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**Carol Ann Tomlinson**

Saturday 24 May

**Differentiation and the Brain**

*Session 2*

**CAROL ANN TOMLINSON**

Carol Ann Tomlinson's career as an educator includes 21 years as a public school teacher, 12 years as a program administrator of special services for struggling and advanced learners. She was Virginia's Teacher of the Year in 1974. More recently, she has been a faculty member at the University of Virginia's Curry School of Education, where she is currently William Clay Parrish Jr. Professor and Chair of Educational Leadership, Foundations, and Policy. Also at UVA., she is Co-Director of the University's Institutes on Academic Diversity. She was named Outstanding Professor at Curry School of Education in 2004 and received an All University Teaching Award in 2008. Special interests throughout her career have included curriculum and instruction for struggling and advanced learners, effective instruction in heterogeneous settings, and encouraging creative and critical thinking in the classroom.

Carol is a reviewer for eight journals and is author of over 200 articles, book chapters, books, and other professional development materials. She has authored several books including *How to Differentiate Instruction in Mixed-ability Classrooms* and *The Differentiated Classroom: Responding to the Needs of all Learners* and professional inquiry kit on differentiation. Recently, she co-authored a book with Jay McTighe titled *Integrating Differentiated Instruction and Understanding by Design: Connecting Content and Kids* and with Kay Brimijoin and Lane Narvaez co-authored *The Differentiated School: Making Revolutionary Change for Teaching and Learning*. Carol works throughout the U.S. and abroad with teachers whose goal is to develop more responsive heterogeneous classrooms.

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Printed in Australia

CODE: 11CT0202  
0514

Published in Australia by

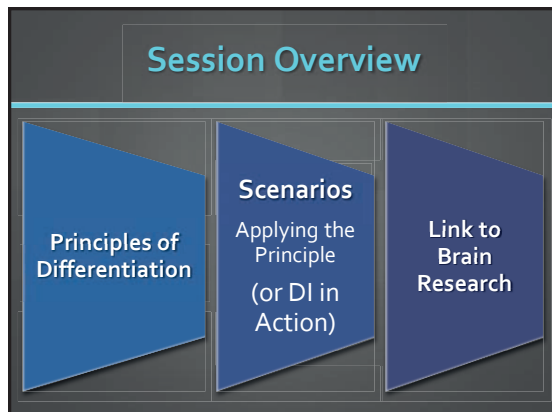
 **Hawker Brownlow**  
EDUCATION



Hawker Brownlow Annual Conference  
Melbourne, Australia  
May 24, 2014

## Differentiation and the Brain: How Neuroscience Supports a Learner-Friendly Classroom

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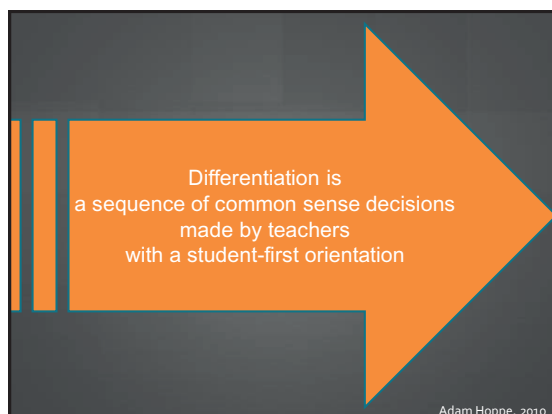
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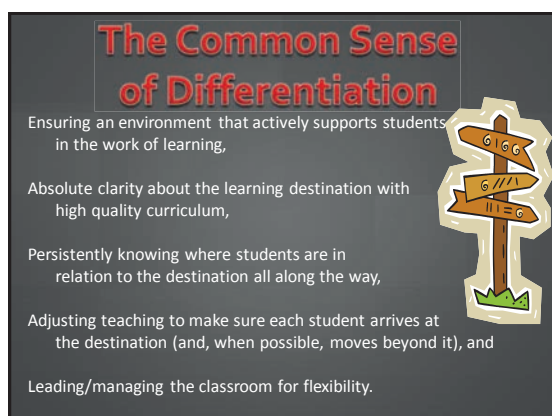
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## The Common Sense of Differentiation

Ensuring an environment that actively supports students in the work of learning,




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### Scenario #1

- I recently ran into a favorite teacher friend, Mr. Justin, at an airport and asked him how his kids were doing. He hesitated a moment because he wondered if I meant his own children or his students at school. He finally said, "Do you mean mine or my class?" I replied, "Both." He said that his own children were fine and he was looking forward to hanging out with them during the upcoming school break. As for his class, he said it had been a hard few weeks. One student's mother had died [did not know the cause], another student was worried about his family getting evicted [he said that he was working with the principal to get the family help], and another student had been on her bicycle and had been hit by a car. Luckily, the little girl would be fine, but all of these events had happened all at once.
- What is important for Mr. Justin to think about regarding the learning environment of his classroom?

