Validity of Learning Styles

"Questioning the validity of learning styles is not a denial of individual learner differences"

LCdr. Remi Tremblay – Canadian Defence Academy
Mr. Piers MacLean - Cranfield University

Outline

- Introduction
- Exercise- Thinking about our current practice
- Setting the stage
- What does the research indicate
- Lets hear from an Expert
- FAQ's – Responding to the viewers
- Exercise
- Research Based Best Practices for Multimedia Instructional Design
- Individual Learner Characteristics
- Putting the research into practice online – One Potential Application
- Conclusion and Open Discussion

Some Facts About Learning Styles

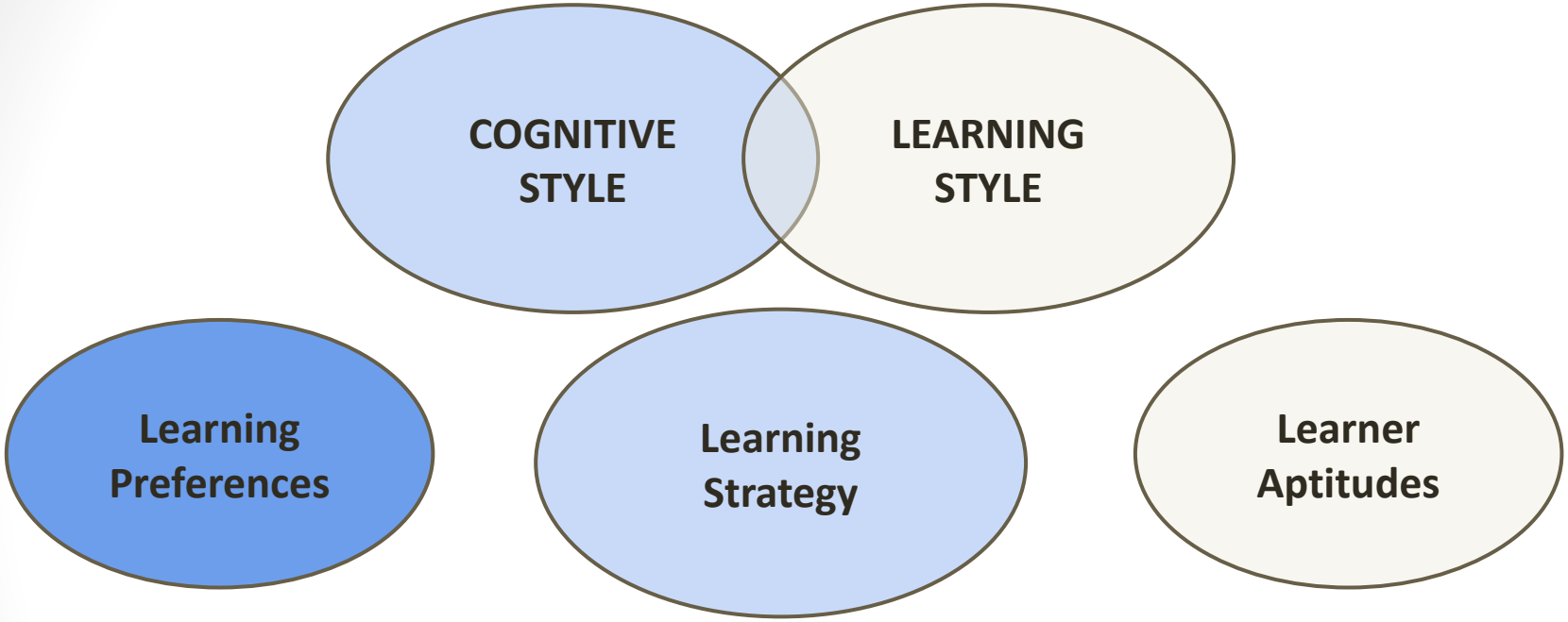
- The concept of "*cognitive* styles" originated in the 1930's (Allport)
- Research on "learning style" emerged in the early 1960's
- By 2006, over 650 books on learning styles have been published in the U.S. and Canada
- Over 4,500 articles have been written about learning styles in professional publications
- Over 26,000 web sites are available for measuring and addressing learning styles

Breaking the Ice

- Think about how you currently incorporate learning styles into your training and education programs.

- Take a few minutes and reflect on the following. How do you currently:
  1. Identify individual differences in learners (innate characteristics, tools used to measure a learner's "style" etc.)?
  2. Address those individual differences in your instructional designs?
  3. Validate your instructional design to ensure it made a difference at the individual and group level?

Setting the Stage



The terms learning style and cognitive style are closely related and are often used interchangeably. Both operate without the individual's awareness and are assumed to be less amenable to change and conscious control.

Some working definitions

- **Cognitive Style:** An innate habitual approach to processing information when engaging in cognitive tasks
- **Learning Style:** An innate pattern of thinking, perceiving, problem solving, and remembering when approaching a learning task
- **Learning Strategy:** A chosen plan of action in how to approach a given learning task
- **Learning Preferences:** An expressed personal preference favoring one type of learning environment, method of teaching or instruction over another
- **Learner Aptitudes:** Special innate capacities that give rise to competencies in dealing with specific types of content in the

A Selection of Popular Learning Styles

Allinson & Hayes' Cognitive Styles Index	CSI
Apter's Motivational Style Profile	MSP
Dunn & Dunn's model and instruments of learning styles	-
Entwistle's Approaches and Study Skills Inventory for Students	ASSIST
Felder-Silverman Index of Learning Styles	ILS
Fleming & Mills' Visual Aural Reading and Kinaesthetic	VARK
Gardner's Multiple Intelligences	-
Gregorc's Styles Delineator	GSD
Herrman's Brain Dominance Instrument	HBDI
Honey & Mumford's Learning Styles Questionnaire	LSQ
Jackson's Learning Styles Profiler	LSP
Kolb's Learning Style Inventory	LSI
Myers-Briggs Type Indicator	MBTI
Riding's Cognitive Styles Analysis	CSA
Sternberg's Thinking Styles Inventory	TSI
Vermunt's Inventory of Learning Styles	ILS

Multiple Intelligences (Gardner)

- Verbal linguistic
- Logical-mathematical
- Musical
- Spatial
- Bodily Kinaesthetic
- Interpersonal
- Intrapersonal
- Naturalist

VARK (Fleming & Mills)

Sense intake-output preference

- Read- Write (Digital): Symbols
- Aural (Auditory): Sounds
- Visual: Graphics/Pictures
- Kinaesthetic: Space/Motion

