Teaching To Transform The Brain
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Notes to accompany slides

Slide number 1. Teaching To Transform The Brain

- The goal of teaching can be framed as "helping to bring about a transformation in the student."
- The transformation will always require a change in the brain and that change requires specific conditions in all learners.
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Is there an overarching concept to use as a frame of reference in thinking about transforming the learner?

Slide number 2. Learning – Whose Job Is It Anyway?

- Curriculum reform, past and current, has had the goal of creating students that educate themselves, self-directed learners.
- However, we have always changed the curriculum, but we never changed the students.
  - We have never taught them how to educate themselves.
  - It is the students' job to educate themselves; the faculty are responsible for showing them how.
- We need to take advantage of brain science, human performance research, and education research.

What do we have to know to understand how to help students transform their brains?

Slide number 3. Main Points Today

1. Deliberate Practice is an educational standard that will improve learning and simplify teaching.
   - It is superior in every regard to the current educational standard of compliance.
   - In fact, compliance is automatically incorporated into DP.
2. Brain research reveals that learning styles result from an individual experiencing greater facility in using one area of the brain over another.
   - Since the brain is always a "work in progress," DP can improve performance in areas of learning that are limiting.
3. Unless students make decisions and act on them, learning will be in the "receiver" mode and the students will maintain the "child" role of dependency on the teacher.
   - Students who make decisions and act on them generate their own understanding through feedback and evaluation, thus they "produce" both knowledge and the skill that is needed to use their knowledge to solve problems.

- A receiver of information cannot be a problem solver. The process of producing knowledge through decision making and action automatically produces problem solvers.

How is the Growth Mindset related to Deliberate Practice and why is this an important place to begin our thinking?

Slide number 4. Why Is It Important To Know How The Brain Works?

- The Growth Mindset reveals that we can choose to increase our intelligence.
- A knowledge of how the brain works reveals how we can use Deliberate Practice to increase intelligence.
- There are different kinds of intelligence related to the different skill areas of the brain.
    - Deliberate Practice can selectively develop these skill areas.

Is there another type of mindset that can be compared to the Growth Mindset?

Slide number 5. Growth vs Fixed Mindset

- The learner with the growth mindset believes that a test is just a means for determining areas that need attention.
    - They expect to develop that through practice (namely, Deliberate Practice).
- The learner with the fixed mindset believes that the test is measuring their intelligence – and possibly its limitations.
    - They sense a finality to the assessment and see no way out.

Why emphasize only the Growth Mindset?

Slide number 6. Mindset Comparison

- When a class is divided before instruction begins and one half is taught how the brain learns, that half always scores higher than the control.
- Fixed mindset people fear failing grades because they believe it reveals that they have reached the limit of their intelligence.
    - Fear blocks self-awareness because it encourages denial.
    - Denial blocks attempts to remedy weakness.
- Growth mindset people see no limit on their intelligence.
    - Most likely to apply Deliberate Practice

Why is Deliberate Practice important to the Growth Mindset?

Slide number 7. Growth Mindset Through Deliberate Practice

- Human performance research has shown that highly skilled (expert) performance is not correlated with IQ.
    - Expert skill acquisition, however, is always correlated with Deliberate Practice.

    - Learners with the Growth Mindset know how to improve performance by selecting what to improve.
- Presenting information is not the most important role of a teacher since this can be done by a machine.
    - A teacher can detect limitations and show how to correct them – and only the student can correct them.
    - When the learner reaches competency, they are self-directed and can detect and correct their own flaws without a teacher.
- When a skill is performed without continual analysis for flaws, it becomes unconscious and awareness is lost.
    - Loss of awareness leads to automated performance.
    - Automated performance eventually leads to degraded performance.

What is a simple example of how the brain works in learning?

Slide number 8. Learning How The Brain Learns

- The thalamus is a gateway that provides information for thinking.
    - There is always a mixture of new input and information from long term memory during learning.
- The answer to the question as to whether you talk to think or think to talk reveals an important property of your thalamus.
    - If you talk it out first, you expect to change your mind in mid-sentence.
    - If it is about something you already know about, then you have already thought it through and are likely to talk right away.
    - The less familiar the subject the more the "think it through" types process quietly before talking.

What does talking to think vs. thinking to talk tell us about the brain?