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## Heads Together...



Think about Mr. Justin's class or your own. What are important elements of the learning environment that need to be considered for a differentiated classroom?

Growth Mindset  
Teacher Student Connections  
A Sense of Team or Community

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## Links to Brain Research

### Idea

1. Before the brain can attend to cognitive learning, students must feel physically safe and emotionally secure. Emotion is a strong force, and when learners experience strong negative emotions, the limbic system kicks in and both shuts down cognitive processing and enhances our memory of the negative event in order to support survival. In other words, "reflex" trumps "reflection" when negative emotions occur.

### Source

(Sousa & Tomlinson, 2010)

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## Links to Brain Research

### Idea

2. A positive learning environment increases endorphins in the bloodstream which generates a positive feeling and stimulates the brain's frontal lobe to support memory of the learning objective and of the positive situation.

### Source

(Sousa & Tomlinson, 2010)

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## Links to Brain Research

### Idea

3. A negative learning environment leads to increased cortisol in the bloodstream which raises the learner's anxiety level, shuts down processing of what it perceives to be low-priority information (the lesson content), and focuses the brain on what it perceives to be high-priority information (the situation causing the stress) so that the stressful situation is remembered rather than the lesson content.

### Source

(Sousa & Tomlinson, 2010)

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## Links to Brain Research

Idea	Source
4. For teacher-student relationships to be effective, teachers must attempt to see the world through a student's eyes—to be empathetic. Students who experience caring relationships with a teacher learn better than students who do not.	(Sousa & Tomlinson, 2010)
5. "Differentiating instruction is a manifestation of teacher empathy for students."	

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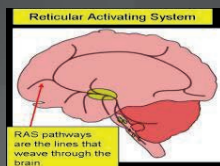
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Before information can reach the relational, patterning, and memory storage areas of the brain, it must pass through the reticular activating system (RAS). The RAS filters all incoming stimuli and decides which data a person attends to or ignores. The most powerful stimulus for the RAS is physical need; the brain will not be able to engage in the task of learning unless basic survival needs are first met. If students associate their classrooms with a visceral sense of fear, the RAS will filter out all but life-sustaining sensory information. This survival response to the stress of the classroom will greatly limit brain access to incoming information, and the students will fall farther behind (Cooper, Bloom, & Roth, 1996).

Willis, J. M.D. - (2007) *Brain-Friendly Strategies* - Alexandria, VA: ASCD, p. 43

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## Hierarchy of Response to Sensory Input




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## The Common Sense of Differentiation

Absolute clarity about the learning destination with high quality curriculum,



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### Scenario #2

- Jamie teaches reading at a local middle school. She is concerned about implementing the new learning standards in her classroom which is a focus at her school. She and her colleagues have been discussing the reading standards for 7<sup>th</sup> grade for literature and collaborating to determine the learning goals they believe should be the focus of a upcoming fiction unit.
- What would be important for Jamie and her colleagues to think about regarding the curriculum in this differentiated classroom?

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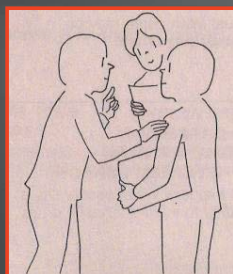
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## Heads Together...



Think about Jamie's class or your own. What are important elements regarding curriculum that need to be considered for a differentiated classroom?

Plan for Engagement  
Clear KUDs  
Emphasis on Understanding  
High Relevance  
Teaching Up

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## Links to Brain Research

Idea	Source
1. Curriculum races are not brain-friendly. Working memory is very limited. Time for practice and reflection are necessary for new learning to take place.	
2. When learners are confronted with too much information, the chances for long-term storage decrease significantly.	(Sousa & Tomlinson, 2010)
3. The brain likes patterns (works more efficiently with them). Establishing patterns takes time and requires lessons that are focused on meaning-making.	

