Information Processing for Learning in Health Care

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Information Processing for Learning in Health Care

- Objectives
  - What are the key aspects of the learning process?
  - What are the levels of learning?
  - How is biomedical information utilized for clinical reasoning?
  - How is information obtained and applied?
  - Why does information management have value?

Educational Scholarship

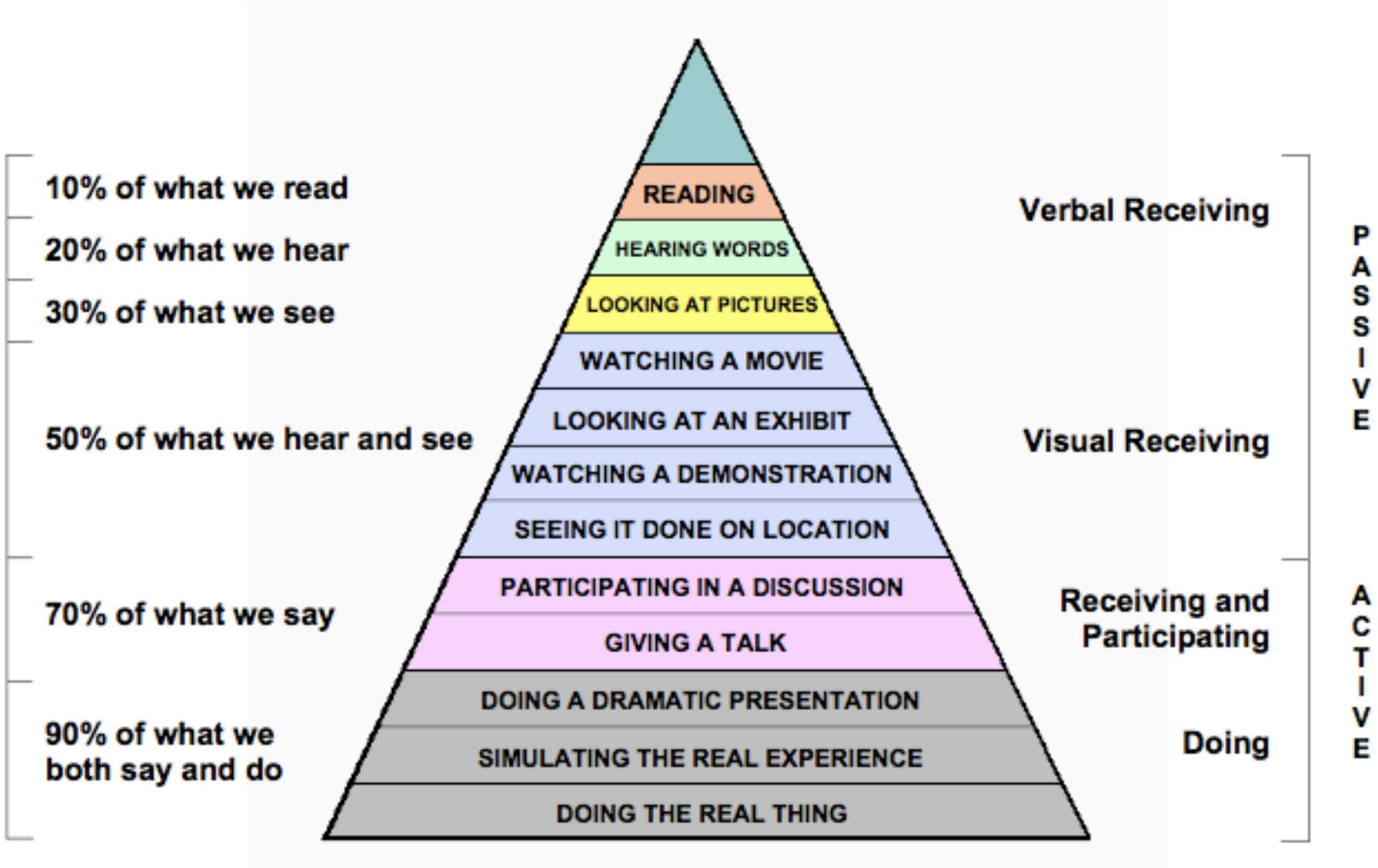
- How do our students learn best?
- Does anyone know how learning is best supported?
- What makes a difference in long-term outcomes?
- What outcomes are desirable?
  - Long term improvements in knowledge, skills, and attitudes.
  - Application of life-long learning.

