OPTIMIZING PRACTICE OPPORTUNITIES IN MATHEMATICS TO HELP STUDENTS WITH DYSCALCULIA RETAIN ESSENTIAL CONCEPTS AND SKILLS

HIGH INTENSITY INSTRUCTIONAL TECHNIQUES (HIIT) 4 MATH

DLD@NIGHT

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Focus on Retention

- Designing instruction to help students of all skill levels achieve success in mathematics.
- Cognitive Process of Retention
- Intensifying Retention Activities
  1. **Interleaving Practice Format (IPF)**

Retention

- Teaching new content is a major part of our job, but also helping students RETAIN (remember) content is essential.
  - Nature of mathematics interconnected content
  - New content often builds from previous content
- Teaching is essentially dominated by our goal of putting information “IN”
- More effective techniques for helping students take information “OUT” is ESSENTIAL
Guiding Questions

• Is retention a major challenge for you and your students?

• Do students seem to demonstrate they’ve learned something only to forget it when it comes up again?

Learner Characteristics

• **Strategic Learners**
  – Able to analyze a problem and develop a plan
  – Able to organize multiple goals and switch flexibly from simple to more complicated goals
  – Access their background knowledge and apply it to novel tasks
  – Develop new organizational or procedural strategies as the task becomes more complex
  – Use effective self-regulated strategies while completing a task
  – Attribute high grades to their hard work and good study habits
  – Review the task-oriented-goals and determine whether they have been met

Learner Characteristics

• Non-Strategic Learners
  – Unorganized, impulsive, unaware of where to begin an assignment
  – Unaware of possible steps to break the problem into a manageable task, possibly due to the magnitude of the task
  – Exhibit problems with memory
  – Unable to focus on a task
  – Lack persistence
  – Experience feelings of frustration, failure, or anxiety
  – Attribute failure to uncontrollable factors (e.g., luck, teacher’s instructional style)


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Breakout Activity

- Take a moment and think about the activities you do that are focused on reviewing previously taught math concepts and skills.
  - Basically any activity that you might call a “review.”

- Common Activities:
Consider this...

- Deficits in data, does not necessarily indicate students didn’t learn it the first time!
  - Learning without retention is pointless!
- We are “not really” being evaluated on what we “teach students”, we are being evaluated on what our students are able to “REMEMBER.”

Purposes of Practice

- Identifying the “purpose” of a practice activity is critical to achieving the desired outcome
- Mismatch of purpose and structure can negate the entire activity.....inefficient use of time.
  - Allocated time is important but not sufficient
- Focus on the PURPOSE of practice opportunities in both core and intervention.
  - Is the purpose acquisition...or initial learning?
  - Is the purpose retention....cumulative review?
  - Is the purpose to build fluency and/or automaticity?
  - Is the purpose to promote generalization?
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• Interleaving Practice Format (IPF)
Practice Activities in Mathematics

- Take a moment and think about how the practice activities you provide students are organized.
- Focus in on the sequence of problems in terms of how the math problems are presented?
  - Problem 1 to Problem 2 to problem 3.....

Practice Structures in Mathematics

BLOCKED (MASS) Structure:
- Problems of the same type are sequence consecutively
  - aaaaaaaaaaaaaaaaaaaa
  - aaaa, bbbb, cccc, dddd

- Purpose:
  - Promotes initial acquisition of understanding and accuracy

- IMPORTANCE:
  - Initially VERY IMPORTANT
Practice Structures in Mathematics

**WARNING!**

**BLOCKED Structure**
DOES NOT PROMOTE, FACILITATE, AND/OR INCREASE RETENTION

**Blocked Practice** =

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Practice Structures in Mathematics

**WARNING!**

**BLOCKED Structure**
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**Blocked Practice**

Blocked Practice plays a very important role in initial stages of practice, so it can not be omitted

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Example of Blocked Practice

Find the LCM of the following numbers by listing their multiples.

1) 4: _______ _______ _______
   6: _______ _______ _______
   LCM = _______

2) 6: _______ _______ _______ _______
   9: _______ _______ _______ _______
   LCM = _______

3) 3: _______ _______ _______ _______
   8: _______ _______ _______ _______
   LCM = _______

Same type of problem sequence consecutively (Problem Type A)

Find the product by using the “zero rule”

4) 500 x 30 = _______
5) 70 x 4 = _______
6) 2,000 x 600 = _______

Same type of problem sequence consecutively (Problem Type B)

Find the standard form (the answer) when given the base and exponent

7) 7^2 = _______ = _______
8) 6^1 = _______ = _______
9) 5^3 = _______ = _______

Same type of problem sequence consecutively (Problem Type C)
Example of Blocked Practice

Why is this an example of blocked practice?