Brain lateralisation theory (left brain and right brain

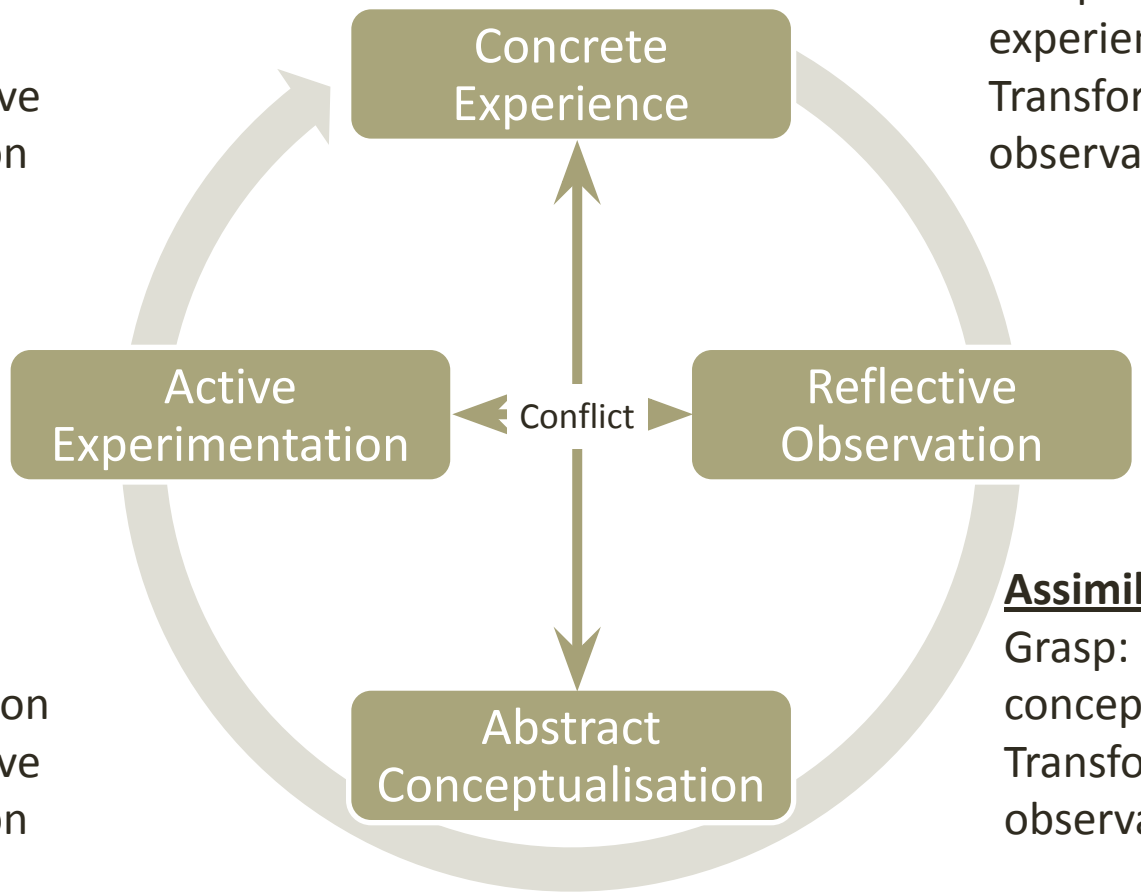
	Deductive	Inductive
Left	Read/Write (Digital)	Aural (Auditory)
Right	Visual	Kinaesthetic

Learning Styles Inventory (Kolb)

Accomodators
Grasp: concrete experience
Transform: active experimentation

Sensing

Divergers
Grasp: concrete experience
Transform: reflective observation



Doing

Watching

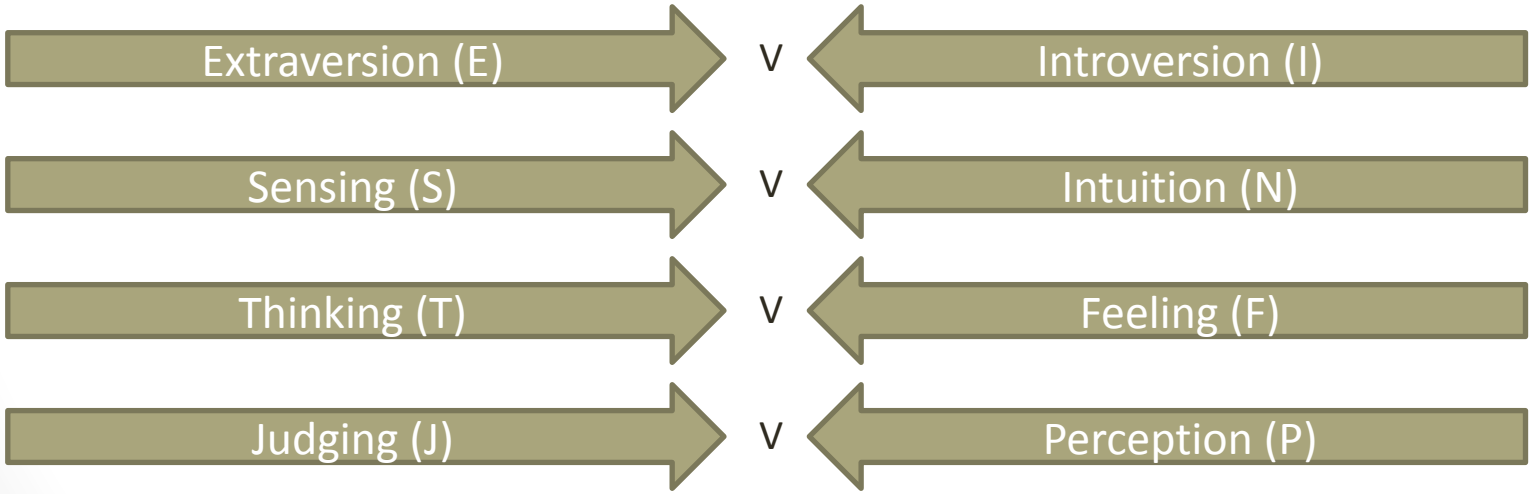
Convergers
Grasp: abstract conceptualisation
Transform: active experimentation

Assimilators
Grasp: abstract conceptualisation
Transform: reflective observation

Thinking

MBTI (Myers & Briggs)

- Based on Jung's observation that differences in behavior result from inborn tendencies to use the mind in different ways
- Combination of personality modes (E, I, J, P) and cognitive modes (S, N, T, F)



What the Research Says

Tool/Instrument	Style	Validity/Impact*
Cognitive Styles Index (CSI	Intuition-Analysis	Undetermined
Gregoric Style Delineator (GSD)	Concrete-abstract/sequential – random	Questionable
Learning Styles Inventory (LSI)	Experiential learning model	Questionable
Inventory of Learning Styles (ILS)	Depth of processing meaning, production	Questionable
Myers Briggs Type Indicator (MBTI)	16 Personality Types	Low

* The validity of each tool with respect to instructional impact is based on current psychometric research consensus.

Coffield et al. (2004): 13 from original 71 models

Table 15
13 learning styles models matched against minimal criteria

✓
criterion met

×
criterion not met

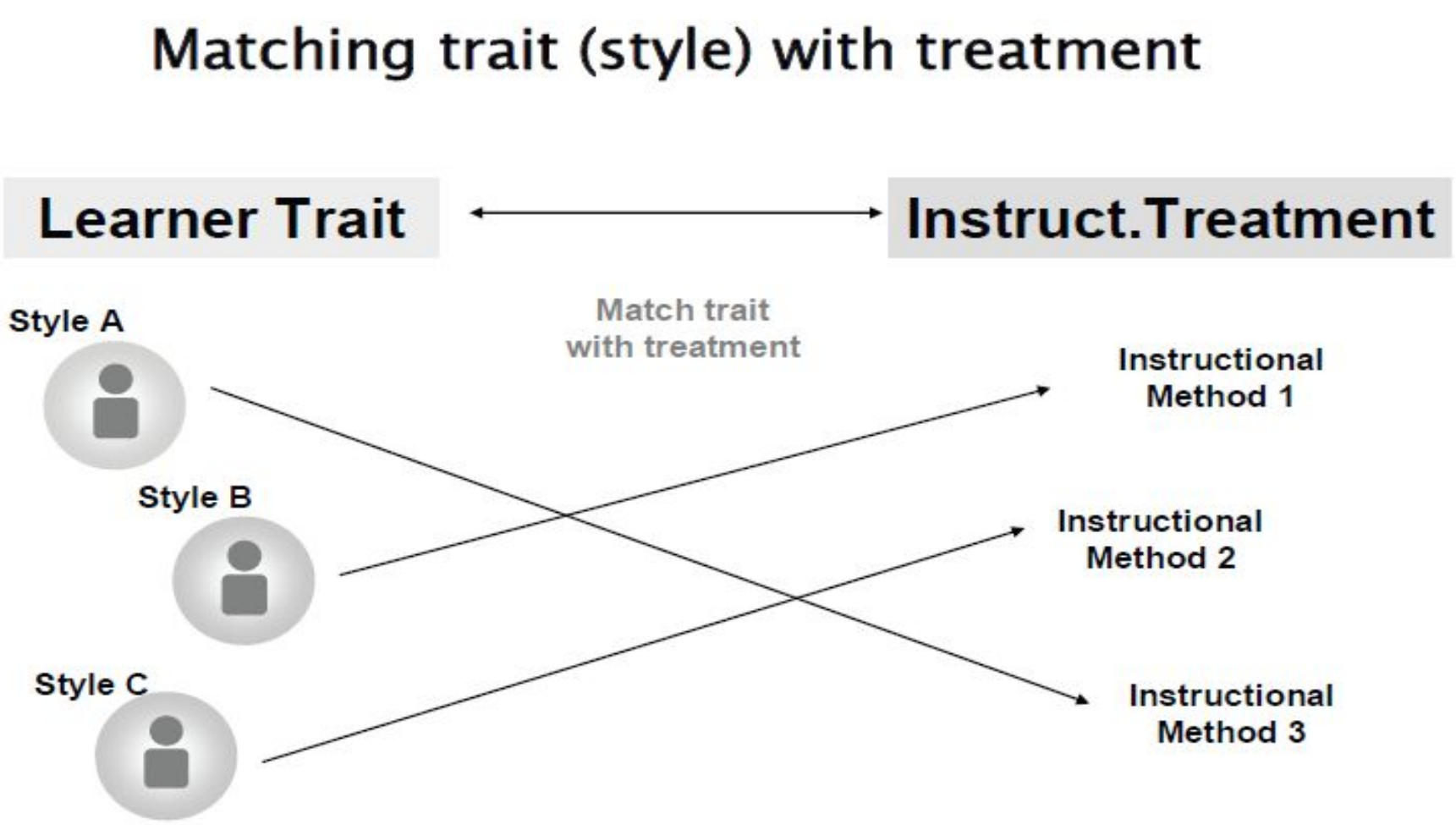
–
no evidence either way or issue still to be settled

