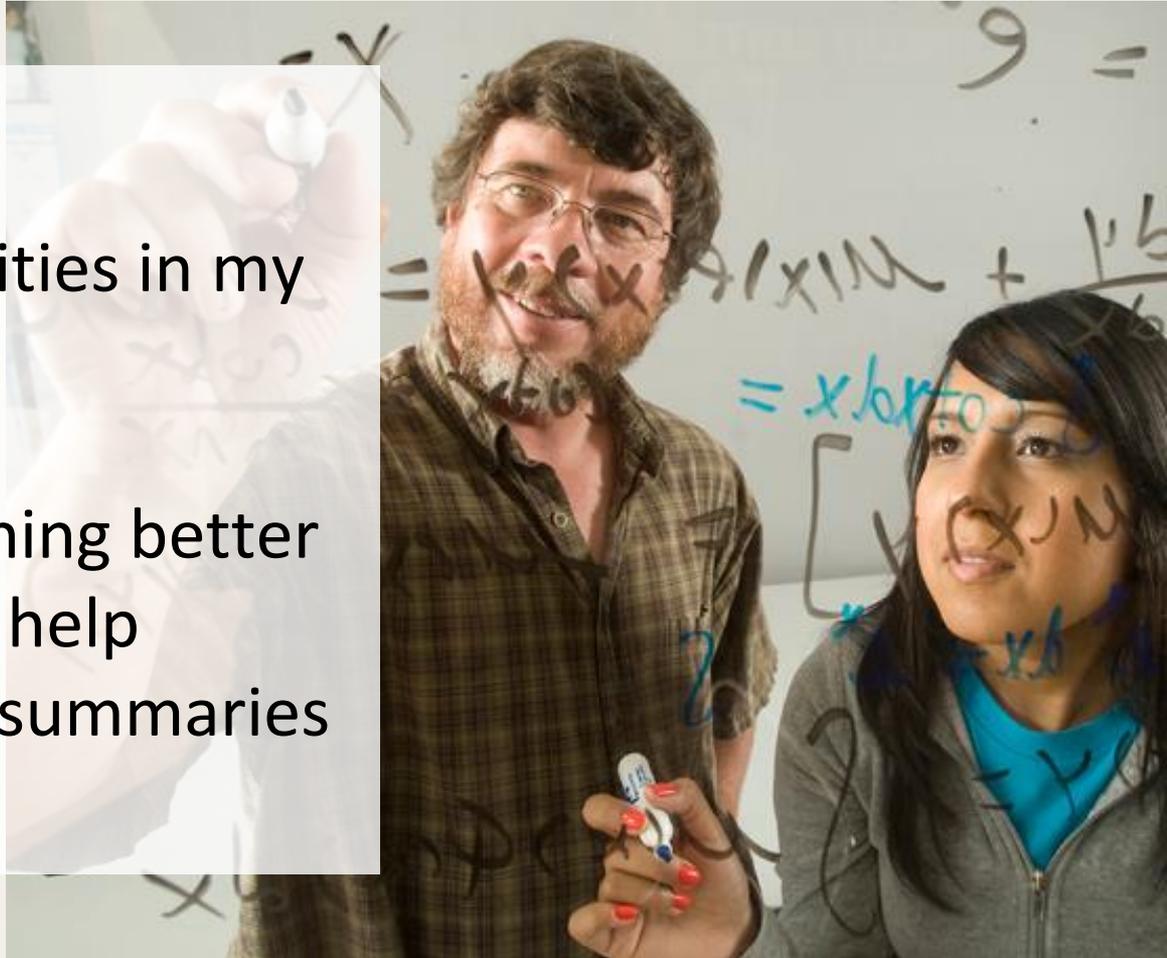
- Read, Pause, underline keywords,
- Color coding
- Organizing step
- going through the steps
- Putting the text into your own words
- reading the steps out loud
- Draw it out
- make pictures when you can.



What's Next?

Include more Reading
Apprenticeship activities in my
courses

Think Alouds and learning better
reading strategies will help
students with making summaries



In the Chat Pod...

Do you see yourself using a Best Summary LAT in your course?

Do you see yourself using a Think Aloud RA routine in your course?

Questions or comments



Peri Shereen

Learning Assessment Technique: **Entry and Exit tickets**

Reading Apprenticeship routine: **CERA (Course Embedded Reading Assessment)**

What's next?



