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Teaching Clinical Reasoning to Medical Students

#MedEd Masterclass
Jan 2021

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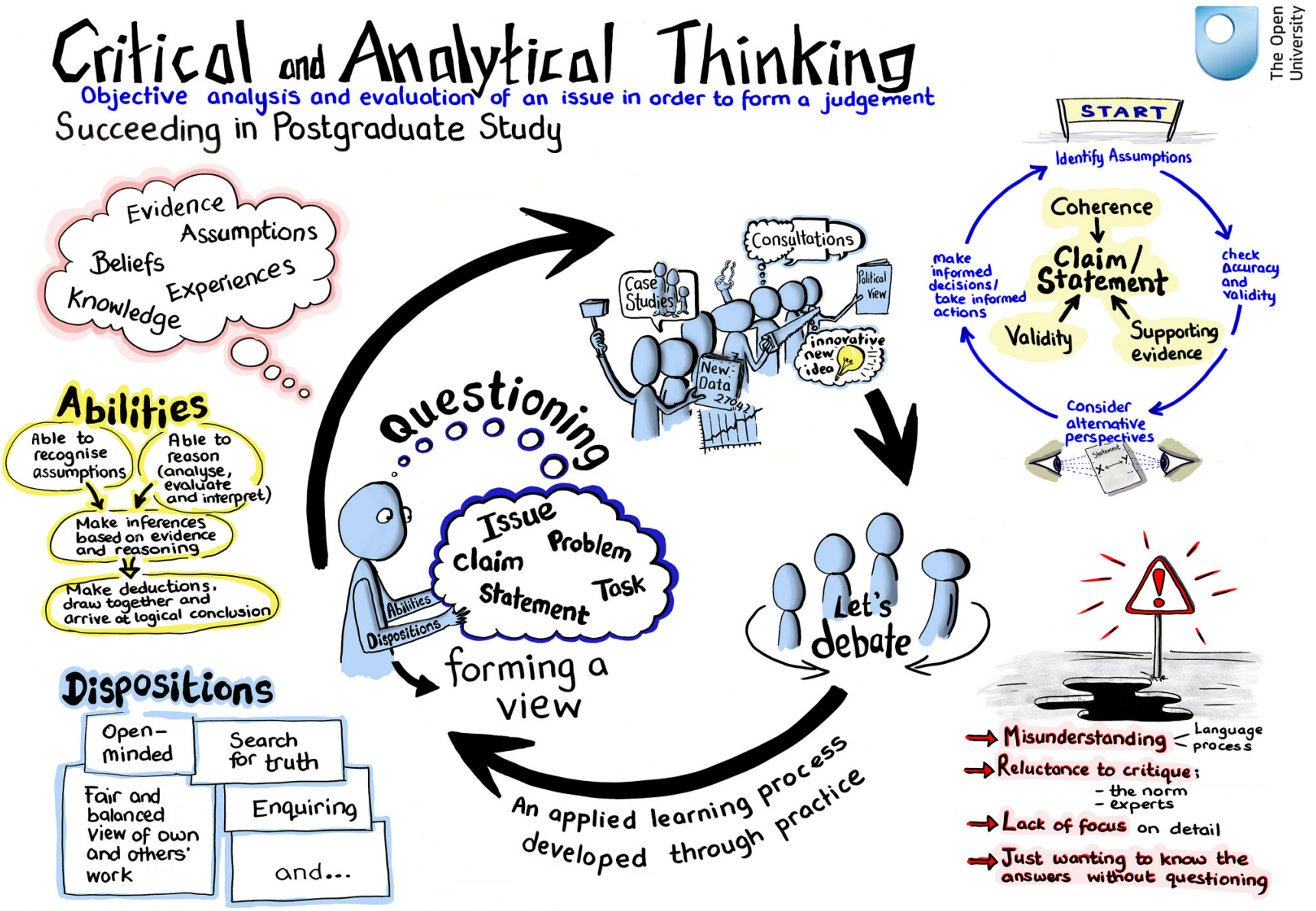
Definitions

- Clinical reasoning describes the thinking and decision making processes associated with clinical practice
- ‘A skill, process, or outcome wherein clinicians observe, collect and interpret data to diagnose and treat patients. Clinical reasoning entails both conscious and unconscious cognitive operations interacting with contextual factors such as the patient’s unique circumstances and preferences and the characteristics of the practice environment.’