Note
The evaluation is in all cases 'external', meaning an evaluation which explored the theory or instruments associated with a model and which was not managed or supervised by the originator(s) of that model.

		Internal consistency	Test–retest reliability	Construct validity	Predictive validity
1	Jackson	–	–	–	–
2	Riding	×	×	×	×
3	Sternberg	×	×	×	×
4	Dunn and Dunn	×	×	×	✓
5	Gregorc	×	×	×	✓
6	Honey and Mumford	×	✓	×	×
7	Kolb	–	✓	×	×
8	Entwistle	✓	–	✓	×
9	Herrmann	–	✓	✓	–
10	Myers-Briggs	✓	✓	×	×
11	Apter	✓	✓	–	✓
12	Vermunt	✓	✓	✓	×
13	Allinson and Hayes	✓	✓	✓	✓

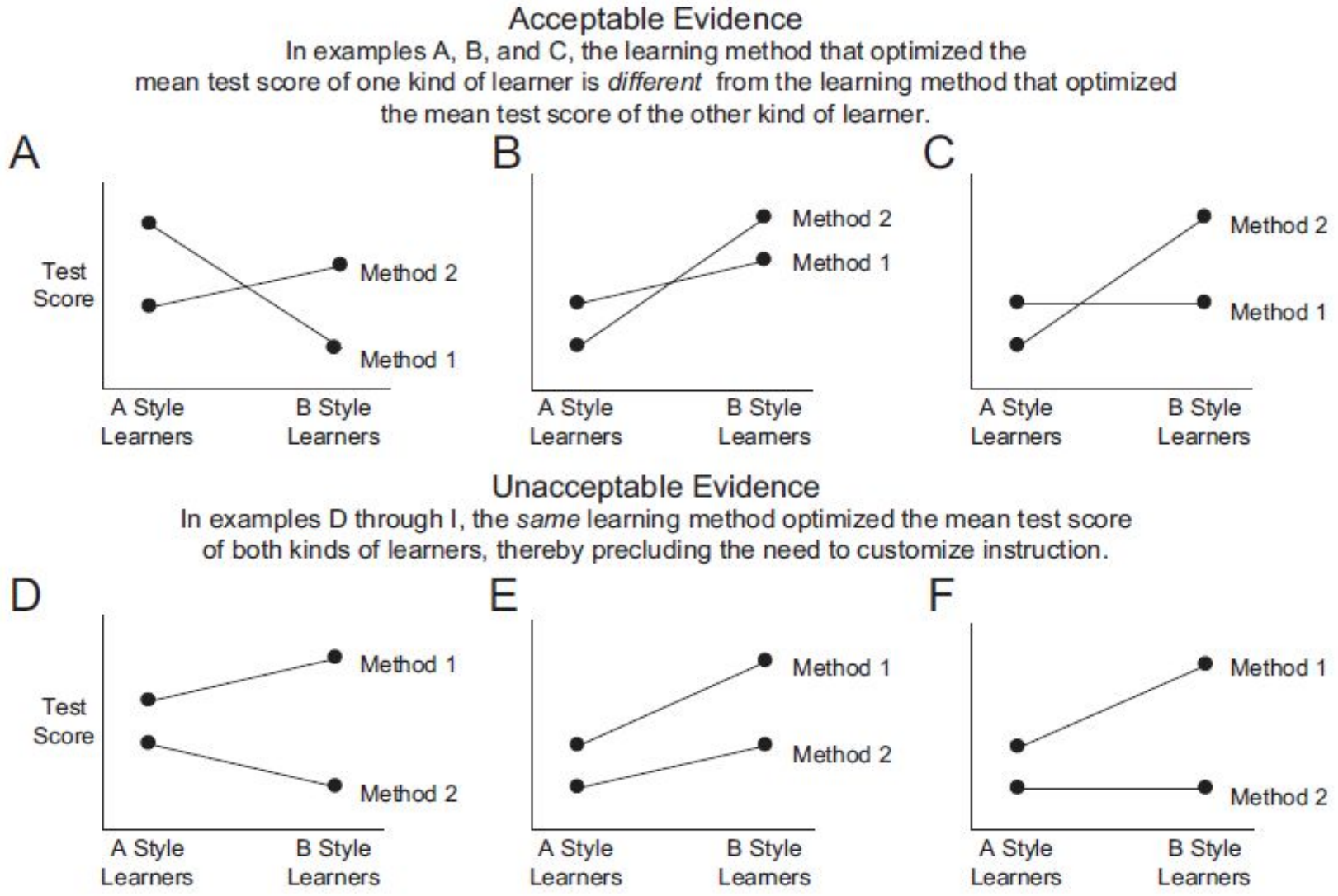
Coffield, F., Moseley, D., Hall, E. & Ecclestone, K. (2004) Learning styles and pedagogy in post-16 learning: A systematic and critical review.

Do you remember the ATI research ?



Aptitude (trait) – Treatment Interaction (1980's)
Adaptive e-Learning (2006)

What about Other Scientific Research?



http://www.willatworklearning.com/2006/08/learning_styles.html - $1000 challenge

Lets hear from an Expert

Professor Daniel Willingham
Describes research showing that learning styles are a myth

http://www.youtube.com/watch?v=sIv9rz2NTUk

FAQ's About Learning Styles

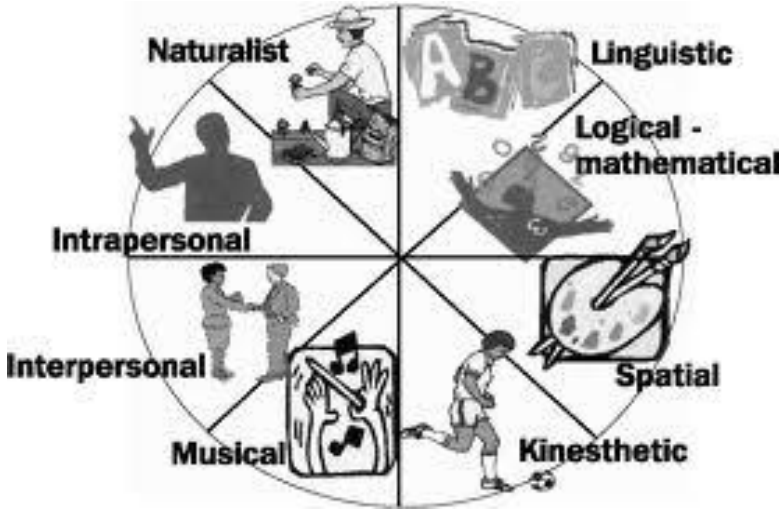
How can you *not* believe that that people learn differently? Isn't it obvious?

- People do learn differently, but I think it is very important to say exactly how they learn differently, and focus our attention on those differences that really matter. If learning styles were obviously right it would be easy to observe evidence for them in experiments. Yet there is no supporting evidence.