Learning Styles

- There are individual differences in learning styles:
  - Visual
  - Auditory
  - Reading/writing
  - Kinesthetic
- Most learners are multimodal (but NOT multitaskers)
- More than one mode at a time increases learning capacity over a single mode.

WE TEND TO REMEMBER OUR LEVEL OF INVOLVEMENT

(developed and revised by Bruce Hyland from material by Edgar Dale)



Principles of Active Adult Learning

- Process: Active learning in groups fosters teamwork, collegiality, and professionalism
- Content: Active learning fosters retention of knowledge for better performance over time.

Active Learning

- Active processing of information, not passive reception of information, leads to learning.
- Instructors can encourage this process by carefully considering the type and organization of information as well as instructional strategies.
- Students must construct their own understanding of concepts, relationships, and procedures.
  - Attention span = 1 / internet usage
  - Attention span = 1 / multitasking
  - (Attention span) $^{\text{curiosity}}$

Principles of Active Adult Learning

- Learners are responsible and self-directed
- A foundation of life experiences and knowledge is valuable to share
- Learners are goal-oriented (want to pass exams)
- Learners are relevancy-oriented (is this something I'll really do?)
- The learning experience is practical, not theoretical
- Respect is shown to everyone

Adult Learning Practices:
What should be done by instructors?

- **Be enthusiastic**! Learners feed off of the energy generated by others.
- **Be professional**. Be a positive role model.
- **Be prepared**. The learning materials must be thoroughly developed and reviewed. The instructions must be clear and precise

Adult Learning Practices:
What should be done by instructors?

- **Be humble**. The session should bring out the best in the learners, who should be the focus of the experience. This is not the time to impress everyone with your brilliance.
- **Be patient**. Learners come from different backgrounds and are at different levels of knowledge, skill, and experience. Work with what you've got. Don't be in a hurry. The learning process goes slower for non-experts. The stress level should not be too high.

Adult Learning Principles:
What should be done by learners?

- **Come prepared**. The session works best when everyone comes with something to share. The slowest person sets the pace.
- **Be collegial**. The session is about teamwork. The group process works poorly when individuals talk just to ***tell*** others what they know; the process works well when individuals talk to get others to ***understand*** what they know. Make it a point to get everyone involved.

Adult Learning Principles:
What should be done by learners?

- **Be professional**. What if a family member of the person in the case being discussed were in the room?
- **Identify learning issues**. Don't just jump to a conclusion. You won't get answers until you can identify the problems and ask the relevant questions.

Why Do Instructional Systems Fail?

- Lack of clear goals and objectives. If you can't write them down, then they don't exist. 'Winging it' doesn't foster adult learning.
- Lack of preparation. Teaching materials must be carefully developed and deployed.
- The level of learning is set too high or too low.
- Lack of assessments. If it isn't assessed, it never happened. Any instruction without assessment can be safely ignored. Are the assessments valid?
- Lack of professionalism. If we're learning to do a job with life-and-death decisions, then we should act like we're on the job.

Health Science Education: Focus

- Does the content and process focus on:
  - Clinical relevance
  - Patient safety
  - Health promotion

Learning Theory: Short Term Memory

- It is generally possible to keep only 5 to 9 separate pieces of new information from sensory input in working memory at any one time.
- Between two and four of these pieces can be processed simultaneously, and only for a few seconds.
- Almost all of this new information is lost after 20 seconds unless it is refreshed through review.
- (learn – forget) X (n)

Learning Theory: Long Term Memory

- Long-term working memory supplies information that is not limited to just a few items at a time.
- Information available from long-term memory becomes organized by schemas that can be complex but also automated. This is how expertise is applied.
- The expert has built up many informational items in long-term memory in organized patterns that can be recalled and applied quickly.

How is Learning Applied?