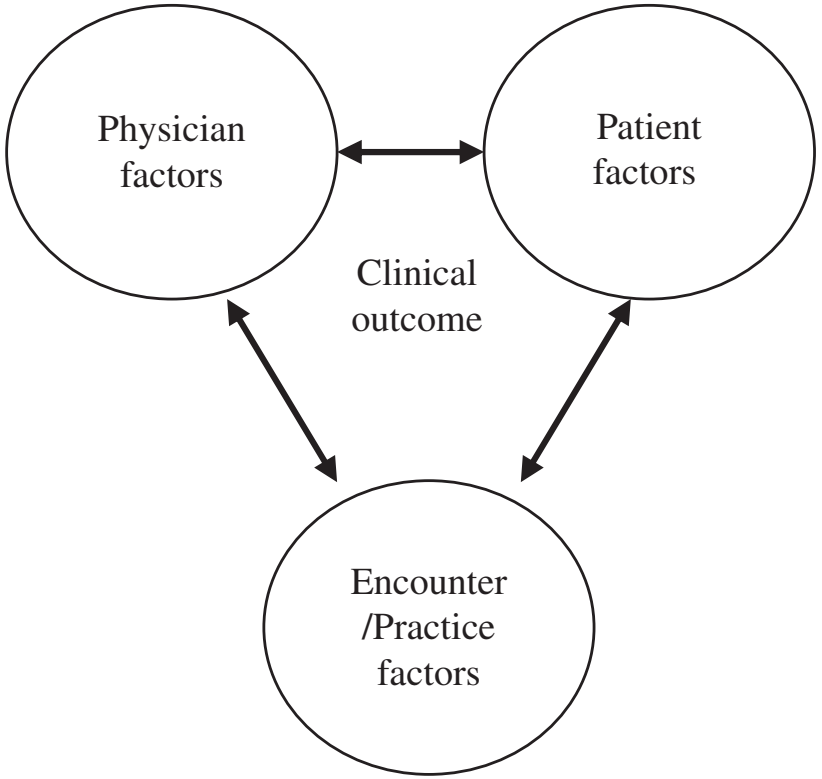
Daniel M et al. (2019). Clinical reasoning assessment methods: a scoping review and practical guidance. Academic Medicine; 94(6): 902-912

Critical thinking vs clinical reasoning



Environment, context and culture

(Knowledge, skill, motivation, well-being, experience, culture, expertise)



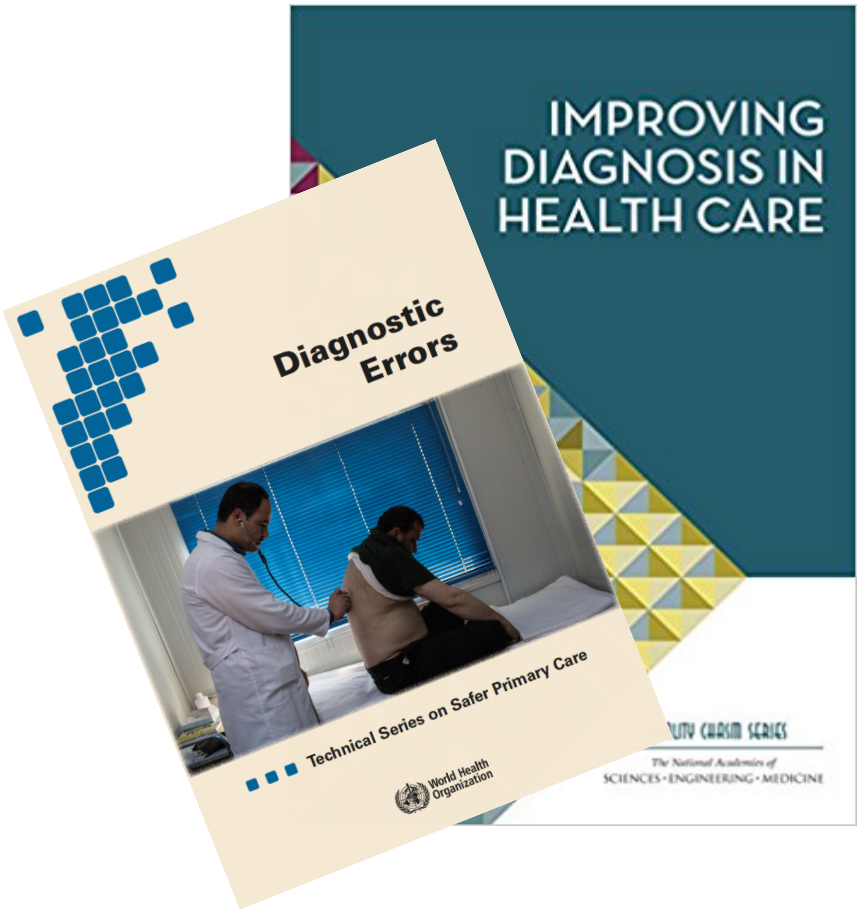
(Acuteness of illness, patient's medical literacy, culture, familiarity with the physician, education, understanding of physician's spoken language)

(Appointment length, appointment location, support systems and clinic staffing)

Durning SJ & Artino AR. (2011). Situativity theory: A perspective on how participants and the environment can interact: AMEE Guide no. 52. Medical teacher; 33(3): 188-199.