Learning Assessment Technique (LAT)

“Exit and Entry Tickets”

Description

Formative assessment

Students “reflect on lecture (reading, video, etc) and write a brief response to a question”

Goal: “gather information about students’ understanding of core facts, terms, concepts, and ideas”

Provides quick and immediate responses, allowing efficient assessment of student recall and understanding



Learning Assessment Technique (LAT) “Exit and Entry Tickets”

Implementation (Number Theory)

Administered one page entry and exit ticket to assess specific learning outcomes for that day’s lecture

Both entry and exit ticket had the following questions

- Recall definition

- Recall main result

- Apply main result

Evaluated each question on a score of 0-2

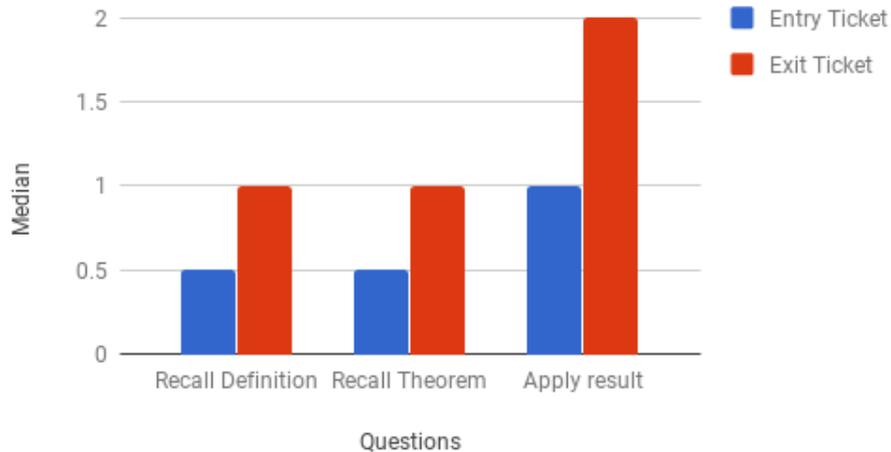
Analyzed the results of entry and exit tickets by calculating the mean and median scores on each type of question



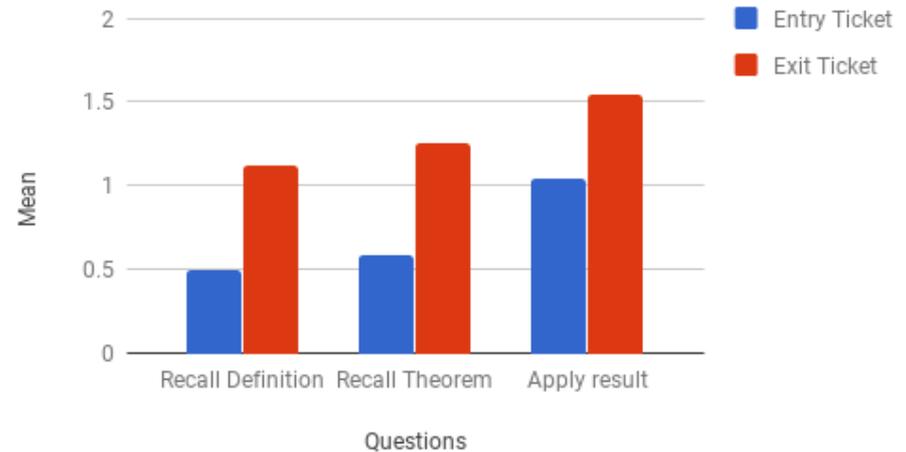
Learning Assessment Technique (LAT) “Exit and Entry Tickets”

Successes

Median



Mean



Learning Assessment Technique (LAT) “Exit and Entry Tickets”

Learning challenges exposed by LAT

Accessing their notes and textbook as resource

Students had access to their notes during exit ticket, but could not provide the definition associated with the main learning outcome



Reading Apprenticeship Routine

“Administering a CERA”

Description

“Curriculum-Embedded Reading Assessment”

Formative Assessment

“Measures literacy growth”

Informs instructor of student awareness of their reading processes

Students read an excerpt of text, and then

- Summarize

- Reflect on their reading process

- Self-assess

- Answer comprehension questions



Curriculum-Embedded Reading Assessment (CERA) Individual Writing Prompts

Please respond to the following questions (in pen).

Part I. Summary

1. In your own words, write a short summary (one or two sentences) of this piece.

Part II. Reading Process

2. What kinds of things were happening in your mind as you read this?
3. What did you do that helped you to understand the reading?
4. What questions or problems do you still have with this piece?

Part III. Self-Assessment

5. How easy or difficult was this piece for you? (circle one)
pretty easy not too hard pretty hard too hard
6. How well would you say you understood this piece?

Part IV. Comprehension Questions (*teacher to supply for the given text*)

- 7.
- 8.
- 9.
- 10.