Slide number 9. Low Gain vs. High Gain

- The thalamus has a volume (gain) setting that cannot be changed.
    - With a low volume, not enough information is available to think with.
    - With a high volume, too much noise prevent clear thinking.
- Since we can't change the volume, we change our behavior to regulate the input.
    - Extraverts become more active and increase visual and auditory input.
    - Introverts become less active (outwardly) and speak more slowly with less eye contact.
- That which is perceived as personality is just an outward manifestation of people trying to do their best thinking.

What other aspects of personality can help us learn how the brain works?

Slide number 10. What Is Jungian Personality? – and What Is Jungian Personality - ***Not***?

- We are only considering Jungian personality in this presentation – it is the most accurate portrayal of information processing by the brain.
  - Jungian personality can be viewed as the outward manifestation of underlying physiology.
  - Other personality models have utility as well, but are better used where they have a strength.
- Carl Jung studied consistent behavior patterns and classified them to reflect predictable behavior in similar situations.
  - Unconscious behavior reflects the way we are wired and implies that our biology provides variations on the theme.
- Important concept:
  - The steps in information processing are the same but we differ in how much thinking time is spent on each step.
- Jungian personality only describes behavior when we do not have to make a conscious effort to behave differently.
  - e.g. If we are introverted, we need to use extraverted behavior when it is time to present a lecture.
  - Presenting a lecture doesn't mean we suddenly prefer extraversion.
  - It is normal behavior to override unconscious behavior at any time necessary.
- No dimension of Jungian behavior has a negative description.
- All behavior choices have a positive contribution just as using one's offhand occurs as a natural balance to their handedness.

How does Jungian personality help us conceive of learning as a skill?

Slide number 11. Is Learning A Skill?

- What we have considered to this point is:
  1. Understanding how the brain learns produces higher achievement.
  2. Understanding how the brain learns permits Deliberate Practice in learning.
  3. Personality preferences have an underlying correlation with individual physiology.
- There is a logical sequence by viewing the aspect of Jungian type that correlates with learning style.
- Learning style can be viewed as a preference for a step in the experiential learning sequence
  - It can be related to an area of the brain that is preferred
  - Learning style has its greatest value in revealing the area of the brain that is not preferred.
  - The non-preferred area is amenable to Deliberate Practice.
- When the learner develops whole brain skills, they become skilled critical thinkers.

How does Jungian personality identify a learning style?

Slide number 12. Myers-Briggs (Jungian) Personality Types As A "Learning Style"

- Instead of thinking of personality as behavior, think of it as a mental model for processing information.

- The Myers-Briggs Type Indicator was developed to identify and sort preferences.
- Research has shown that Jungian type affects academic performance.

What insights from personality research can help us understand learning interventions through Deliberate Practice?

Slide number 13. Type vs. GPA and Type vs. SAT

- Each point on the chart is statistically significant – type makes a difference!
  - The chart is a composite of two data plots, not a correlation plot.
  - Plotting both together and placing the line as a visual aid permits comparison between types.
- The types with an S and an N group together to reveal that they are learning style indicators.
  - The S and N are described in the next slides but in general represent linear memorizers vs. integrative big picture learners.
  - Remember that these are only preferences just like extraversion and introversion.
- The initial goal was to help linear learners acquire learning skills used by the integrative learners.
- The hypothesis was that when a linear learner used methods that searched for a big picture, their performance would be improved.
  - It worked – and continues to work!

What other insights into personality type help us understand learning style?

Slide number 14. Myers-Briggs Personality Types

- Myers-Briggs types are composed of a preference from each of four different dimensions:
  1. E – talking to think or I – thinking to talk
  2. S – focus on details and specifics or N – focus on big picture and possibilities
  3. T – decisions from logic or F – decisions from values
  4. J – goal achievement or P – goal discovery
- When it is necessary to use the non-preferred function, it takes extra energy to concentrate on it.
- The preferred function is a comfort zone or a “most trusted” way of thinking.
- Work is when you are in your opposite, play is when you are in your type preference.

Why are Sensing and Intuition considered learning styles?

Slide number 15. Sensing (S) vs. Intuition (N)

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- A basic requirement for learning to occur is focus and attention.
- Sensing types spend most of their thinking time on specifics and details.
  - This includes lists, protocols, guidelines, directions, etc.
  - The mental attitude is to be able to replicate or recognize what is being perceived as well as possible.
- Intuitive types spend most of their thinking time on possibilities and pattern relationships.