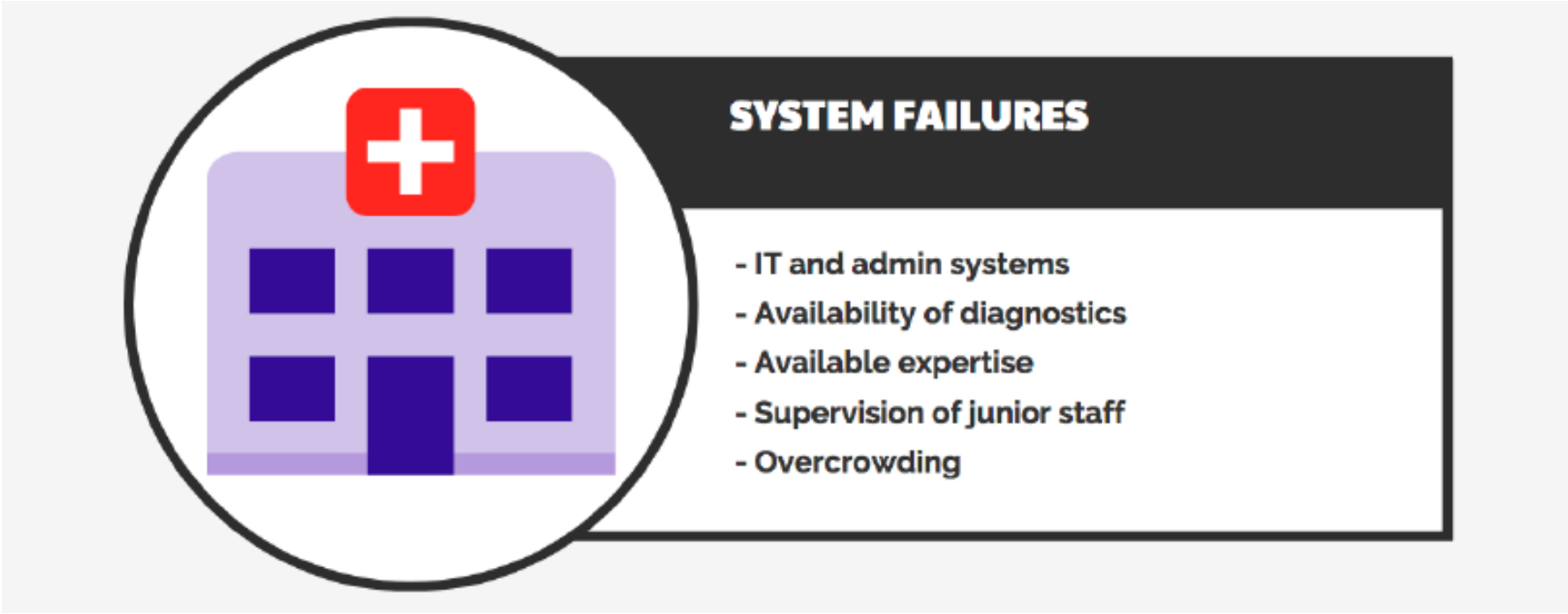
Context

- 10-15% of diagnoses are incorrect
- Diagnostic error causes significant harm
- Diagnostic error accounts for 40,000 – 80,000 deaths annually in the US, somewhere between breast cancer and diabetes
- Chances are, we will all experience a diagnostic error in our lifetime



US Institute of Medicine. (2013). 25-year summary of US malpractice claims for diagnostic errors 1986-2010: an analysis from the National Practitioner Data Bank. BMJ Qual Saf; 22(8): 672-680

Why do diagnostic errors happen?



Graber et al. (2005). Diagnostic error in internal medicine. Arch Intern Med; 165: 1493-1499

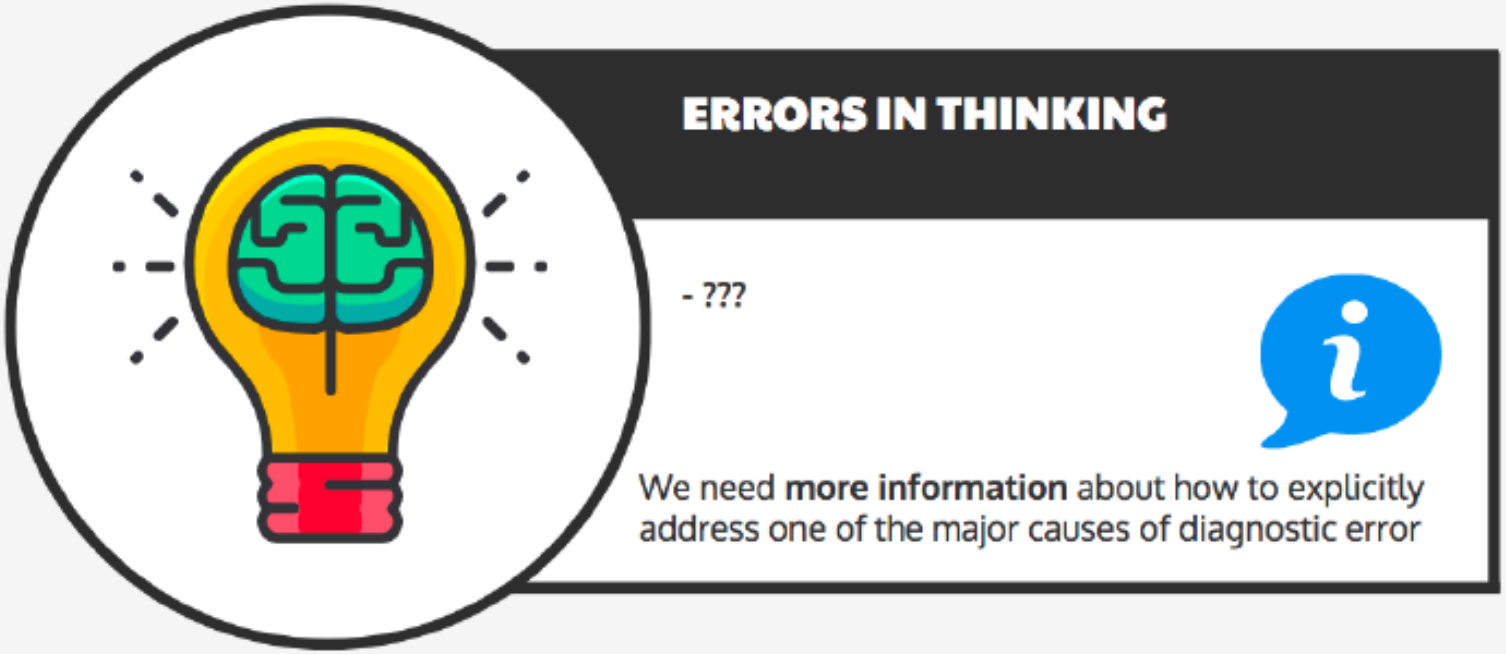
Why do diagnostic errors happen?