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## Links to Brain Research

Idea	Source
4. Successful pattern making requires an affirmative answer to two elements: (a) sense (Do I get this?) and (b) meaning (Is this relevant to me?) When learning makes sense to the individual and is relevant to the individual, there is significantly more brain activity and dramatic improvement in retention.	(Sousa & Tomlinson, 2010)
5. Whenever an individual's brain decides that something doesn't make sense or isn't relevant, the chance of long-term storage diminishes greatly. When both sense and meaning are present, the probability of long-term storage is high.	

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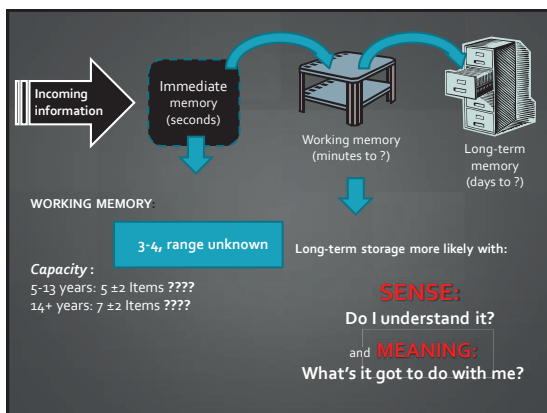
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### Build Neural Networks

- Less is More
- Shorter is Better
- Keep it Relevant

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INFORMATION	MEANING

Effective teaching is not either information or meaning.

It's helping students see the meaning in the information they learn.

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### The Common Sense of Differentiation

Persistently knowing where students are in relation to the destination all along the way,

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### Scenario #3

- Mr. Roderick's has 30+ students in each of his 5 Algebra classes and finds that he has several students that he worries are struggling to keep up in the current unit on quadratic equations. He also fear that he has other students who are under-challenged in some of his classes. He knows he needs to develop a system of determining where his students are in their understanding of the content but hasn't yet figured out what to do.
- What would be important for Mr. Roderick to consider regarding assessment in this differentiated classroom?

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### Heads Together...



Think about Mr. Roderick's class or your own. What are important elements regarding on-going assessment that need to be considered for a differentiated classroom?

Formative assessment to inform teaching & learning  
Feedback vs. grades/judgment  
Student involvement in assessment

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### Links to Brain Research

#### Ideas

#### Source

1. Formative assessment (non-graded) is less likely to be stressful to students, thus reducing the likelihood of "reflex" in the limbic system trumping "reflection" in the cortex.
2. Effective use of formative assessment should build student competence, thus reducing stress in more summative settings and increasing performance on summative measures.

(Sousa & Tomlinson, 2010)

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## Links to Brain Research

Ideas	Source
3. Rote-learning assessments evoke only a convergent response from students. Performance-type tasks also evoke divergent responses. In the former, only a limited area of the brain is involved. In the latter, multiple areas are involved.	(Sousa & Tomlinson, 2010)

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## Links to Brain Research

Ideas	Source
4. Students' brains lose when assessment doesn't require use of executive function, especially during the years when executive function is developing in the brain. Society also loses because of the increasing number of jobs/roles that require divergent and executive function.	(Sousa & Tomlinson, 2010)

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## Links to Brain Research

Ideas	Source
5. When higher-level thinking is assessed and more areas of the brain are involved in responding, there are more avenues to successful response, less likely increase to cortisol (stress), and greater likelihood of endorphins (pleasurable response to the assessment), and greater learning (practice, sense, meaning).	(Sousa & Tomlinson, 2010)

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## Links to Brain Research

### Ideas

6. Imaging studies indicate that students perform assessment tasks better when the tasks are "aligned with their intentions"—in other words, when the assessment task is clearly matches with learning goals that were clearly defined throughout the learning process.

### Source

(Sousa & Tomlinson, 2010)

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### WHAT IS NEURO-LOGICAL ASSESSMENT?

In most subjects and classes, we tend to teach for a week or two and test on that material only after the extended period of the unit of study. A more brain-attuned method is to assess daily and even several times during a lesson to see what students understand. That is *neuro-logical*, because if knowledge gaps are not corrected early, the brain will fill in blanks with misinformation. This misinformation may be stored as long-term memories that are difficult to change once embedded.

Research-Based Strategies to Ignite Student Learning by Judy Willis, M.D. • ASCD • p.82

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A variety of assessment modalities and some student choice in assessment type can bring students to the assessment with less anxiety and increase the positive learning experience, as well as provide the opportunity for them to demonstrate what they know and not simply what they memorized, forgot, or never learned.