    - This creates a big pictures, but it sacrifices time spent on details.
    - The mental attitude mimics “attention deficit disorder” because of the constant distraction new elements of the pattern.
- Either type of student can use the other function, but it is difficult.
    - Under the time and performance pressure of medical school most students work only within their type
    - Remember: type is a comfort zone; it is the most trusted way to think

What effect does each preference have on the way the learner takes a test?

Slide number 16. Test Taking Style

- The Sensing type student looks for the answer that matches what they have memorized.
    - This is one-step thinking.
    - Failure to recognize a correct answer indicates that the question wasn’t read well.
    - Re-reading and guessing are the only options available.
- The Intuitive type student also looks to see if they recognize the answer.
    - Their powers of memorization are less developed and they frequently have to begin ruling out wrong answers.\
    - On questions that require 2- and 3-step thinking, they are well prepared by their pattern learning.
    - Wrong answers don’t fit the patterns.
- Ultimately, test taking skills can be traced back to learning skills.

How do the challenges to Sensing types and Intuitive types compare?

Slide number 17. Problems With Big Pictures Vs Details

- Because sensing types expect a big picture concept to be taught as a fact they do not seek out a big picture on their own.
- Because intuitive types need facts to build their big picture, they lose interest in the facts once their big picture is conceived.

How do these approaches to learning affect acquisition of higher order thinking skills (HOTS)?

Slide number 18. Memorization vs HOTS Type Differences

- Recall knowledge is critical learning because it constitutes the vocabulary that we use for thinking.
    - Facts by themselves do not confer understanding.
    - Students who rely only on fact memory are receivers of information, but don’t produce it.
- HOTS permit us to manipulate facts to draw inferences and make deductions needed in problem solving.
    - Grouping facts into categories and comparing categories for similarities and differences requires decisions.

    - The process of decision making is the point in time that the learner produces their own knowledge.
    - Producing knowledge creates understanding.
- Both fact knowledge and HOTS will be shown to correlate later with steps in concept mapping.

How does the brain process fact memorization compared to problem based decision making?

Slide number 19. Transforming The Brain

- Since the brain is changed anatomically as learning occurs, we need to examine some aspects of the important anatomy.
- Information about how the brain changes will define the responsibilities of the student and of the teacher.

What general steps are followed when the brain transforms experience into knowledge?

Slide number 20. Experiential Learning Cycle Achieving Long Term Potentiation

- The experiential learning cycle was deduced by Kolb from existing schools of thought in education.
- While the four steps are more likely in dynamic interplay in actual thought, it is helpful to focus on one process at a time.
    1. Concrete experience represents a beginning for a cycle that never stops.
    2. Observations and reflections help us recognize the level of familiarity with the concrete experience.
    3. Generalization about possibilities and alternatives helps us make sense of the new information in the context of past experiences.
    4. Decisions concerning the best alternative or possibility help us examine the utility of the alternative.
        - This last step serves as concrete experience for the cycle to continue.
        - The success or failure of acting on a decision is accompanied by an emotion – a critical element in consolidation of memory.
- Next week, Rob Carroll's presentation will refer to this cycle with the admonition that medical education should offer opportunities to address all four steps.
- The typical foundational science curriculum doesn't ask for this cycle to be completed.
- Whatever the modality for delivery of the information, if the learner is not making a decision, the cycle stops at recognition (reflective observation).
- Therefore, it becomes the responsibility of the learner to decide to complete it themselves.
- This identifies a major deficiency in medical education, not in the content being taught, but in teaching the skills needed for higher order thinking.

How does the brain carry out the steps in the Experiential Learning Cycle?

Slide number 21. Experiential Learning By The Brain

- Concrete experience is organized by the sensory area of the brain.
  - However, perception involves prior experience, so the temporal area also provides sensory input.
  - The temporal area processes long term memory
  - Typically part of what we see is from the temporal lobes, i.e. we see with our brain.
- Reflective observation is analogous to searching the hard drive on a computer for facts and other information.
  - In this case the hard drive is the temporal cortex.
  - This is the cortex that the Sensing type learner uses the most.
- The frontal (also, more specifically, the prefrontal) cortex asks questions about the new experience.
  - What is this like? What does it imply? Can I use this to make a decision? What choices do I have?
  - The frontal area also makes a decision about these questions
  - Decisions are made in order to take action.
- The frontal cortex is ideally located to direct the motor area to drive action such as speech or writing/drawing.
  - Action based on a decision (a rationale is a decision) is the basis for all "active" learning.
  - Keep in mind that both motor and sensory functions are also learned skills.