HUMAN FACTORS

- Workload / interruptions
- Overcomplicated processes
- Equipment
- Rota design
- Rest breaks

Cooper N. (2017). Human factors. In: Cooper N & Frain J [Eds]. ABC of Clinical Reasoning. Wiley.

Why do diagnostic errors happen?



Cognitive errors

ORIGINAL INVESTIGATION

Diagnostic Error in Internal Medicine

Mark L. Graber, MD; Nancy Franklin, PhD; Ruthanna Gordon, PhD

Results -
'System-related factors contributed to diagnostic error in 65% of the cases and cognitive factors in 74% … the most common cognitive factors involved faulty synthesis.'

Arch Intern Med 2005; 165: 1493-1499

Teaching clinical reasoning

How to improve the teaching of clinical reasoning: a narrative review and a proposal

Henk G Schmidt[1] & Sílvia Mamede[2]

‘The field cannot rely on clerkships as a breeding ground for this skill. The variety of cases offered to students is simply too limited, and the provision of coaching and feedback too haphazard … Medical educators need to do more and in a more systematic fashion. The establishment of a clinical reasoning curriculum as part of undergraduate training is in our view long overdue.’

Medical Education 2015; 49: 961-973

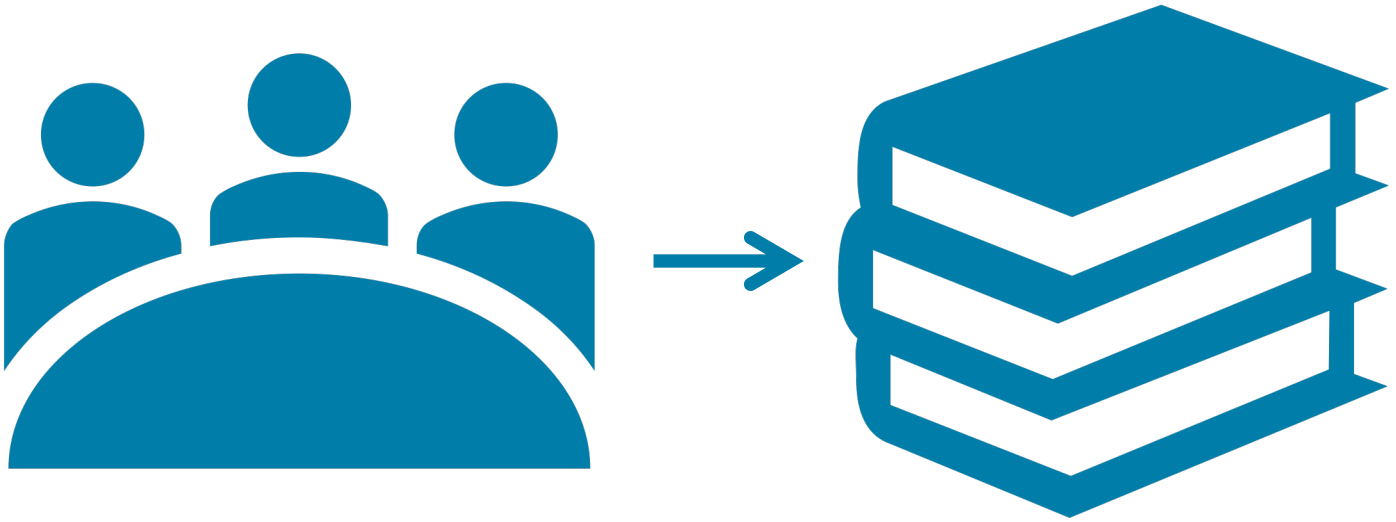
MEDICAL TEACHER
2020, AHEAD-OF-PRINT, 1-8
https://doi.org/10.1080/0142159X.2020.1842343

Taylor & Francis
Taylor & Francis Group

Consensus statement on the content of clinical reasoning curricula in undergraduate medical education

Nicola Cooper, Maggie Bartlett, Simon Gay, Anna Hammond, Mark Lillicrap, Joanna Matthan, Mini Singh, and On behalf of the UK Clinical Reasoning in Medical Education (CReME) consensus statement group

www.creme.org.uk



nominal group technique

literature review

Consensus statement

Five domains (areas) of clinical reasoning education:

1. Clinical reasoning concepts
2. History and physical examination
3. Choosing and interpreting diagnostic tests
4. Problem identification and management
5. Shared decision making