Research-Based Strategies to Ignite Student Learning by Judy Willis, M.D. • ASCD • p.91

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## The Common Sense of Differentiation

Adjusting teaching to make sure each student arrives at the destination (and, when possible, moves beyond it),



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## Scenario #4

- Carrie studies some recent assessment data from her 2<sup>nd</sup> period Chemistry class. Since the assessment was designed to determine where her students are with respect to what she wants her students to Know, Understand and Be Able to Do for the unit on Chemical Reactions, she notices that she has students who are not where she thought they would be.
- What would be important for Carrie to consider regarding instruction in this differentiated classroom?

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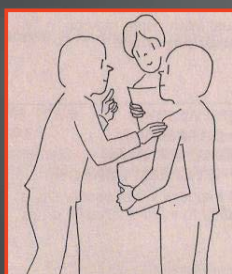
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## Heads Together...



Think about Carrie's class or your own. What are important elements regarding instruction that need to be considered for a differentiated classroom?

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## Links to Brain Research

### Idea - Readiness

1. When we accomplish a novel task, dopamine is released, resulting in a sense of pleasure, but also in increased focus, memory, and motivation. Designers of computer games (and some effective educational software) use the dopamine-reward system to help learners persevere and grow from their entry points.

### Source

(Sousa & Tomlinson, 2010)

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## Links to Brain Research

### Idea - Readiness

2. Students who believe they can accomplish a task are likely to attempt it and remember it (ZPD & Mindset) than students who have reason to believe they cannot.
3. When a task is perceived as too easy, the hippocampus identifies it as having already been accomplished, offering no novelty and no meaning (no pleasure).
4. If the student finds no meaning in the task, the brain is unlikely even to orient itself to the task, let alone activate its novelty and memory areas.

### Source

(Sousa & Tomlinson, 2010)

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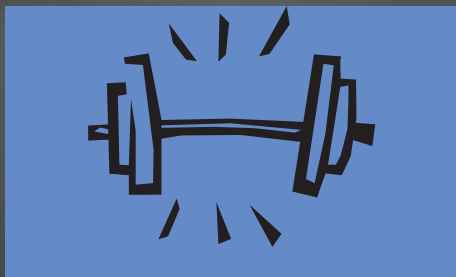
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## Zone of Proximal Development



Lev Vygotsky, 1978

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## Links to Brain Research

### Idea - Interest

1. Many of the behaviors that define interest—particularly motivation—have considerable support from neuroscience. High motivation leads to greater attention, increased willingness to learn, and persistence.
2. High motivation leads to greater interest, and high interest is intrinsically motivating.
3. It is likely that the motivation a student experiences when learning something interesting is more rewarding than when he/she is learning for "award."

### Source

(Sousa & Tomlinson, 2010)

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## PRIME THE PUMP



Students are more engaged when they are interested in the information available for them to learn. Open-ended questions that do not have single, definite, correct answer and that are student-centered (connected to their interests or experiences) can keep them interested, especially if they receive encouragement for expressing their ideas.

Research-Based Strategies to Ignite Student Learning by Judy Willis, M.D. • ASCD • p. 42

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Remember that interest and discovery drive achievement, and students are more likely to remember and really understand what they learn if they find it compelling or have some part in figuring it out or discovering it for themselves. In addition, when interest is high, stress and

anxiety are decreased and students are more accepting of their errors, more willing to try again, and less self-conscious about asking questions. Because of their increased focus, they are more likely to comprehend information that might otherwise be challenging for them.

Research-Based Strategies to Ignite Student Learning by Judy Willis, M.D. • ASCD • p. 65

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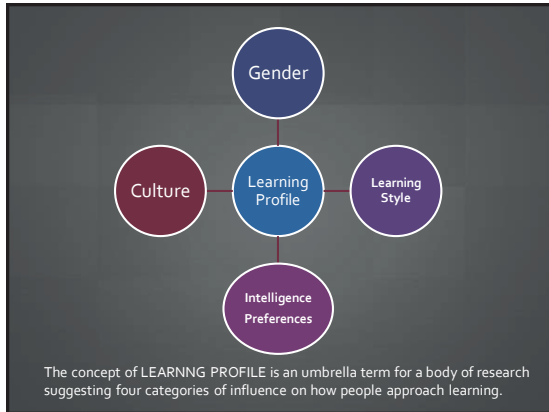
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**The Common Sense of Differentiation**

Leading/managing the classroom for flexibility.