At what point does the brain transform experience into knowledge?

Slide number 22. Receiving Information vs. Production Of Knowledge

- The general flow of information is "sense-integrate-act" (from Zull, see references)
- Until a decision is made, new input from experience remains a simple experience.
- When experience is integrated by the frontal cortex to produce a decision, an action results.
  - It is through the decision/action step that experience is transformed into knowledge.
- The outcome of the action is the reinforcement, positive or negative, that serves as feedback.

Is there a correlation between the areas of the brain and HOTS?

Slide number 23. Which Areas Of The Brain Process Each Of The Following?

- This taxonomy was developed by Edys Quellmalz and is easier to use in medical education (see references for Quellmalz taxonomy).
- The cortex is used differently with increasing levels of complexity.
  - The prefrontal cortex is called on to a greater extent as complexity increases.
- Recall: Remembering or recognizing key facts, definitions, concepts, etc.
- Analysis: Understanding relationships between the whole and its component parts and between cause and effect.
  - More than rote repetition; instead it involves reflectively structuring knowledge in new ways.
- Comparison: Explaining how relationships are similar and how they are different.
  - Comparisons may be either simple or complex.
- Inference: Reasoning inductively or deductively.

    - Asked to recognize or explain the evidence.
    - Required to relate and integrate the information to come up with the generalization.
- Evaluation: Expressing and defending an opinion.
    - Judges quality, credibility, worth, or practicality using established criteria and explain how the criteria are met or not met.

How much do we need to emphasize the prefrontal cortex in designing instruction?

Slide number 24. If You Build It (Frontal), They Will Come (Temporal).

- To sum up, when frontal learning activities are occurring, temporal memory is being reinforced.
- Active learning uses all areas of the cerebral cortex.
    - Both HOTS and rote memory are enhanced together.
    - The extra time required for HOTS requires sacrifice of comprehensive coverage.
- Only a fraction of the total curriculum needs to address frontal processing.

How does the brain change physically when learning occurs?

Slide number 25. Developing Expert Skills – Physically Transforming The Brain

- We will first consider what events are necessary for the physical changes that occur during learning.
- We can then explain forgetting and also how learning skills are functionally equivalent to clinical skills.

How does action during learning lead to the necessary changes in the brain?

Slide number 26. How Does Experience Make The Brain Grow?

1. Action from a decision initiates a signal that starts the growth of new synaptic connections.
2. The synapses are forming a network that represents the new concrete experience and feedback on success/failure.
3. Emotion from success/failure causes the consolidation of new synaptic connections as long term memory.
4. Consolidation of new neural networks occurs during sleep and is one of the major functions of sleep.
    - If deep non-dreaming sleep is experimentally disrupted, learning is blocked.
    - If new protein synthesis is blocked preventing consolidation, learning is blocked.

How does incomplete use of the learning cycle create the “illusion of memory?”

Slide number 27. Phosphorylation – The Illusion Of Memory

- The illusion of memory is explained by understanding the signals that create neural networks.

- All mechanisms in the brain concerning learning are mechanisms designed to protect the brain by forgetting.
- The name for the signaling process is phosphorylation (think “phosphor” as if lighting up the cell).
- The essential step that prepares the synapse for consolidation is protein synthesis.

How does activity affect the signaling needed to override forgetting?

Slide number 28. Forgetting Can Be A Good Thing

- If the concrete experience is sitting and reading, a common practice among most learners, the signal is created.
  - But the signal is on a countdown timer!
- In the absence of deciding and acting on what is being read, the timer removes the signal and the learner never learns.
- When the material being read is converted into a rationale, or a logical association such as a concept map, the timer is reset long enough to support consolidation during sleep.
- These synaptic signals provide the hippocampus (shaped like a seahorse centered on both sides of the brain) with a place to start consolidation of memory.
  - The hippocampus replays the experience from the previous day during each REM cycle of sleep (REM, rapid eye movement, is repeated during each cycle and is the dreaming period).
  - During each replay, information that is not connected to an emotion is pruned and information connected to an emotion is retained through physical growth of dendrites (branching of the neuron).
- Said more concisely, you can’t learn what you don’t care about.
- Not only do you learn during sleep, that is the only time you learn.
- Learning skills, therefore, are used to prepare our brains to learn during sleep.