Consensus statement on the content of clinical reasoning curricula un undergraduate medical education. UK Clinical Reasoning in Medical Education group. Medical Teacher; 2020: https://doi.org/10.1080/0142159X.2020.1842343

Consensus statement

Six evidence-based teaching strategies:

1. Strategies that build understanding
2. Strategies that employ structured reflection
3. Practice with cases and corrective feedback
4. Strategies that structure knowledge around problem-specific concepts
5. Strategies that employ retrieval practice
6. Strategies that differ according to stage of learning

Consensus statement on the content of clinical reasoning curricula un undergraduate medical education. UK Clinical Reasoning in Medical Education group. Medical Teacher; 2020: https://doi.org/10.1080/0142159X.2020.1842343

Key concepts

Knowledge

Knowledge organisation

Deliberate practice

What do we mean by 'knowledge'?

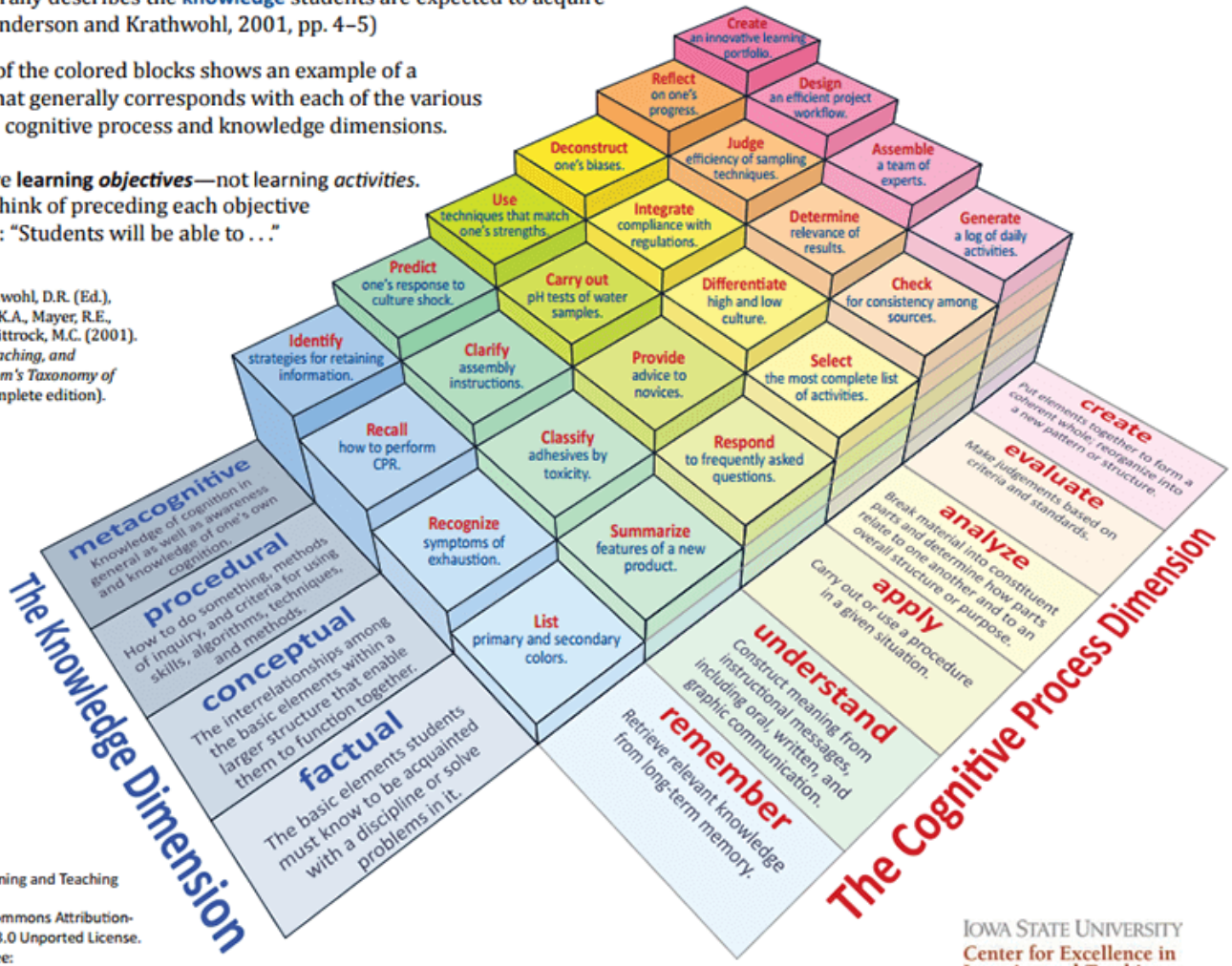
A statement of a **learning objective** contains a **verb** (an action) and an **object** (usually a noun).

- The **verb** generally refers to [actions associated with] the intended **cognitive process**.
- The **object** generally describes the **knowledge** students are expected to acquire or construct. (Anderson and Krathwohl, 2001, pp. 4–5)

In this model, each of the colored blocks shows an example of a learning objective that generally corresponds with each of the various combinations of the cognitive process and knowledge dimensions.