- There are differences among kids that both seem obvious to us and for which evidence is easily obtained in experiments, e.g., that people differ in their interests, that students vary in how much they think of schoolwork as part of their identity ("I'm the kind of kid who works hard in school") and that kids differ in what they already know at the start of a lesson.

Learning Style versus Learning Abili What does it matter?

- The idea that people differ in ability is not controversial—everyone agrees with that. Some people are good at dealing with space, some people have a good ear for music, etc.



- So the idea of “style” really ought to mean something different. If it just means ability, there’s not much point in adding the new term.

All right then, what do *you* think is the difference between style and ability?

- Ability is *that* you can do something.

- Style is *how* you do it.

- Thus, one would always be happy to have more ability, but different styles should be equally desirable. I find a sports analogy useful here. Two basketball players may be of equal ability, but have different styles on the court, one being a risk-taker, and the other quite conservative in his play.
- Sometimes people say it's obvious that there are learning styles because blind and deaf people learn differently. This is a difference in ability, not style.

I thought there was no good evidence, not that the evidence proved that learning styles don't exist!

So why do you say they don't exist?

The review (Pashler, H., McDaniel, M., Rohrer, D. & Bjork, R. 2008. Learning styles: Concepts and evidence did conclude just that. The ideal experiment has not been conducted. A lot of less-than-ideal experiments have been conducted, and they are not promising for learning styles theories at all.

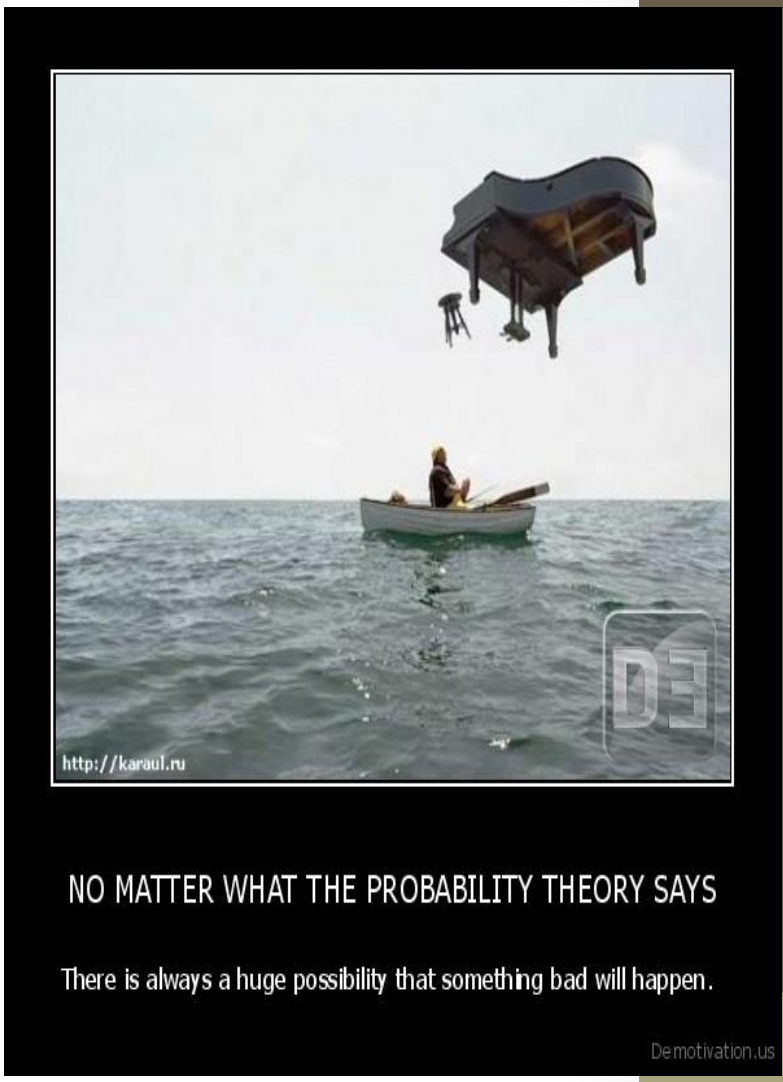
"About these experiments you've conducted for twelve years...no one remembers hiring you."

Reprinted from The Funny Times / PO Box 18530 / Cleveland Heights, OH 44118
phone: (216) 371-8600 / e-mail: ft@funnytimes.com

Two important points to keep in mind when evidence for a theory is lacking:

(1) it's absolutely true that we *could* find out tomorrow that there are learning styles after all.. Note this is always the case--you can't absolutely prove a theory untrue. But as things stand, there's no scientific reason to think that the theories that have been proposed are correct;

(2) the fact that we haven't definitively proven a theory wrong seems like a poor reason to advocate using the theory in classrooms.



Exercise

- If learning styles can't be proven, what does this mean for your instructional design? (15 Minutes)
- Break into groups of three and consider what research based practice could we potentially use to improve instruction and multimedia content delivery.
- Record your top three ideas and present them back to the group

Dr. Richard Felder

- Still remains a proponent of Learning Styles
- Views learning styles more as individual preferences
- Advocates appealing to students using good instructional design / effective pedagogy

edtech.mst.edu

Using Effective Pedagogy

- Teaching to address all categories of a learning styles model is not a radical idea, and specific suggestions for how to do it should look familiar to anyone who has studied the literature of effective pedagogy.

  - *Don't just lecture—provide opportunities in class for both practice in course-taught methods* (for the active learners) *and reflection on the outcomes* (for the reflective learners).

  - *Teach basic principles and theories* (which intuitive learners are comfortable with), *but only in the context of their real-world applications and with numerous examples of how to apply them* (without which many sensors may have difficulty grasping the underlying concepts).

Using Effective Pedagogy

- *Provide information both visually* (pictures, diagrams, flow charts, concept maps, demonstrations,…) *and verbally* (written and spoken explanations) *rather than making almost everything verbal* (as is usually done except in art and architecture courses).

- *Teach new course material in a logical and systematic way* (which thinkers and sequential learners need), *but be sure to show how it connects to the students' prior knowledge and experience and to problems of global and social importance* (for feelers and global learners).

Using a balanced perspective

- Learning styles are not either-or categories, but preferences that may be mild, moderate, or strong. The fact that students may be classified as, say, sensing learners, says nothing about either their intuitive skills or their sensing skills. It follows that students with any learning style can succeed in any career or endeavor.

- Both logic and published research suggest that students taught in a manner matched to their learning style preferences tend to learn more than students taught in a highly mismatched manner. It does not follow, however, that matching instruction to fit students' learning styles is the optimal way to teach. For one thing, it is impossible if more than one learning style is represented in a class.

Where the rubber hits the road

- *The optimal teaching style strikes a balance (not necessarily an equal one) between the poles of each dimension of the chosen learning styles model.* When this balance is achieved, all students are taught sometimes in their preferred mode.

- The ideal balance among learning style categories depends on the subject, level, and learning objectives of the course and the backgrounds and skills of the students. Part of the instructor's job is to attempt to ascertain that ideal and to teach in a manner that comes as close to it as possible.

http://www.pacificariptide.com/pacifica_riptide/2012/07/outreach-where.html

Research-based Best Practices for Instructional Design

- The work of Ruth Clark and Richard E. Mayer
- Learning: three metaphors
- Constructing mental representations
- Eight principles for using multimedia
- Beyond the principles