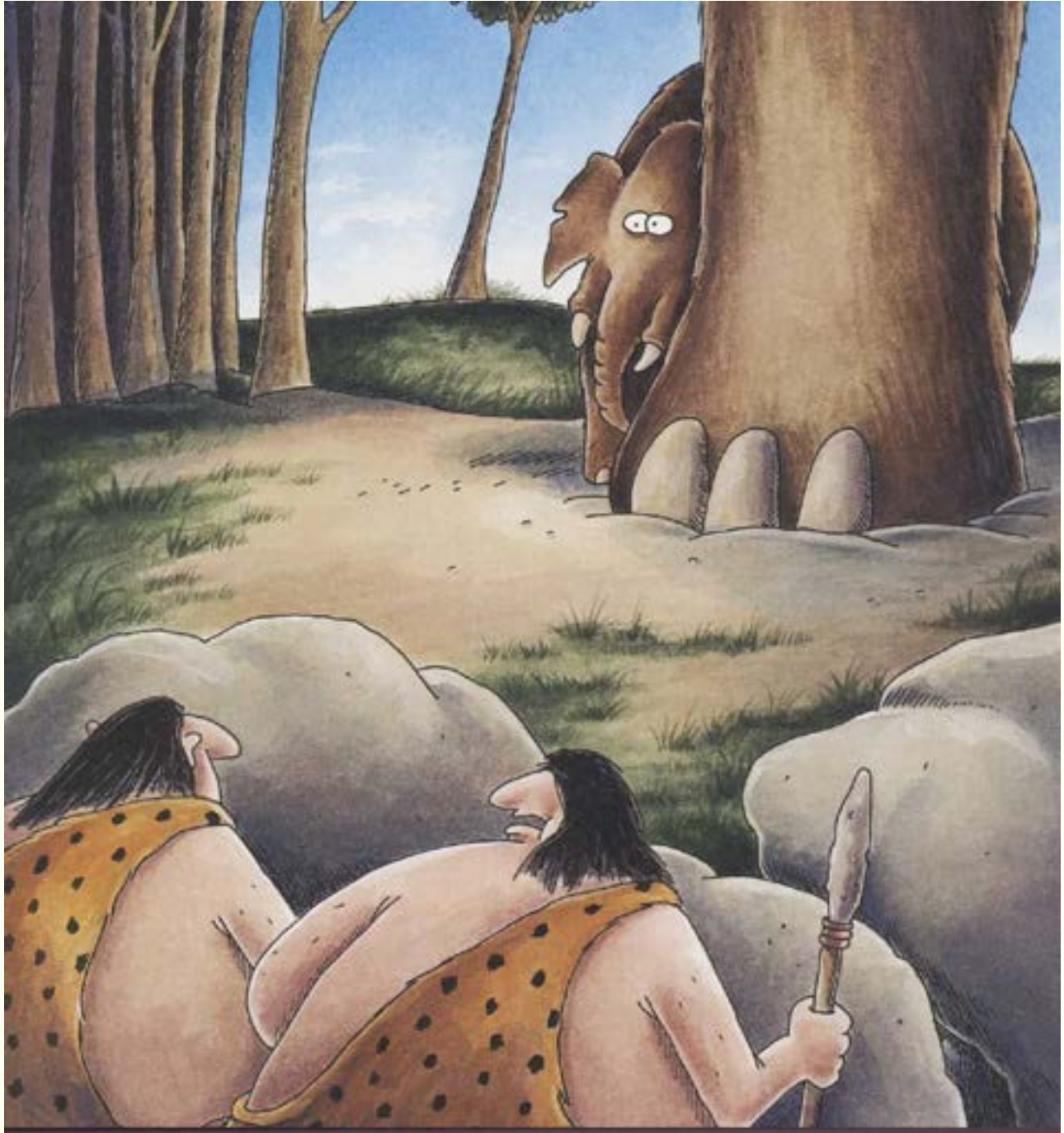
- Novice: uses life experiences and intuition
- Intermediate trainee: just enough knowledge to be confused and dangerous
- Expert: uses knowledge base, training, and experience (10,000 hours)

Novice Learners

- Novice learners must first acquire simple ideas with limited information content.
- Novices are trying to process many new variables, and the possible combinations of those variables is a mathematical factorial multiplication, not simple addition.
- Novices should start with simple problems with limited new data.
- Novices need a willingness to try and not be discouraged by repeated failure.

Intermediate Learners

- At higher levels of learning, more variables and unknowns can be introduced into problem sets.
- Confused by information they have not yet fully organized in long-term memory; should seek out methods for schema construction.
- They exhibit variable performance in problem solving, at times performing worse than novices, and are painfully aware of their limitations, with many perceived mistakes.
- Need understanding and encouragement of faculty instructors



"Ha! We got him now!"