Remember: these are **learning *objectives***—not learning *activities*. It may be useful to think of preceding each objective with something like: "Students will be able to . . ."

*Anderson, L.W. (Ed.), Krathwohl, D.R. (Ed.), Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., & Wittrock, M.C. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of Educational Objectives* (Complete edition). New York: Longman.

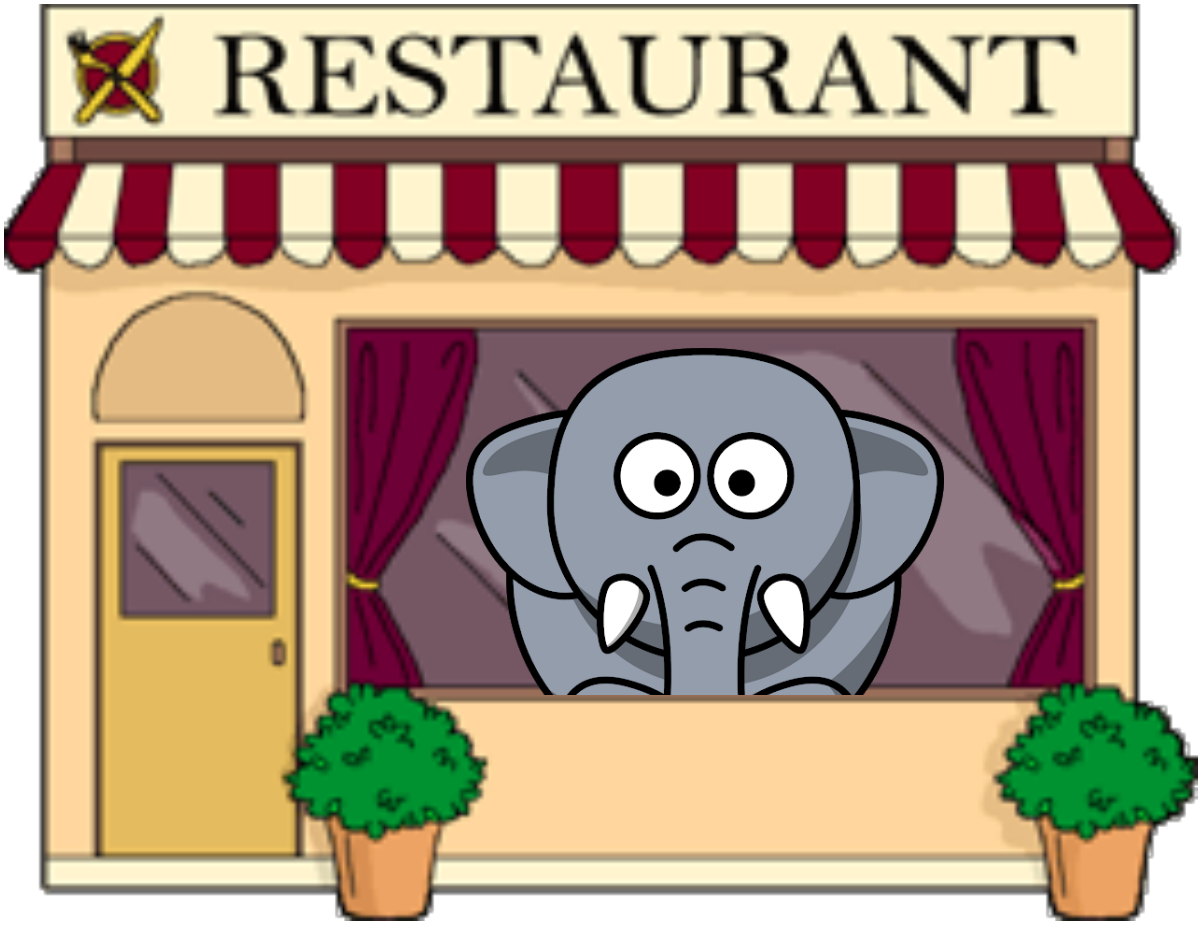


Model created by: Rex Heer
Iowa State University
Center for Excellence in Learning and Teaching
Updated January, 2012

For additional resources, see:
www.celt.iastate.edu/teaching/RevisedBlooms1.html

IOWA STATE UNIVERSITY
Center for Excellence in Learning and Teaching

Knowledge organisation



Lubarsky S et al. (2015). Using script theory to cultivate illness script formation and clinical reasoning in health professions education. Can Med Educ J; 6(2): e61-e70.

Knowledge organisation

Adv in Health Sci Educ (2009) 14:677–684
DOI 10.1007/s10459-008-9149-8

Qualitative differences in knowledge structure are associated with diagnostic performance in medical students

Sylvain Coderre · Deirdre Jenkins · Kevin Mclaughlin

Coderre S, Jenkins D & McLaughlin K. (2009). Qualitative differences in knowledge structure are associated with diagnostic performance in medical students. Adv in Health Sci Educ; 14: 677-684

Deliberate practice

- Tasks that stretch
- Repeated practice
- With coaching and feedback
- **Self-regulation** on the part of the learner

'This type of learning is not possible without the students' full cooperation and active participation in the learning process. Students need to plan, evaluate their actual and intended performance, reflect and reason in order to make appropriate adjustments to their complex skills.'

