Differentiation is a sequence of common sense decisions made by teachers with a student-first orientation.

The Common Sense of Differentiation

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

Absolute clarity about the learning destination with high quality curriculum,

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

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

Leading/Managing the classroom for flexibility.
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.

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.

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.

4. Human brains have a region dedicated to processing social interactions—an indication of the importance social cues play in our lives—especially in the lives of young learners. It’s crucial for learning for student and teacher to perceive and respond to one another’s behavior accurately and appropriately.

5. When students feel a teacher response is negative, it decreases their desire to cooperate, which, in turn, can reinforce the teacher’s negative feelings about the student.

6. 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.

7. Differentiating instruction is a manifestation of teacher empathy for students.


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**Learning Environment, DI, & the Brain**

1. 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).

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When teachers take the time to make connections with their students, they become the positive, and sometimes only, consistent influence in students' tumultuous lives. During adolescence, the power of a teacher to make a permanent difference in a student's life and potential is incalculable.

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

8. Fear of failure is a major obstacle to learning. Teachers who differentiate instruction effectively decrease fear of failure responses through addressing student readiness, talking with students about the role of "failure" in learning, sharing their own failures, and providing effective feedback via non-graded formative assessment to help students build toward mastery before summative/graded experiences.

9. Teacher mindset (Dweck) is compatible with brain science in terms of its potential to support or diminish safe learning, student ownership of learning, and student outcomes.


Children who have lower academic expectations for themselves tend to ask for help less often. Teachers who emphasize self-improvement and effort and who encourage creative problem solving and risk taking, rather than competitive comparisons of student ability, encourage students to ask for help. When students focus on how well they personally have improved they will be more comfortable asking for help (Ryan, 1998).

Research-Based Strategies to Ignite Student Learning by Judy Willis, M.D. • ASCD • p.83
"An average student with a teacher whose teacher-student interactions scored 1 standard deviation below the mean in Emotional Support would, on average, place in the 41st percentile in end-of-year tests.

The same student with a teacher whose interactions scored 1 standard deviation above the mean in emotional Support would, on average, place in the 59th percentile in end-of-year tests."

Allen, J., Gregory, A., Mikami, J., Hamre, B., & Pianta, R. Predicting Adolescent Achievement with the CLASS-S Observation Tool: A CASTL Research Brief. University of Virginia, Curry School of Education.

Hierarchy of Response to Sensory Input

#1 Survival data
#2 Emotional data
#3 Data for learning

Please share your 2-3 take-home ideas with two colleagues.
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.

3. The brain likes patterns (works more efficiently with them). Establishing patterns takes time and requires lessons that are focused on meaning-making.

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.

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 probably of long-term storage is high.


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**Curriculum Quality, DI, & the Brain**

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**Curriculum Races Are Not Brain-Friendly**

I’ve got stuff to cover!!

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**Working Memory:**

- **Immediate memory (seconds):** 3-4, range unknown
- **Working memory (minutes to ?):** 3-4, range unknown
- **Long-term memory (days to ?):** 3-4, range unknown

Long-term storage more likely with:

**SENSE:**

Do I understand it?

and **MEANING:**

What’s it got to do with me?

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Diaz Sousa, 2012
Whenever new material is presented in such a way that students see relationships, they generate greater brain cell activity (forming new neural connections) and achieve more successful long-term memory storage and retrieval.

A student must care about new information or consider it important for it to go through the limbic system expeditiously, form new synaptic connections, and be stored as a long-term memory. In other words, memories with personal meaning are most likely to become relational and long-term memories available for later retrieval.
Effective teaching is not either information or meaning.
It's helping students see the meaning in the information they learn.

Curriculum Quality, DI, & the Brain

6. Both sense and meaning are highly personal/individual. Differentiation recognizes that reality and addresses it through attention to readiness, interest, and learning profile.

7. By manipulating new learning in a variety of ways, learners build neural networks leading to better retention and retrieval of the new information.

8. Establishing clear learning goals helps develop a student focus on what matters most in learning and will lead to more successful performance on assessments that align with those goals.

9. While genetics influences a role in brain growth, environmental influences seem to play an even greater role. Having a rich learning environment for all learners should be the goal of schools. What happens in the classroom impacts brain development and eventual level of intelligence—may actually raise or lower a student’s IQ.


Enriching The Inclusive Learning Environment

Multisensory exposure to information, student-centered activities, and discovery and hands-on learning experiences are the strategies most likely to build strong neuronal circuits and sustained memory storage (Reeve & Bolt, 1999). Willis, J. M. D. – (2007). Brain-friendly strategies. Alexandria, VA: ASCD, pg. 110.
Take-Home Ideas about Curriculum & DI

Please share your 2-3 take-home ideas with two different colleagues.

Assessment, DI, & the Brain

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.

3. When students only learn information for a test, they may develop the capacity to hold the information in working memory until the test (a matter of a few weeks?), record it on the test, and then discard it as no longer needed. They then can no longer recall what they "learned" and have little or no retrieval, application, or transfer ability later on.

4. Effective use of assessment is an exercise in clarity not in judgment. It should improve student performance, not just audit it (Wiggins, 1998). In other words, it should contribute to both sense and meaning.


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
5. 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.

6. 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.

7. 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 of cortisol (stress), and greater likelihood of endorphins (pleasurable response to the assessment), and greater learning (practice, sense, meaning).

8. 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.