Reading Apprenticeship Routine

“Administering a CERA”

Implementation (Advanced Linear Algebra)

Pre-Implementation

Model think aloud, develop reading strategies

Implementation

Discuss importance of developing reading in mathematics

Students are given ten minutes to read textbook excerpt

Students then spend ten minutes answering CERA questions

Whole class discussion on reading and problem-solving process;
add to reading strategies



Reading Strategies

Underlined

Identified key words that were important

Ask questions of the text

Followed the questions with answers from the text

Worked out the example in detail

Reworded sentences (paraphrase)

Make the connections

Reread sentences after annotating

Drew arrows to reference

Identified the main point

Wrote down definitions

Challenge text

Drew pictures/visualized

Identified goal and wrote it

Identify key buzz words

Identified steps towards goals

Highlights point of confusion, continue, then come back



What's Next?

Continue use of exit tickets (administered online)

Pre-CERA early in the semester to develop reading strategies

CERA rubric

- Assess student reading

- Inform reading goals for the semester

Develop reading strategies throughout the semester

Post-CERA late in the semester to assess students literacy growth over the semester

In the Chat Pod...

Do you see yourself using an Entry and Exit Ticket LAT in your course?

Do you see yourself using an RA Curriculum-Embedded Reading Assessment (CERA) in your course?

Questions or comments



Alison Lynch

Learning Assessment Technique: **Peer Problem Review**

Reading Apprenticeship routine: **Think Aloud Pairs Problem Solving (TAPPS)**

What's next?



Learning Assessment Technique (LAT)

“Peer Problem Review”

Formative assessment technique gives:

Students feedback on their problem solving and written communication

Instructor feedback on student learning

Students each receive a problem, try to solve it, and then pass the problem and solution to a nearby student

The student who receives the problem and response then analyzes and evaluates the solution



Learning Assessment Technique (LAT) “Peer Problem Review”

Implementation in Calculus I

Students divided into pairs

In each pair, the two students worked individually on different (but similar enough) Related Rates problems

After 10-15 minutes, the students swapped problems and reviewed their partner’s solution using a rubric



Related Rates Rubric

Grade your peer's Related Rates solution using this rubric.

Problem: **A** **B** **(circle one)** **Your Name:**

Category	2	1	0
Diagram	Includes a diagram that is appropriate for the problem and properly labeled	Includes a diagram, but the diagram is unlabeled or improperly labeled	Does not include a diagram
Setup	Defines all variables and correctly identifies what is given and what you are trying to find	One of the three is missing or incorrect (defines all variables, identifies what is given, identifies what you are trying to find)	Two or more of the three are missing or incorrect (defines all variables, identifies what is given, identifies what you are trying to find)
Relationship	Identifies the correct relationship between the two key quantities	Identifies an incorrect relationship between the two key quantities	Does not identify a relationship between the two key quantities
Implicit Differentiation	Correctly computes the implicit derivative of both sides	Computes the implicit derivative of both sides, but makes 1-2 mistakes	Does not compute the implicit derivative or makes 3+ mistakes in computing the derivative
Plugging in and Evaluating	Correctly plugs in the given quantities and solves for the correct rate of change	Makes 1-2 mistakes in plugging in and solving	Does not plug in and solve or makes 3+ mistakes
Final Answer	Writes a final answer with correct units	Writes a final answer with incorrect units	Does not write a final answer
Clarity	The steps of the solution were well-organized and easy to understand.	Some steps in the solution were hard to follow, but I could understand most of it.	The solution was difficult to read and follow.

Learning Assessment Technique (LAT) “Peer Problem Review”

Results

Learning success

Students understood overall structure of the problems and main concepts needed to solve problem

Learning issue

Students struggled to identify the relevant relationship needed to solve the problem



Reading Apprenticeship Routine

“Think Aloud Pairs Problem Solving”

Students work in pairs, one as **the problem solver** and one as **the listener**

The problem solver tries to solve a challenging problem, sharing their thoughts and approaches aloud as they work

The listener prompts the problem solver to share their thoughts, but doesn't ask guiding questions



Reading Apprenticeship Routine

“Think Aloud Pairs Problem Solving”

Implementation in Calculus I

Students worked on a pair of challenging Related Rates problems, taking turns as problem solver and listener

On each problem, the problem solver thought aloud for 5 minutes, then the listener shared the reading and problem solving strategies observed

After both tasks, the class generated a combined list of strategies used



Word Problem Strategies

Identify relevant information

Change words so they make more sense to you

Create a table or graph

Carefully read the problem

Use background information such as the section title

Take it step by step

Highlight key points

Identify variables

Explain things in your own words

Relate vocabulary to words you already know

Reference past homework and notes



Reading Apprenticeship Routine “Think Aloud Pairs Problem Solving”



Next steps

Revisit the strategy list regularly and add to it as a class

Do this activity more frequently with a wider variety of problem types so students become more familiar with the activity



In the Chat Pod...