What happens when a student reads so that they understand clearly and then they go to sleep?

Slide number 29. What Happens If Active Testing Is Not Done?

- The sensation of understanding is real but the belief it will be remembered is an illusion.
  - It is real but not permanent.
- Knowledge must have emotion connected to it.
  - Patients are emotional.
  - Dialogue is emotional.
  - Completion of a concept map is emotional.
- Compared to learning the same information experienced with a live patient, learning from a case report is much less effective.

What do the physical changes in the brain look like?

Slide number 30. Can You Find The Sittin’ And Readin’ Dendritic Tree?

- Without the use of a microscope, the changes in the brain would not be visible.
- When nerve cells are isolated from trained and untrained animals, the difference is readily apparent.
  - In the example shown here, the long extensions, termed axons, are removed in preparation.
  - The dendrites, or dendritic trees produced by branching, reveal the important growth.
  - The way to interpret the results is that greater branching is a good thing. It represents associative computing power, i.e. a neural network.
- The end result of transforming experience into knowledge through action is LTP cells with expanded dendritic trees.
- The hippocampus rehearses the activities of the previous day during stage 4 sleep and retains information that is emotionally important.
- Dendritic growth is consolidation.
  - Can occur in any area and is responsible for neuroplasticity.

How does information flow through the brain when we just sit and read?

Slide number 31. Short Circuiting The Learning Cycle

- Sitting and reading is the dominant method of learning for medical students.
  - Information is processed by the sensory and temporal cortex during this activity.
- There is the additional potential for recitation during reading or follow-up with flash cards.
  - Both of these modalities substantially bypass the frontal area
  - No decision is made. No rationale. No action.
- None of the conditions needed for consolidation during sleep are present.
- Sitting and reading is a waste of time.
- Remembering without decision making is likewise a waste of time.

How can we help students educate themselves?

Slide number 32. What Type Of Teaching Strategies Help To Produce Complete Learning Cycles?

- Three examples discussed next illustrate how the teacher can influence whole brain learning.
- Many more variations are available depending on the learning goals and objectives.
  - Any variation must be scrutinized for potential bypassing of the frontal cortex.
- Bypassing the frontal cortex inevitably leads to absence of decisions and decision based action.

How does a teacher utilize a prefrontal pause?

Slide number 33. Prefrontal Pause

- When learners are given a question that requires a rationale and they talk to a neighboring learner, they use the front of their brain.
  - Most lecture content is going to the back of the brain, long term memory.

    - Between lecture topics, long term memory can be put to use briefly through dialogue.
    - Questions can be entertained after the dialogue.
- Can be combined with audience response systems.
    - Feedback with audience response from students working alone loses any insight into how they make decisions with the material – they could just be guessing.
- Prefrontal pauses can be counted toward active learning for LCME reports.
- Labeling slide as "Prefrontal Pause" reminds students that the purpose of dialogue is to use Broca's area.
    - Broca's area requires a decision because dialogue has to "make sense."
    - Broca's area also is an integrative area, thus building integrative skills.
- Exercises such as this will have carry-over effects during individual study.

How does question analysis work to develop the front of the brain?

Slide number 34. Question analysis

- Multiple choice questions are a metaphor for a patient.
    - The answer choices represent a differential diagnosis Each answer choice must be analyzed for a rationale to exclude it.
- The rationale must be clear and concise.
- Asking for minimum knowledge needed requires the student to make a decision.
- This is standard practice in the group exercises in Team-Based Learning.
    - Caution: Using this in lecture can be time consuming.
- Carry over into individual study improves reading by giving the student something to look "for."
- Looking at = passive; looking for = active.
- This is ideal for small group activities.
- This forms the basis for the weekly Step 1 Preparation phase during the first two years of the curriculum in the TTUHSCSOM Expert Skills Program.

What is the contribution of concept mapping to the production of knowledge from experience?

Slide number 35. Concept Map Example - Novice

- A concept map is a visual representation of relationships between facts and concepts that is constructed by the learner, in this case a first year resident in pediatrics.
    - A concept map constructed by someone else, including the teacher is of little value.
    - "The magic is not in the map, it is in making the map."
- This example from JAMA, Sept. 6, 2000, Vol 284, illustrates several features:
    - Links – connections between two concepts representing a fact statement.
    - Branches – levels of hierarchy that are organized by grouping terms.
- When a learning assignment is mapped, it drives reading to its deepest and most effective level.
    - No other method can match mapping for efficiency and effectiveness.
    - Additional introductory information can be obtained in a free video at the SuccessTypes website.