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Links to Brain Research	
Idea	Source
1. Flexible classroom environments are brain-friendly. They allow students to enter a state of “relaxed alertness”—an optimal learning state of low threat and high challenge.	(Sousa & Tomlinson, 2010)

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## Links to Brain Research

Idea	Source
2. Orderly, flexible environments encourage communication through teacher and peer questioning and feedback, helping students think more deeply, identify critical information and concepts, and communicate understandings to others. All of these actions develop the brain's executive function and contribute to establish cerebral networks that are necessary to remember what is learned.	(Sousa & Tomlinson, 2010)

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## Links to Brain Research

Idea	Source
3. Research findings in cognitive neuroscience support the idea that students in more flexible classrooms show increased competence over students in more traditional environments (in vocabulary acquisition, creative performance, problem solving behaviors, etc.).	(Sousa & Tomlinson, 2010)

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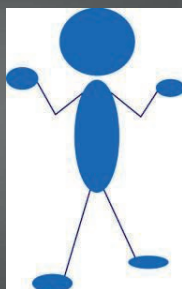
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AND SO????????



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## Support for DI from Brain Science

1. Each brain is uniquely organized. The pervasive notion that one curricular, instructional, and assessment approach will work for all students of a given age is not compatible with what we know about the brain. This, of course, is a primary premise of differentiation.
2. The brain is a pattern-maker. It is more likely to make patterns and store information in long-term memory if the information has meaning to the individual. When students perceive a task lacks meaning, the brain is likely to divert to more stimulating (and generally off-task) behaviors. Differentiation's emphasis on personal and cultural relevance and on student interests is thus supported by brain science.
3. Emotions are processed in the limbic system. When an individual makes a connection with knowledge, it creates an AHA that is satisfying and contributes to continued motivation to learn. When students are over-taxed, frustrated and can't generate the Ahas, or when they are making no connections new to them, the brain shifts away from a learning-is-interesting mode. Differentiation offers students learning opportunities that are more likely to result in Aha moments for them as individuals and therefore to see learning as rewarding.

Sousa, D., & Tomlinson, C., (2010). *Differentiation & The Brain*. Bloomington, IN: Solution Tree

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## Support for DI from Brain Science

4. Student learning is shaped by the nature of the environment. Emotions respond not only to the individual's own classroom experiences, but also to the experiences they see others have. It's important for students to experience success themselves, but also to see others experience it. If a student fears the response of peers when he/she gives a "wrong" response, it's more likely the student will avoid that response. If students see others being consistently discouraged or "turned off" in the classroom, the impact is negative for the observer as well as the student having the aversive experience. The emphasis differentiation places on a constructive environment is supported by brain science.
5. Curriculum and assessment that have clear goals, are well-aligned, have a meaning-and-pattern making orientation, and focus students on complex tasks predict better learning.
6. Flexible learning environments support both student and teacher learning.

Sousa, D., & Tomlinson, C., (2010). *Differentiation & The Brain*. Bloomington, IN: Solution Tree

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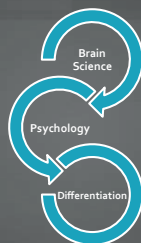
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## A Final Thought

Neuroscientific findings are new and tentative,

But much of what we appear to know simply reinforces what we have already known.

Both bodies of research generally affirm the key tenets and practices of Differentiation—which is a research-based model.



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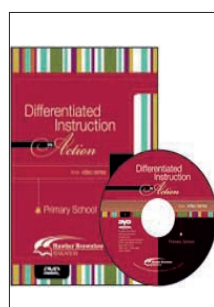
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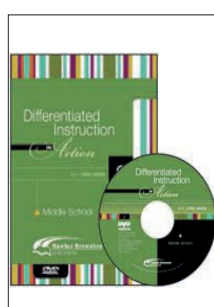