Do you see yourself using a Peer Problem Review LAT in your course?

Do you see yourself using a Think Aloud Peer Problem Solving (TAPPS) RA routine in your course?

Questions or comments



THANK YOU

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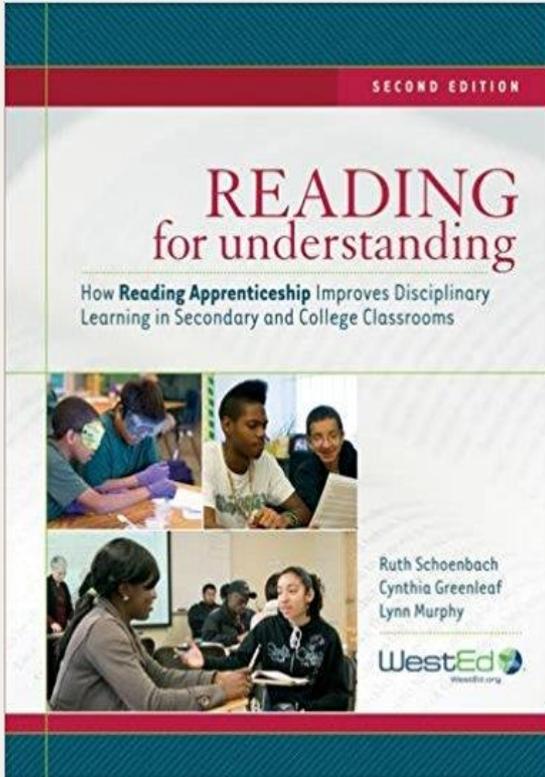
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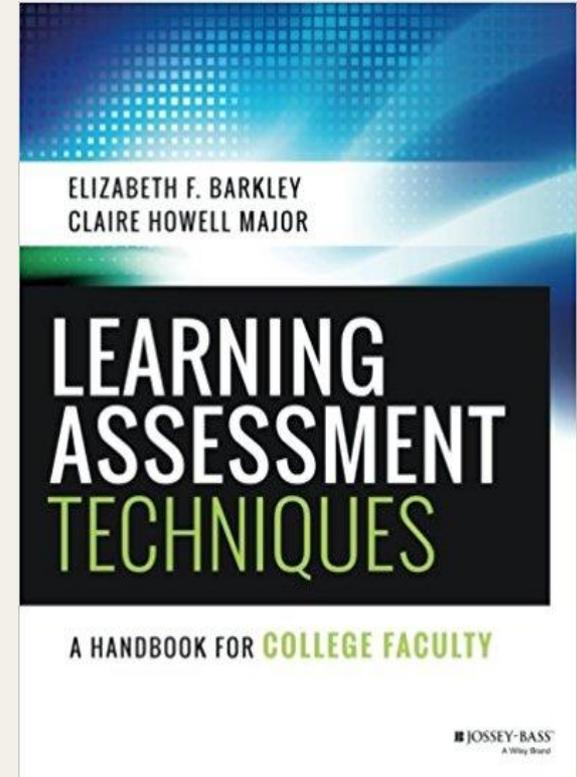
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Schoenbach, R., Greenleaf, C., & Murphy, L. (2012). *Reading for understanding: How reading apprenticeship improves disciplinary learning in secondary and college classrooms*. John Wiley & Sons.



Barkley, E. F., & Major, C. H. (2015). *Learning assessment techniques: A handbook for college faculty*. John Wiley & Sons.



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Wrap-up: In the Chat Box...

How confident are you that using **Reading Apprenticeship (RA)** strategies in your courses will increase your students' ability to engage with difficult concepts and problems

How confident are you that **using Learning Assessment Techniques (LATs)** will generate results you can use to improve teaching and learning in your courses

Questions/comments



Questions & Discussion

What is the **purpose** of the readings you assign in your courses?



Questions & Discussion

Do your students **struggle with reading**?

If so, how do you know?



Questions & Discussion

How do you help your students **develop and apply problem-solving strategies**?



Questions & Discussion

How do you help your students **learn with their peers**?



Questions & Discussion

What kinds of **assessment strategies** do you use to provide yourself with information on how well your students are learning what you want them to learn?

How have you **used** that information?



Questions & Discussion

How do you **communicate** to your students what you want them to learn and why?