Ericsson KA. (2004). Deliberate practice and the acquisition and maintenance of expert performance in medicine and related domains. Acad Med; 79 (10): S70-S81.

Sandars J & Cleary TJ. (2011). Self-regulation theory; applications to medical education. AMEE Guide no 58. Medical Teacher; 33(11): 875-886.

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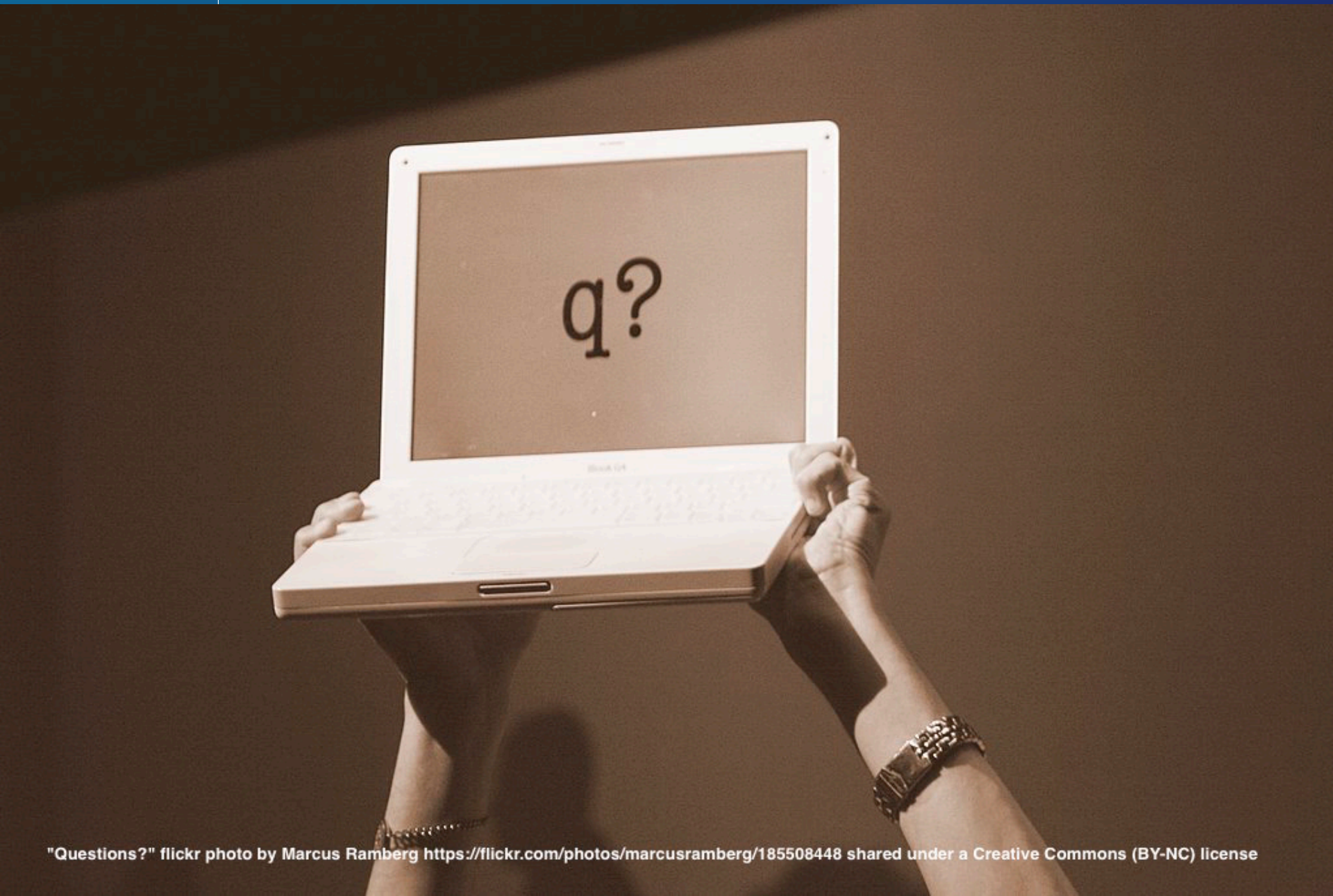

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Clinical reasoning concepts

Teachers and learners need a shared vocabulary and understanding in order to have meaningful discussions:

- Why clinical reasoning matters
- Script theory / script-based teaching
- Deliberate practice theory
- Dual process theory
- Problem representation and use of language
- Cognitive errors
- Factors that impair the reasoning process

Increasing emphasis at different stages of training

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History and physical examination

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Presenting signs

Patients without meningitis	Patients with meningitis
• Temperature >38°C (52%)	• Temperature >38°C (43%)
• Neck stiffness (32%)	• Neck stiffness (30%)
• Kernig's sign (5%)	• Kernig's sign (5%)
• Brudzinski's sign (5%)	• Brudzinski's sign (5%)
• GCS <13 (7%)	• GCS <13 (10%)
• Mean wbc in CSF 1	• Mean wbc in CSF 359

Thomas KE et al. (2002). The diagnostic accuracy of Kernig's sign, Brudzinski's sign, and nuchal rigidity in adults with suspected meningitis. Clinical Infectious Diseases; 35(1): 46-52