Expert Level

- Experts combine the simple ideas into complex schemas and automatically using extensive long-term memory banks, while novices struggle to process new information with short-term memory.
- Expert schemas are reinforced though multiple usage and speed the automated processing of large amounts of information – pattern recognition.
- This explains why expert teachers can become frustrated with novice/intermediate students.

Cognitive Flexibility

- At higher levels of learning, cognitive flexibility theory aids complex instructional situations. There are two key principles:
  - First, focus on common beliefs and misconceptions that apply to related concepts, and challenge those misconceptions.
  - Second, de-emphasize compartmentalization of knowledge.
- Avoid the problem of "linear thinking" to oversimplify complex problems into simple, exclusive, sequential "cause and effect" events.

Forward vs. Backward Learning

- Instead of just memorizing disconnected facts in isolation (forward learning), learn the material from a clinical context (fill in backward from the clinical scenario).
- Determine how each fact or concept interacts with the others. Build associations and links to other facts and concepts.
- Must generalize from one context (case) to another (this is harder than it seems).

Learning Theory

- Surface learning: rote memorization to cram for a test. Little interest in concepts and their application.
- Strategic learning: game the system to get the best score on the next test. Effect is like mounting credit card debt.
- Deep learning: Students have an interest in the content of learning and seek to become able to apply it. They focus on clinical relevance.

Approaches to Learning (Clinical Reasoning)

- Convergers: rely on deduction to solve problems.
- Divergers: use creative problem solving and view a problem from many perspectives before acting.
- Assimilators: employ an inductive approach with schemes and algorithms to organize problem solving.
- Hands-on: want to obtain experience as a way of learning.

Clinical Reasoning

- Reasoning forward from just biomedical knowledge is an arduous and error-prone process
- In clinical scenarios, experts rely on pattern recognition, and biomedical knowledge becomes a check on the process.
- 10,000 hours are required to become an expert.

Information Resources

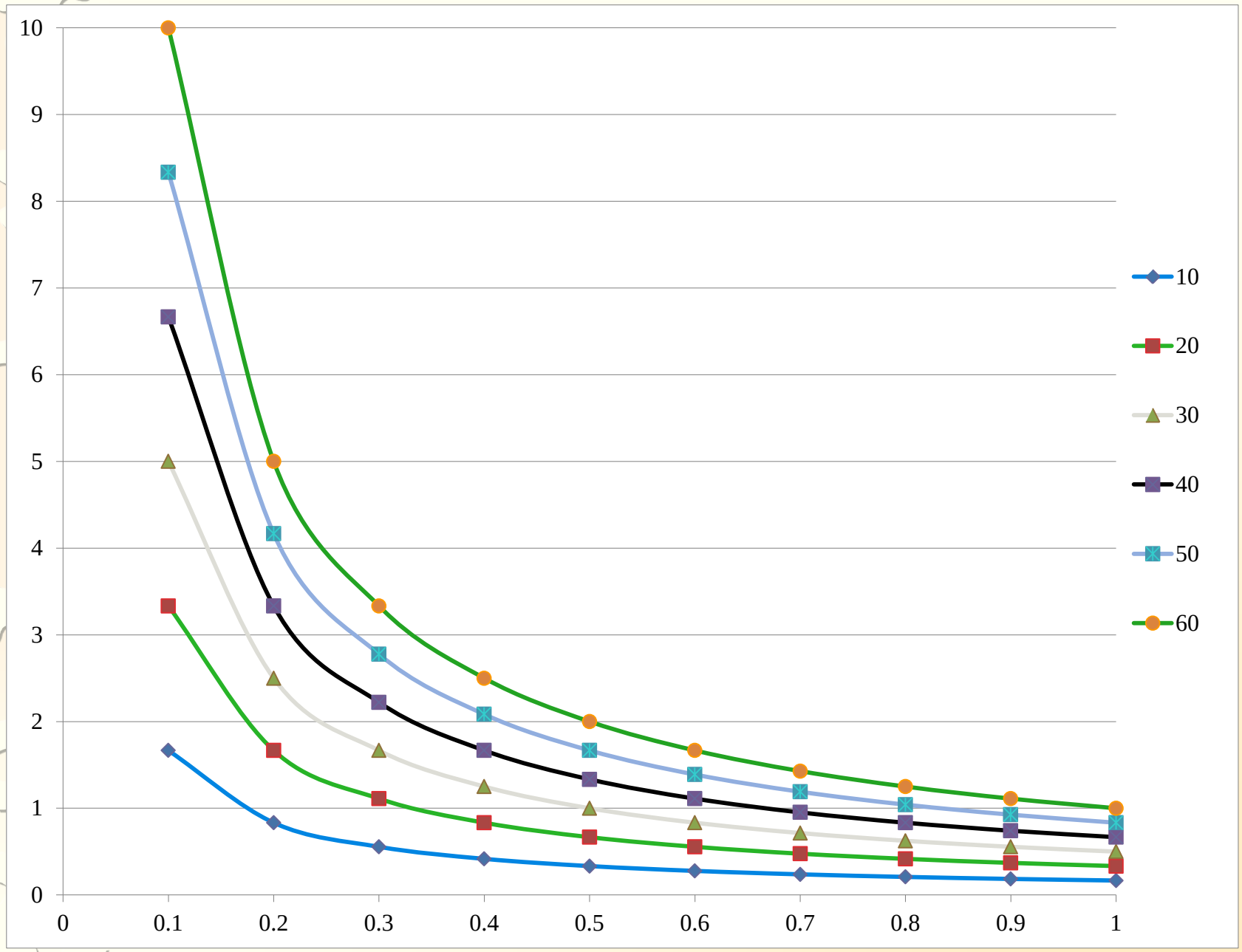
- Novice students need guidance.
- Novices cannot be expected to find the key information and concepts on their own.
- At higher levels of training more resources can be utilized by students.