What is the purpose (or should be) of this practice sheet?

What will this blocked practice likely not help?

Is this a “bad” practice sheet?

Example of Blocked Practice

Why is this an example of blocked practice?

What is the purpose (or should be) of this practice sheet?
Retention Strategy: IPF

Example of Blocked Practice

Find the LCM of the following numbers by listing:
1) 4: _______ _______ _______
2) 6: _______ _______ _______
LCM= _______

Example of problem sequence consecutively (Problem Type A)

Same type of problem sequence consecutively (Problem Type A)

Interleaving Practice Format (IPF):

• Problems of the same type are sequence in a mixed format (NOT Consecutively)
  • Abc abc abc
  • Abcd, abcd, abcd

• Purpose:
  • Promotes long term RETENTION (DURABLE LEARNING)

• IMPORTANCE:
  • VITAL
  • Rarely occurs

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Practice Structure in Mathematics

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Interleaving Practice Format

• Mixing it up….dissimilar problems

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Example of IPF

Find the LCM of the following numbers by listing their multiples.
Find the product by using the “zero trick.”
Find the standard form (“the answer”) when given the base and exponent.

1) 4: ______ ______ ______ ______
   ______ ______ ______ ______
   LCM= ______

2) 70 x 4 = _________
   Problem Type B

3) 7² = _________ = _________
   Problem Type C

A, B, C pattern continues 3 to 4 more times for a total of 9 to 12 Problems

IPF Practice

1) How long is the pencil?
   _________ centimeters

2) Is 57 greater than (>) or less than (<) 118?
   57 [ ] 118

3) Solve the problem.
   32+5= ______

- Problem type A:
  - Measurement
- Problem Type B:
  - Comparing numbers
- Problem Type C:
  - Solve

• Patterns repeats 3 additional times for 9 total problems
1) 568
   a. What is the digit in the hundreds place? _______
   b. What is the digit in the tens place? _______
   c. What is the digit in the ones place? _______

2) What is the time on the analog clock? _______

3) Is 112 odd or even? _______

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**IPF Practice**

- Problem type A:
  - Rounding
- Problem Type B:
  - Reading a clock
- Problem Type C:
  - Odd or Even
  - Patterns repeats 3 additional times for 9 total problems

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**IPF Example**

1. Add the fractions
   \[ \frac{7}{12} + \frac{1}{18} \]

2. Simplify the expression
   \[ (5 + 2) + 9 \]

3. Plot and label the points
   A(4,6)  B(7,2)  C(3,0)

4. Add the fractions
   \[ \frac{2}{5} + \frac{1}{10} \]

5. Simplify the expression
   \[ 7(3) + 7 - 2 \]

6. Answer the following question about the graph
   Which fraction is on the y-axis but not the x-axis of Zach's neighborhood map?

7. Add the fractions
   \[ \frac{3}{5} + \frac{3}{8} \]

8. Simplify the expression
   \[ (20 - 4) \times (3 + 1) \]

9. Plot and label the points
   A(8,5)  B(2,9)  C(4,4)
### Problem type A: Adding Fractions
1. Add the fractions: $\frac{7}{12} + \frac{1}{18}$
2. Add the fractions: $\frac{2}{5} + \frac{1}{10}$
3. Add the fractions: $\frac{3}{5} + \frac{3}{8}$

### Problem type B: Simplify an Expression
4. Simplify the expression: $(5 + 2) + 9$
5. Simplify the expression: $7(3) + 7 - 2$

### Problem type C: Graphing
6. Answer the following question about the graph:
   - Which location is on the x-axis, but not the y-axis of Zark’s neighborhood map?

### IPF Example

### IPF Practice as Warm-up Whole Group Activity
Interleaving Practice Format (IPF)

- Interleaving practice format (IPF) is a **structure applied to practice activities** to improve long term learning outcomes.
  - Produces “durable” learning
- IPF involves the **intentional mixing-up** of items within the same practice session
  - abc abc abc OR abcd abcd abcd
  - Much more effective than blocking practice
  - **Blocking** design groups similar problems together
    (aaaaaaa bbbbbbbb cccccc)

Rohrer (2012); Rohrer, Dedrick, and Stershic (2014); Taylor and Rohrer (2010)
Interleaving Practice Format (IPF)

- Interleaving practice format (IPF) results in much longer learning
  - Students retain information and improve as time passes
- Why does the mixed sequence of problems produce much longer retention?