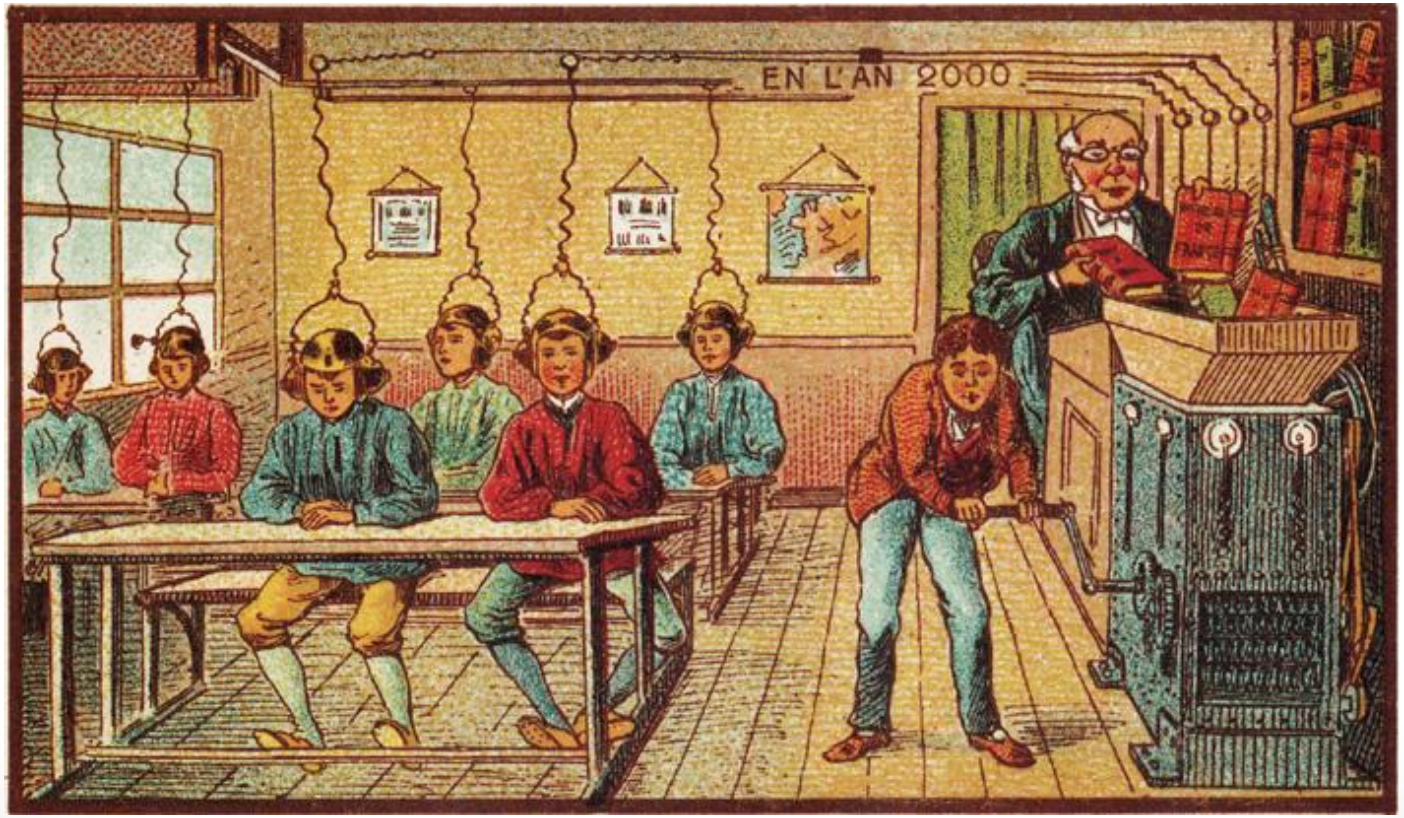
Three Metaphors of Learning: Response strengthening

- Learning is strengthening or weakening of associations
- Learner is passive recipient of rewards and punishments
- Instructor is dispenser of rewards and punishments

Source: www.marines.mil, photo by: Sgt. Aaron Rooks

Three Metaphors of Learning: Information Acquisition

- Learning is adding information to memory
- Learner is passive recipient of information
- Instructor is dispenser of information



At School in the Year 2000 (Villemard, 1910)

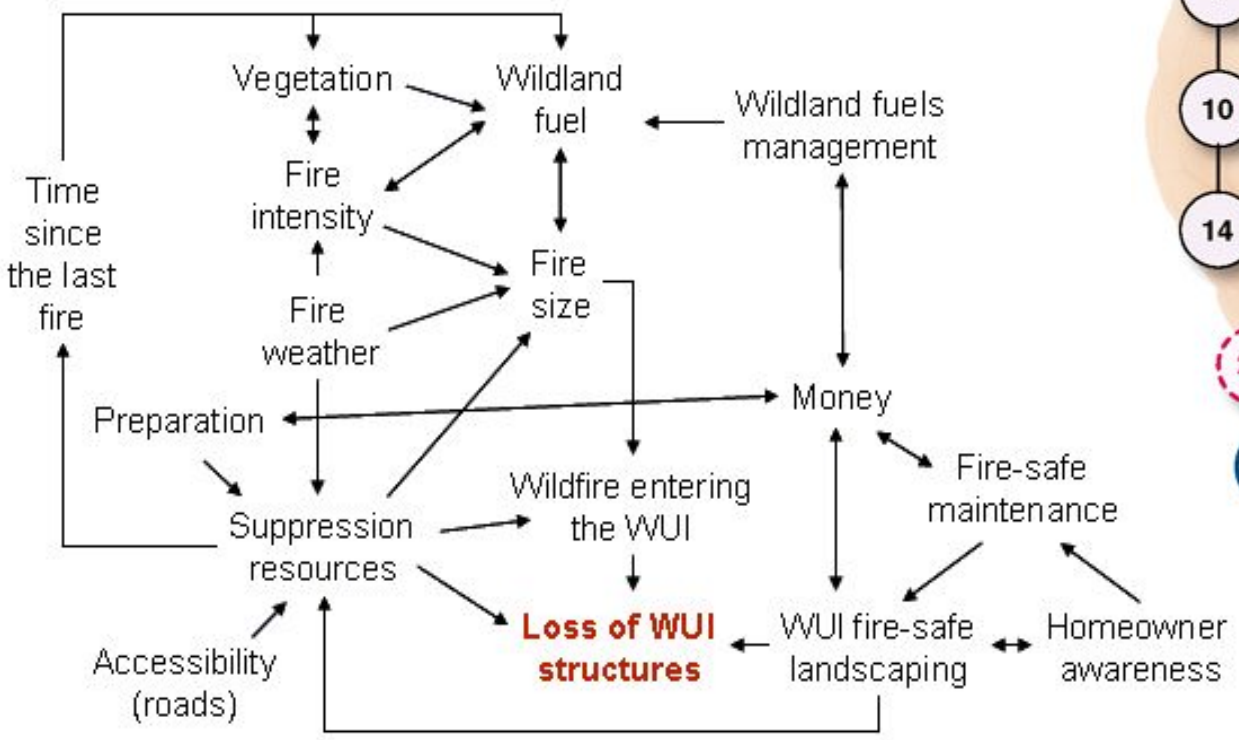
Three Metaphors of Learning: Knowledge Construction

- Learning is building a mental representation
- Learner is active sense maker
- Instructor is Cognitive Guide

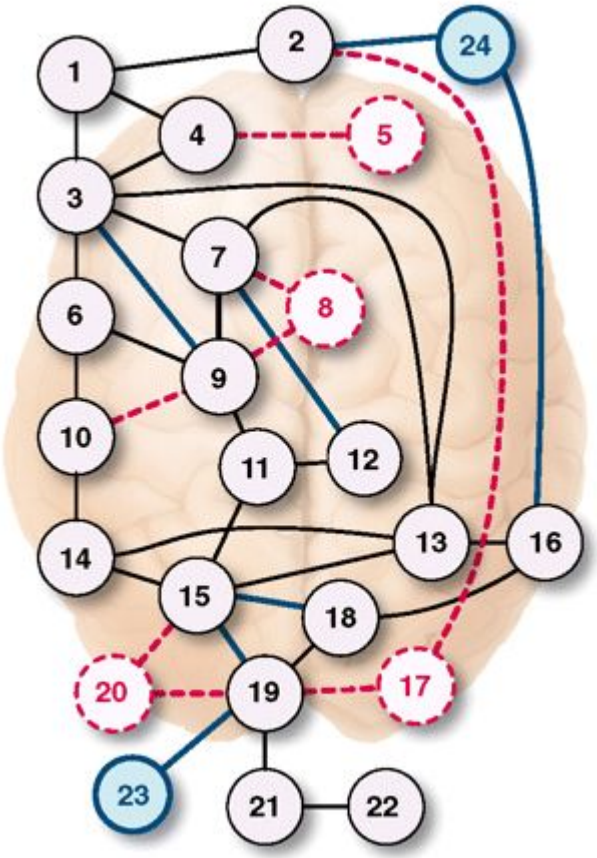
Sacagawea with Lewis and Clark during their expedition of 1804-06 (colour litho) by Wyeth, Newell Convers (1882-1945)