- This example on “seizures” could from a lecture or a text book.
  - It is a good place to start, but it does not reflect the understanding that comes with experience.
  - First we will consider how a map is a tool for the Deliberate Practice of learning skills, then we will examine a more complex map of “seizures” that reveals understanding.

How does map construction permit the application of Deliberate Practice to learning skills?

Slide number 36. Concept Mapping and DP

- We can identify areas of the cortex that are in primary use for each step in the Experiential Learning Cycle (ELC).
  - Learning style differences between learners help us to see that the ELC steps are emphasized differently in each type.
  - Sensing types will tend to spend more time using the sensory and temporal cortex.
  - Intuitive types will tend to spend more time using the prefrontal cortex.
- The limiting skill in completing the full ELC will be revealed by concept mapping.
  - The revelation of weakness in a learning skill could explain the resistance some learners (and faculty) have to the use of maps.
- Concept mapping is appropriate and indicated for every learner that is going to be tested on their ability to use their knowledge to solve problems under conditions of limited time.
- Focus and attention are developed as the learner improves the ability to scan and identify trigger words.
- Temporal skills are developed as grouping terms stand out from details.
- Prefrontal and temporal skills are developed as discrimination is made between subtopics and major topics.
  - This a major challenge to sensing types that have not developed intuitive skills.
- Prefrontal skills are developed as crosslink relationships are discovered through inspectional reading.
- Decisions regarding visual organization of the map can be verbalized for auditory feedback to enhance active construction.
  - Verbalization also helps develop focus and attention.
- Mapping of all new material in the evening that was presented that day provides the hippocampus with both experience and emotion for its role in consolidation.
- Consolidation develops the skill associated with each area of the brain.
  - Consolidation is not limited to declarative memory, but any area that is used.
  - Concept mapping is able to facilitate DP in each of these areas.

How does a concept map look when it represents understanding obtained through experience?

Slide number 37. Concept Map Example - Advanced

- This map from the same JAMA report as previous was constructed by third year resident.
- The map reveals several differences:
  - Many more facts are present indicating a greater breadth of knowledge.

    - Crosslinks are now present indicating higher order thinking skills in establishing relationships (integrative learning).
    - The hierarchy is not a standard “textbook” organization, but one that reflects clinical experience as a context.
- One major advantage of clinical experience is that it forces some degree of application of Deliberate Practice.
- Note that even this map is subject to continued growth as experience increases learning.

What will students experience if they attempt to use concept maps?

Slide number 38. DP Outcomes From Concept Mapping

- Consolidation during learning is like repair during physical training.
    - Both occur during sleep.
    - Both involve synthesis of new proteins and some degree of tissue growth.
    - Both are amenable to manipulation through the choice of training.
- Concept mapping is body building for the brain.
    - During physical training, the musculoskeletal system gets faster and stronger.
    - During concept mapping, the brain gets faster at decision making and accessing memory.
    - During physical training, the muscles grow.
    - During concept mapping, the brain increases its capacity for facts.
- Concept mapping also assists in the transfer of learning to different situations.
    - Example: focus and attention are also used in visual discrimination during interpretation of radiography, ECG tracings, etc.

How can the teacher help students to adopt DP practices in their learning?

Slide number 39. Easiest Route To Change/Influence

- It is most effective to communicate with the learner through their “type.”
    - Each type has behavioral cues:
    - Sensing types will be specific in their dialogue and talk mostly about what has happened.
    - Intuitive type will be interpretive in their dialogue and talk mostly about understanding.
    - Sensing types value knowledge that can be applied.
    - Intuitive types value knowledge for its own sake.
- A learning style, or type, is not a limitation and can be balanced with practice.
- Learning style does not cause bad grades or wasting time.
- Learning style is an insight into what must be done to balance.

What have we learned?

Slide number 40. Recap

- The brain is a work in progress because learning is a continuous process.
- The question is not whether we are learning, but what are we learning.

- Passive learning is an oxymoron.
- Learning only occurs from activity, so ask “What is the activity?”
  - If it is recitation then the learning is superficial.
  - If it is a rationale based on a decision then the learning is higher order thinking.

- Whole brain learning leads to happy accreditation site visits!

Slide number 41. Key References