Example of IPF

Directions for 3 problem Types

<table>
<thead>
<tr>
<th>Problem Type A</th>
</tr>
</thead>
<tbody>
<tr>
<td>4: [ \text{LCM} ] [ \text{answer} ]</td>
</tr>
<tr>
<td>6: [ \text{LCM} ] [ \text{answer} ]</td>
</tr>
<tr>
<td>( 7 \times 2 ) [ \text{answer} ]</td>
</tr>
</tbody>
</table>

A, B, C pattern continues 3 to 4 more times for a total of 9 to 12 Problems
Massed Practice compared to Interleaved Practice.
Good initially....but a HUGE Difference on TEST

Interleaving Practice Format (IPF)

Why does IFP work?
• The blocking structure does not require deeper and careful processing
  – Students recognize the strategy and just blindly apply it because they know in advance
  – No retrieval is necessary, the solution strategy is only held in Short term working memory
• IPF requires the students to think more deeply about each problem because it is different
  – Requires students retrieve different strategies from long term memory
  – Forces students to “pay attention” to the problem features at same time they are retrieving the appropriate solution strategy
Interleaving Practice Format (IPF)

Considerations

1. Blocking is important in the initial stages of learning a new concept/skill
   1. Begin with blocking practice, but then move to IPF once students have “some” familiarity with new topic
   2. Students prefer blocking structured practice even though the research results are crystal clear in terms of improved performance with IPF.

Planning Guidelines

Planning and Implementation

1. Identify problem types by unit or month
   • Map out skills by month or unit
2. Arrange the problem types in an alternating sequence so the problems are dissimilar
   • Abc abc abc OR abc abc abc abc
   • Abcd abcd abcd
   • 9-12 problems per IPF Opportunity
     – Consider grade of students and problem type
# Interleaving Practice Format (IPF) Planning Guidelines

## Planning and Implementation

1. Identify problem types by unit or month
   - Map out skills by month or chapter/unit

<table>
<thead>
<tr>
<th>Month</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>August</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>September</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>October</td>
<td>1, 2, 3, 4</td>
</tr>
</tbody>
</table>

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Interleaving Practice Format (IPF)
Planning Guidelines

Problem Arrangement Considerations:
• 9-12 problems
  – Too many problems will defeat the purpose
• Consider the difficulty level of the problems
  – Basic, Moderate, Advanced
  – Do not group 3 advanced problems together on an IPF
  – Consider mixing the problem levels
    • Moderate Basic Moderate
    • Basic Advanced Basic
    • Moderate Advanced basic
• Biggest questions revolve around what is considered “DISSIMILAR” problems
  – Use your professional judgment

Planning and Implementation
3. Provide IPF opportunities 2 to 3 times per month
   • 20-minute IPF practice sessions
   • Assign on Monday and collect or go over on Friday
4. Provide regular IPF activities across the school year
   • Homework or in class or computer practice
     – Homework: Advantage: No class time used
     – Homework Disadvantage- Not all students will complete and can’t help
     – In class-Disadvantage—Use up class time
     – In class-Advantage-Provide help and increases student completion
IPF Quiz

• List the Non-Negotiable Key Ingredients

• Negotiable Key Ingredients

IPF Implementation Checklist

• Non-Negotiable Key Ingredients
  – Sequence must be mixed and follow the sequence
    • abc, abc, abc OR abc abc abc OR abcd abcd abcd
  – Problems must be dissimilar in process
    • Not the same process
  – Develop IPF Sheets in sets of 9 to 12 problems
  – Provide IPF opportunities at least 2-3 times per month
  – Blocked practice must still occur in the initial stages

• Negotiable Key Ingredients
  – Homework, in-class, computer practice, games
  – The problems grouped together
    • Must be dissimilar in process
Purpose of IPF

Slow the Learning Decay

Summary Retention and IPF

• More purposeful and carefully designed practice opportunities are an essential element to intensifying retention activities
• Blocked practice is important in initial learning; but is not sufficient to enhance retention
  – Bored Brain Syndrome
• Interleaved Practice Format is essential to boost and enhance retention of important mathematical concepts and skills
  – Mix it up!!!!
  – Attentive Brain
Teacher Resource

- [www.retrievalpractice.org](http://www.retrievalpractice.org)
  - Click on “Download our Retrieval Practice Guide"
  - Download the INTERLEAVING GUIDE

RetentionPolicy: IPF DLD@Night 2021

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Retention and IPF

• What are your questions or concerns related to the Retention in Mathematics and the IPF strategy?