Clark and Lewis' 'Representation' (1814)

Mental Representation (AKA 'concept')

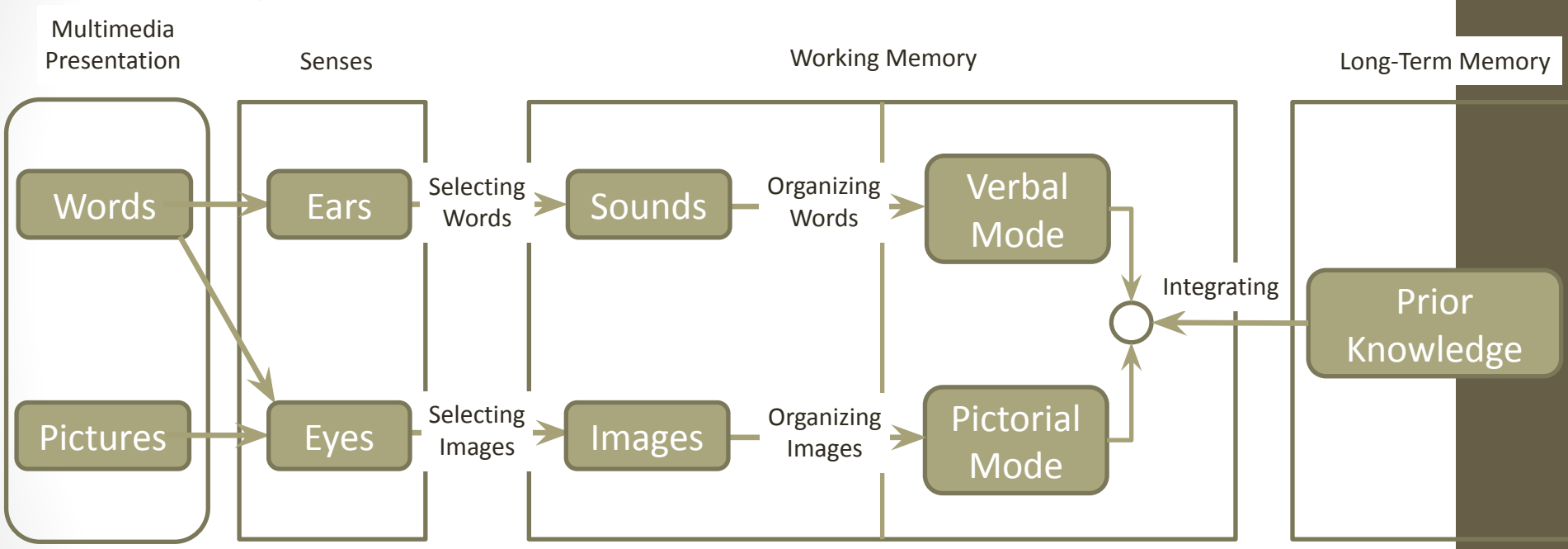


Source: http://www.fs.fed.us



urce: http://www.sciencemag.org

Cognitive Theory of Multimedia Learning (Mayer, 2005)



'Meaningful learning occurs when the learner appropriately engages in all of these processes' (Clark & Mayer, 2011, p.37)

Eight Multimedia Principles

. . .

- ***Multimedia***
  - Use words and graphics rather than words alone
- ***Contiguity***
  - Align words to corresponding graphics
- ***Modality***
  - Present words as audio narration rather than on-screen text
- ***Redundancy***
  - Explain visuals with words in audio or text: not both

Eight Multimedia Principles

. . .

- ***Coherence***
  - Adding material can hurt learning
- ***Personalisation***
  - Use conversational style and virtual coaches
- ***Segmenting and Pretraining***
  - Managing complexity by breaking a lesson into parts

Summary of Research Results fro the Eight Multimedia Principles

Principle	Median Effect Size	Number of Tests with Effects Greater than .5
Multimedia	1.50	9 of 9
Contiguity	1.11	8 of 8
Coherence	1.32	10 of 11
Modality	.97	20 of 21
Redundancy	.69	8 of 10
Personalization	1.30	10 of 10
Segmenting	.98	3 of 3
Pretraining	.92	7 of 7

Source: Clark & Mayer (2011)

Beyond the principles …

- Worked examples
- Practice
- Collaborative learning
- Learner control versus program control
- Thinking skills
- Simulations and games

Knowledge Structures & Graphic Support

Type of Cognitive Structure	Description	Graphic Representation	Example
Process	Explain a cause-and-effect chain	Flow chart	Explanation of how the human ear works
Comparison	Compare and contrast two or more elements along several dimensions	Matrix	Comparison of two theories of learning with respect to nature of the learner, teacher, and instructional methods
Generalization	Describe main idea and supporting details	Branching tree	Presentation of thesis for the major causes of the American Civil War along with evidence
Enumeration	Present a list of items	List	List of the names of seven principles of multimedia design
Classification	Analyze a domain into sets and subsets	Hierarchy	Description of a biological classification system for see animals

General Multimedia Design Principles for Text and Illustration

Principle	Description
Concentrated	The key ideas are highlighted in the illustrations and in the text
Concise	Extraneous descriptions are minimized in the text and extraneous visual features are minimized in the illustrations
Correspondent	Corresponding illustrations and text segments are presented near each other on the page
Concrete	The text and illustrations are presented in ways that allow for easy visualisation
Coherent	The presented material has a clear structure (e.g., a cause-and-effect chain)
Comprehensible	The text and illustrations are presented in ways that are familiar and allow the learner to apply relevant past experience
Codable	Key terms used in the text and key features of the illustration are used consistently and in ways that make them more memorable

Learner Characteristics

SITUATIONAL

Prior Knowledge (schemas)

Low prior knowledge ——— High prior knowledge

Motivation (invested mental effort)

Low ——— High

Perceived Self Efficacy (task confidence)

Low ——— High

Aptitudes (innate capacities)

Low ——— High

Learner Characteristics (empirically validated)

- Schemas - Prior knowledge and experience along with associated schemas are indisputably the biggest factors in predicting a learner's initial success in almost every learning situation.

- Amount of invested mental effort - A highly motivated learner will learn just about anything despite inadequacies in instructional design. Highly motivated learners will often excel in settings where instructional resources are readily accessible.

Additional Learner Characteristics (empirically validated)

- Perceived self efficacy - Low perceived self-efficacy can function as a potential internal distraction. If cognitive resources are consumed with managing negative states associated with an instructional task, learning will be negatively impacted.

- Aptitudes - In Howard Gardner's book, Frames of Mind: the Theory of Multiple Intelligences, he identifies seven aptitude like traits which he refers to as "intelligences." Although these aptitudes are mainly biologically and environmentally determined, their interaction with instructional methods and content is largely situational.

Putting the promise into action

- Part of the original MLS challenge was to provide interventions in the delivery of content (multi channel learning) to suit the learners needs.

- From the presentation so far we know that we know that sound instructional design principles can influence student achievement but what do we do about using the answers with respect to individual learner characteristics in an automated environment?

- One suggestion is to look at computer based tutoring systems

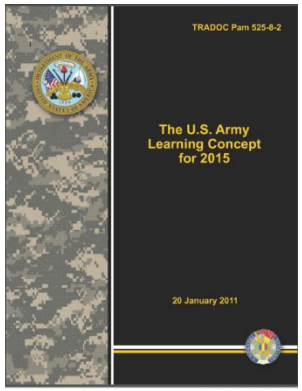
Push for Tailored Training

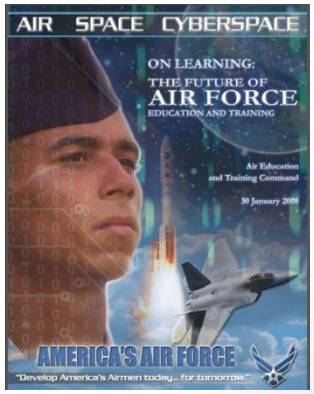
Computer-based tutoring systems (CBTS) have demonstrated significant promise in tutoring individuals in well-defined domains, but…

Fifty years of research have been unsuccessful in making CBTS ubiquitous in military training… Why?