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

Take-Home Ideas about Assessment & DI

Please share your 1-2 take-home ideas with two different colleagues.
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.

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.


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**Zone of Proximal Development**

![Image of a weight barbell]

Lev Vygotsky, 1978

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**BRAIN RESEARCH**

Reticular Activating System

RAS = “Toggle Switch”

Only one of these three states is activated (aroused) at a time:

<table>
<thead>
<tr>
<th>HIGH</th>
<th>MIDDLE</th>
<th>LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot (EEG)</td>
<td>Mild (EEG)</td>
<td>Cold (EEG – sleeplike)</td>
</tr>
<tr>
<td>Limbic aroused</td>
<td>Cortical arousal</td>
<td>Sleep (depression)</td>
</tr>
<tr>
<td>Flight / Fight</td>
<td>Out of Control</td>
<td>Off Duty</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>Proteins</td>
<td>Carbohydrates/Dairy</td>
</tr>
<tr>
<td>Burnout</td>
<td>Achievement</td>
<td>Depression</td>
</tr>
<tr>
<td>Extreme Challenge</td>
<td>Moderate Challenge</td>
<td>No Challenge</td>
</tr>
</tbody>
</table>

“Certain motivational states which interfere with learning condition are especially dangerous: anxiety and boredom. Anxiety occurs primarily when teachers expect too much from students; boredom occurs when teachers expect too little.” M. Csikszentmihalyi

*Learning only happens when the toggle switch is in the middle position*
Provide Realistic Challenge

Challenging students at reasonable, appropriate levels is one of the most powerful strategies for success, but teachers must carefully monitor the level of challenge. If goals do not provide sufficient challenge to engage students, or if the challenge exceeds students' levels of capability, frustration replaces motivation.


A study examining what makes computer games so captivating found that the key element is variable challenge based on player ability. The most popular computer games in the study took players through increasingly challenging levels as they became more and more skillful. As players' skills improved, the next challenge would stimulate new mastery to just the right extent that the player could succeed with practice and persistence (Malone, 1981). Extending that kind of incremental, motivating responsive challenge in the classroom is motivating and imparts a sense of accomplishment.

Take-Home Ideas about Readiness-Based Differentiation

Please share your 2-3 take-home ideas with two different colleagues.

Interest Differentiation & the Brain

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."

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.

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.

Please share your key take-home idea with two different colleagues.
The concept of LEARNING PROFILE is an umbrella term for a body of research suggesting four categories of influence on how people approach learning:

1. Neuroscientific research has discovered limited evidence to support the idea that individuals learn in different ways by using different neural networks to accomplish similar tasks.

2. There is some evidence related to gender-based learning preferences (for example, female brains generally use more brain regions to process language; the brain areas activated during mathematical processing are different in males than in females).

3. EEGs show different regions of the brain activated in individuals of the same gender performing the same task, suggesting that the EEGs are measuring different cognitive or processing styles.

4. The restrictive environments necessary for fMRI and EEG make it difficult for researchers to moderate and assess the environmental variables associated with learning style models.

Take-Home Ideas about Learning Profile-Based Differentiation

Please share your 2-3 take-home ideas with two different colleagues.
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.

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.

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.).

4. Teachers are likely to pursue development of their own knowledge and skills when they work in a school that supports flexible learning environments.


Kinds of Learning Environments

- Dysfunctional learning environments -- characterized by constant struggle to maintain order that overshadows attention to academic work. In such environments, relatively little sustained academic work takes place.

- Adequate learning environments -- characterized by a basic level of control by the teacher, but with a continuing struggle over order. Some academic work takes place, but distractions are frequent.

- Orderly learning environments -- characterized by effective management of academic work.

- Orderly, restrictive learning environment -- found in smoothly run, highly structured classrooms, with tightly managed routines and a relatively narrow range of instructional strategies.

- Orderly, enabling environments -- found smoothly run classrooms, with an often looser (though not loose) structure, and a wider range of routines and instructional strategies in evidence. These classrooms were most likely to focus on meaning and understanding.

Relevant Research for School Decisions

RELATIONSHIP BETWEEN TWO ABILITIES

No. 1: Teachers’ ability to manage a set of complex activities in the classroom

No. 2: Teachers’ ability to teach intellectually challenging material

Because the novel tasks required for problem solving are more difficult to manage than the routine tasks associated with rote learning, lack of knowledge about how to manage an inquiry-oriented classroom can lead teachers to turn to passive tactics that dumb down the curriculum (Carter and Doyle, 1987).
RELATIONSHIP BETWEEN TWO ABILITIES

No. 1: Teachers’ ability to manage a set of complex activities in the classroom

No. 2: Teachers’ ability to teach intellectually challenging material

In a recent study of four high schools, McNeil (2003) confirms that intellectual expectations can be lowered when teachers “teach defensively,” choosing methods of presentation and evaluation that simplify content and reduce demands on students in return for classroom order and minimal student compliance on assignments.

- Preparing Teachers for a Changing World: What Teachers Should Learn and Be Able To Do
  - Draft/Handwritten & Alphabetical / foam dots / p.331

When possible, engage and maintain students’ attention by providing opportunities for them to set their own pace, select the hook that will connect them to the topic, and have some choice in the way they learn the information.

- Research-Based Strategies to Ignite Student Learning by Judy Willis, M.D. • ASCD • p. 43

Please share your 2-3 take-home ideas with two different colleagues.
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.

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 experience. 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.

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.

Keep Growing Your Brain

To Teach Brains