Rates of Knowledge Acquisition

- 600 WPM: scanning level, recognize just a few target words.
- 450 WPM: skimming, get an overview of the text with some connected words, but not whole sentences.
- 300 WPM: comprehension, whole sentences in context, as one would read a novel for pleasure.
- 150 WPM: memorizing, for recall and recitation.
- 100 WPM: using specific objectives to pass a high stakes examination with difficult questions.

Scientific Literature

- The average science textbook has 267,000 words printed in 500 pages at 534 words per page.
- At 100 WPM, a student takes at least 5 minutes to read just words on one page of text, not counting additional figures, graphs, or charts, and processes no more than 12 pages per hour.


Hours Per Day
10
9
8
7
6
5
4
3
2
1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Pages Per Minute
10
20
30
40
50
60

What Students Truly Require

- A well-constructed study plan
- Time management skills for deployment of that plan
- Meaningful feedback regarding their progress

Approaches to Learning

- Assemble a team of learners and you have multiple styles and approaches to learning for synthesis.
- The whole is greater than the sum of the parts.
- You need the content, but the process determines how well it is utilized.

Educational Formula

- Humanware: education of health professionals in the 21st century must focus less on memorizing and transmitting facts and more on promotion of the reasoning and communication skills that will enable the professional to be an effective partner, facilitator, adviser, and advocate.
- New professional model: patient centered, systems based, team delivered health care with a set of common attitudes, values, and behaviors.

Who Owns the Curriculum?

- Schools no longer have control of the curriculum.
- There is a body of knowledge that is readily available 24/7 worldwide.
- We have selected for a group of high achievers adept at finding ways to succeed.
- Our students are ‘short timers’ who pass quickly through the system.
- Multiple paths lead to the same outcomes.

Synthesis

- Teachers in the health sciences need to apply evidence-based approaches. They've lived in a world with no reward for quality in education.
- Learners in the health sciences need to adopt sound, active learning methods. They've grown up in a world that does not encourage critical thinking.

Information Management

- Students need guidance in finding information:
  - What to use?
  - How to access?
  - When to access?
- Students need guidance in using information:
  - What is important?
  - What is communicated?
  - What additional questions are raised?

Learning Environment

- Eliminate distractions
- Rapid information access
- Focused communication

Learning Environment

- Who selects and manages the information resources?
- Who provides the training for students to acquire and use information?
- How does the curriculum support appropriate use of information resources?

Managed Information Resources

- Confidence in the reliability of the information.
- Transparent pre-selection and grouping in a structured way.
- Timeliness in knowledge acquisition: easy to find with a user-friendly searching.
- Value to health care providers: evidence-based, high-quality information is available in an easy, quick and well-directed manner.

Summary

- The quality of the information is important.
- Students need guidance in finding and using information.
- The progression from novice learner through intermediate to expert is arduous.
- Health science knowledge must be learned and applied in the context of clinical scenarios for clinical reasoning to develop.
- Active learning yields greater knowledge retention.