CBTS are expensive to author and are insufficiently adaptable to support the tailored, self-regulated , individual & small unit tutoring experiences required to support:

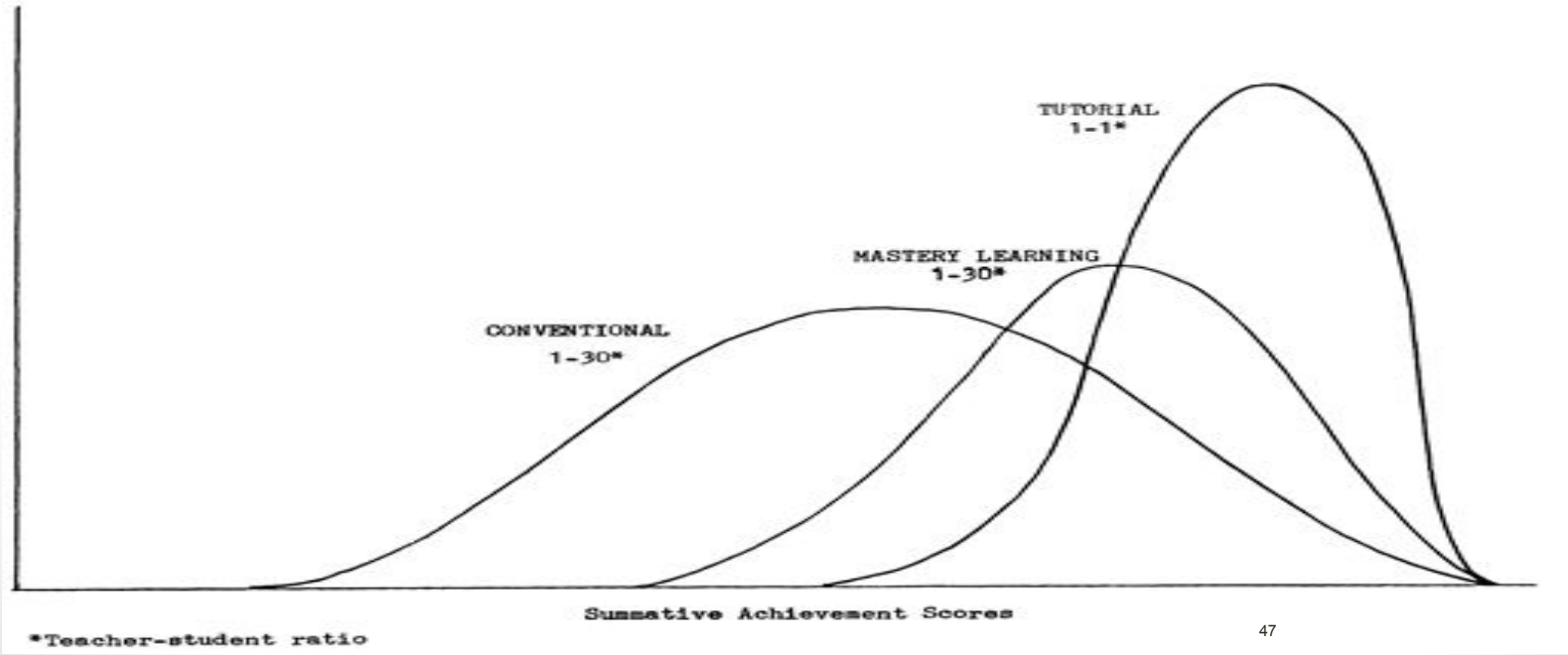
- U.S. Army Learning Model (ALM) for 2015 (TRADOC, 2011)
- U.S. Air Force (AETC, 2008)
- U.S. Navy STEM Grand Challenge (ONR, 2012)
- OSD R&T Vision for PAL
- NATO HFM RTG 237 (Advanced ITS)
- TTCP HUM TP-2 (Training Panel)





Why Computer-Based Tutoring Systems (CBTS)

- ITSs apply Artificial Intelligence tools and methods to individualize instruction
  - Based on benefits associated with one-on-one expert tutoring (2-Sigma Problem; Bloom, 1984)
  - Mediates learning by providing feedback when appropriate and adjusting difficulty levels to maintain desired challenge.

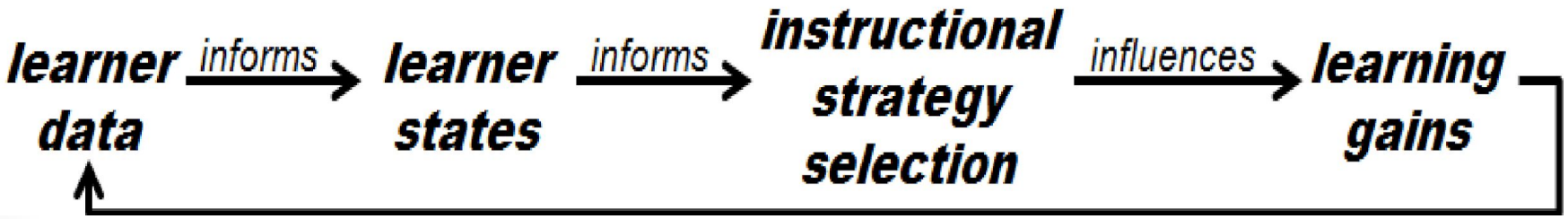


Individual Tutoring Systems – Proven Results

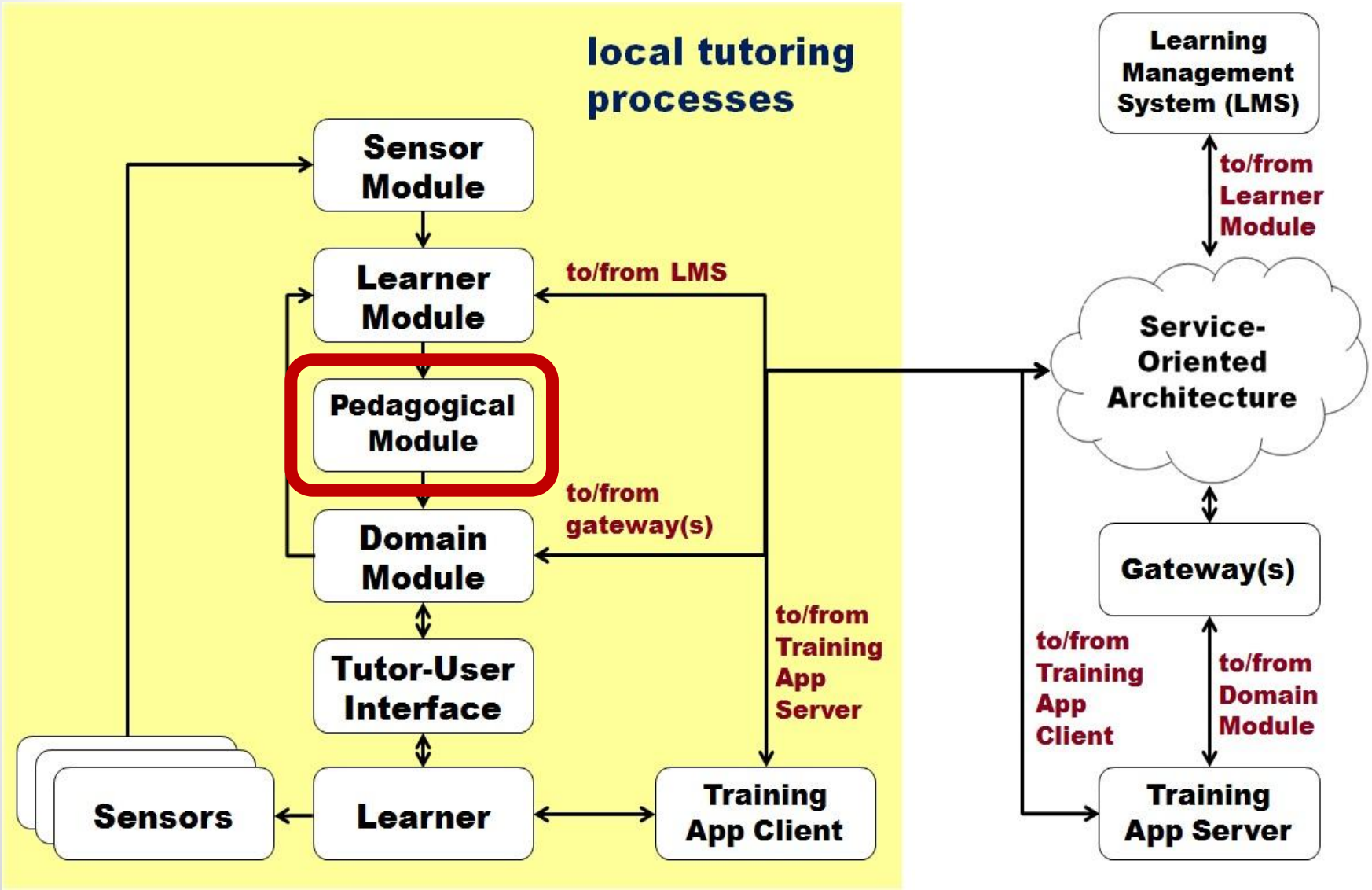
- **VanLehn (2011):**
- 27 Evaluations
  - -Effect size of 0.59 overall
  - -Effect size of 0.76 for step-based tutoring
  - -Effect size of 0.40 for substep-based tutoring