# RELATED RESOURCES

Available from Hawker Brownlow Education



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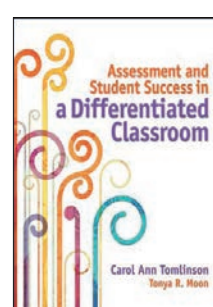
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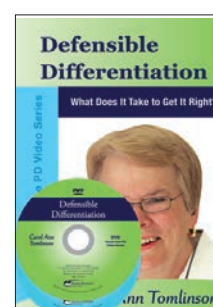
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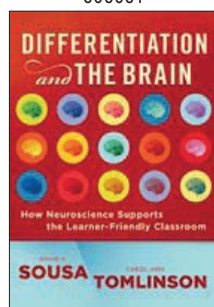
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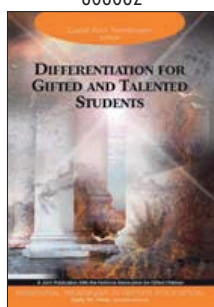
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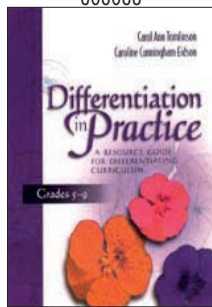
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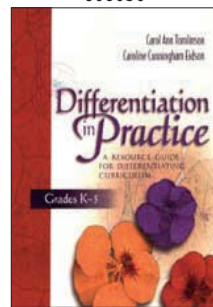
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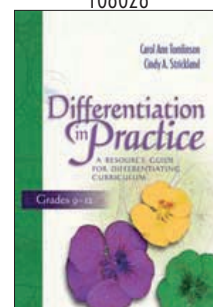
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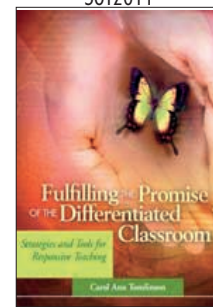
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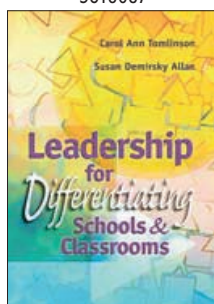
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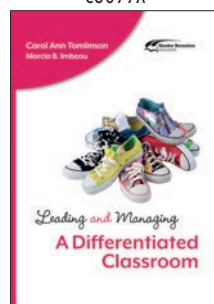
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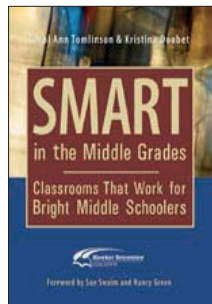
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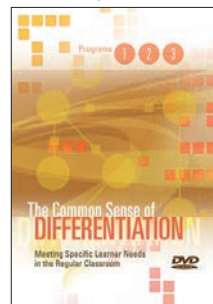
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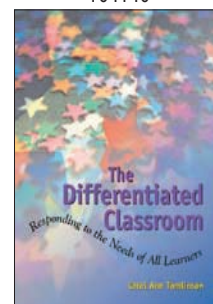
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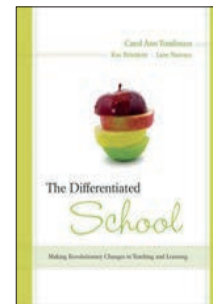
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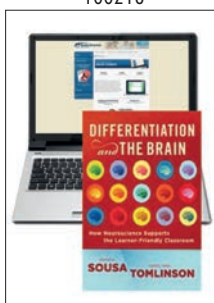
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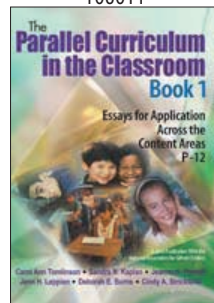
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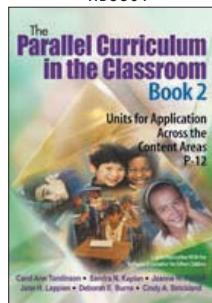
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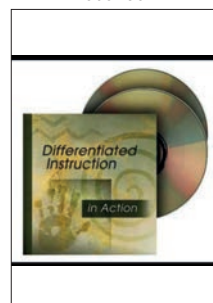
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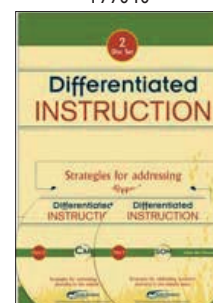
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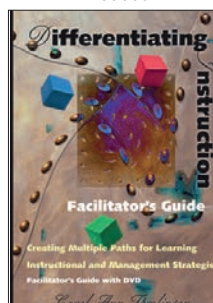
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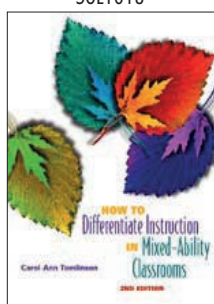
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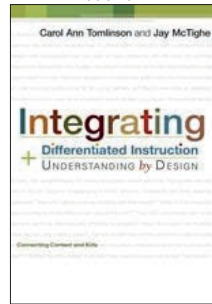
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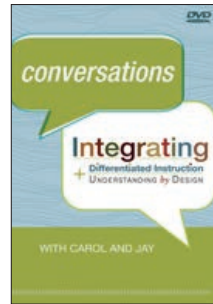
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