- **Kulik/Fletcher (2012):**
- 45 “Systems Evaluations”
  - -Effect size of 0.60 overall
  - -Effect size of 0.75 for 39 properly aligned studies

Overall Intent of GIFT (Generalized Intelligent Framework for Tutoring)

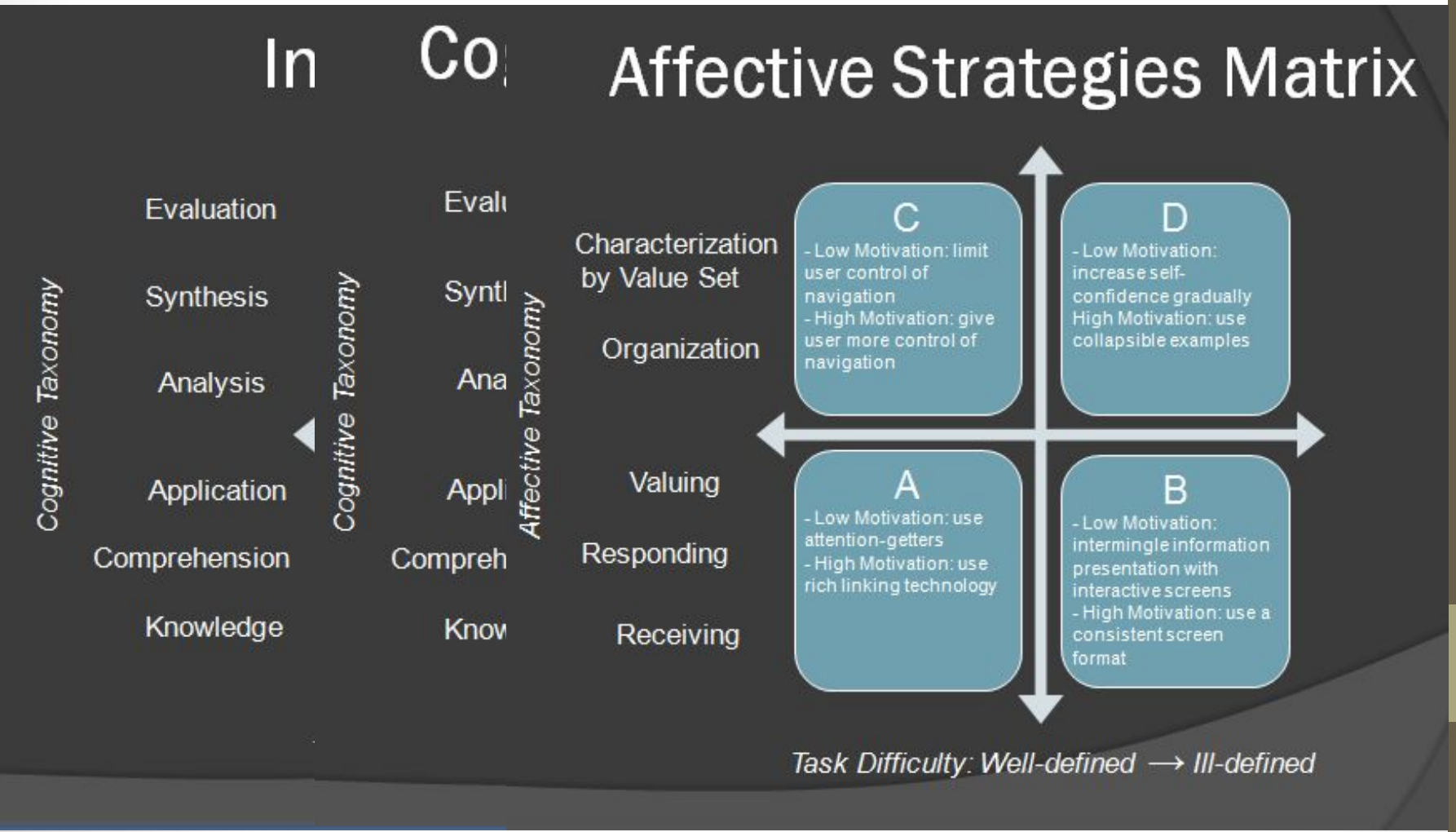


Generalized Intelligent Framework for Tutoring (GIFT)



Pedagogical Modeling

- Designed to balance the level of guidance a learner needs with the goal of maintaining engagement and motivation



Application of GIFT

vMedic will drive the Intelligent Tutoring behaviors within GIFT which in turn, will drive a number of instructional interventions within *"vMedic".*

http://www.youtube.com/watch?v=YrMs5-0E8as&feature=youtu.be

Recommendations

- Select instructional methods and media that match the nature of the content to be taught (i.e., use graphics for content material that is predominately visual in nature, and verbal/textual media for content that is more abstract and declarative in nature).

- Recognize that most learners are adaptable and cognitively flexible, especially if motivated. You don't need to overcompensate for a hypothesized innate trait that—in many instances—may not be valid.

Recommendations

- Supplement your learning “styles” paradigm with other learner attributes that have been tried, tested, and proven true (prior knowledge, motivation, aptitudes, and learner confidence related to the content or task to be learned).
- Recognize that the concept of learning styles is very appealing and has somehow become an integral part of our education and training folklore. How strongly one feels about a particular belief is no justification for ignoring the hard scientific evidence.

Primary References:

Cassidy, S. (2004). Learning styles: An overview of theories, models, and measures. *Educational Psychology, 24*(4), 419.

Clark, R. C., & Mayer, R. E. (2011). E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning. Pfeiffer.

Felder, R. (2010) ARE LEARNING STYLES INVALID? (HINT: NO!) Retrieved from: http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/LS_Validity(On-Course).pdf

Howles, L. (2007). Learning Styles: How to Apply the Latest Research to Designing e-Learning. Retrieved from: http://isg.urv.es/library/papers/learning%20styles_overview.pdf

Nilson, L. "The Truth about Learning Styles." Keynote at the International Lilly Conference on College Teaching. Oxford, OH. 18-21 November 2010

Pashler, H., McDaniel, M., Rohrer, D., and Bjork, R. (2008). Learning Styles. *Psychological Science in the Public Interest*, 9(3):105-119.

Sorden, S. (2005). A cognitive approach to instructional design for multimedia learning. Informing Science Journal, 8, 263-279. Available at http://inform.nu/Articles/Vol8/v8p263-279Sorden34.pdf

Sottilare, R., Brawner, K., Goldberg, B., and Holden, K. (2012). The Generalized Intelligent Framework for Tutoring (GIFT). Retrieved from: https://gifttutoring.org/documents/31