Likelihood ratios: diagnostic weights

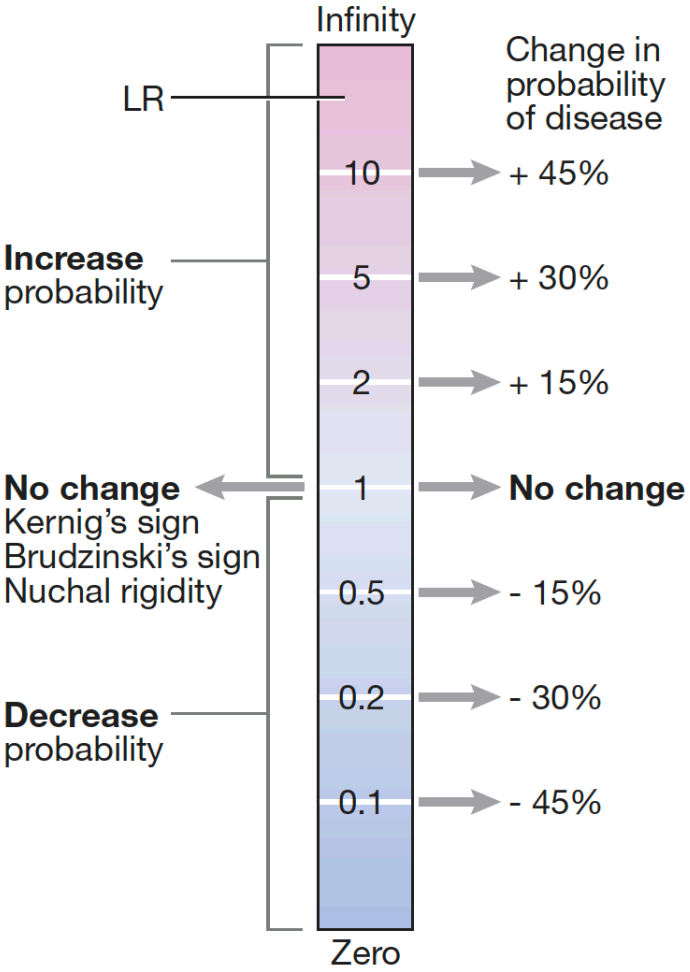

Fig. 1.2 Likelihood ratio (LR) of Kernig's sign, Brudzinski's sign and nuchal rigidity in the clinical diagnosis of meningitis.

$$LR = \frac{\text{probability of finding in patients } \textbf{with} \text{ disease}}{\text{probability of finding in patients } \textbf{without} \text{ disease}}$$

‘Evidence-based’ history and physical examination

Textbooks, and our teaching, need to move from prototypal features of common diseases (novices) to explaining the probability of features in certain diseases appropriate to local context (advanced learners).

‘Simply teaching medical triads may encourage superficial pattern recognition that results in overconfidence and premature closure’

Manzoor F & Redelmeier DA. (2019). The perils of teaching medical triads. Medical Education; 53: 110-112

‘Evidence-based’ history and physical examination

The reason why ‘evidence-based’ history and physical examination is so vital in clinical decision-making is because:

- 76% of diagnosis is history alone (epidemiology + individual’s symptoms)
- Physical examination* adds another 12%
- These combine to give the **pre-test probability**
- Pre-test probability is essential in choosing and interpreting diagnostic tests (as well as diagnosis)

Peterson MC et al. (1992). Contributions of the history, physical examination, and laboratory investigation in making medical diagnoses. West J Med;156:163–165.

Interpreting diagnostic tests

BMJ Open

How well do health professionals interpret diagnostic information? A systematic review

2015

Penny F Whiting,[1,2] Clare Davenport,[3] Catherine Jameson,[1] Margaret Burke,[1] Jonathan A C Sterne,[1] Chris Hyde,[4] Yoav Ben-Shlomo[1]

Conclusions: ‘Commonly used measures of test accuracy are poorly understood by health professionals.’

Problem representation

A 18-year-old man presented to his GP Surgery and was seen by a final year medical student

The student presented the clinical findings to her supervisor

The patient had a 48 hour history of feeling feverish, being off his food, he had vomited once, and complained of central abdominal pain. He had not opened his bowels for 2 days

On examination, he was tender in his right iliac fossa

When asked about her differential diagnosis, the student said ‘constipation’.

Problem representation

"18-year-old man with a 48-hour history of fever, anorexia and right iliac fossa tenderness"

Diagnosis ???

Problem representation

- Converting the history and physical examination (and sometimes test results) in to a precise medical summary – **encapsulation using semantic qualifiers** – helps to organise and retrieve knowledge from long term memory relevant to the case
- The main difference between ‘strong’ as opposed to ‘weak’ diagnosticians is in their use of semantic associations to organise their knowledge
- This elaborated structure is associated with accurate resolution of complex problems (75-80%) as opposed to near zero resolution for ‘dispersed discourses’

Bordage G. (1994). Elaborated knowledge: a key to successful diagnostic thinking. Academic Medicine; 69(11); 883-885

What does ‘shared decision making’ mean?

- Patients and carers
- Clinical teams
- Guidelines, scores and decision-aids
- Evidence-based medicine applied to the patient’s circumstances
- Professional values and behaviours that support optimal decision-making (listening, asking for help, clear communication)

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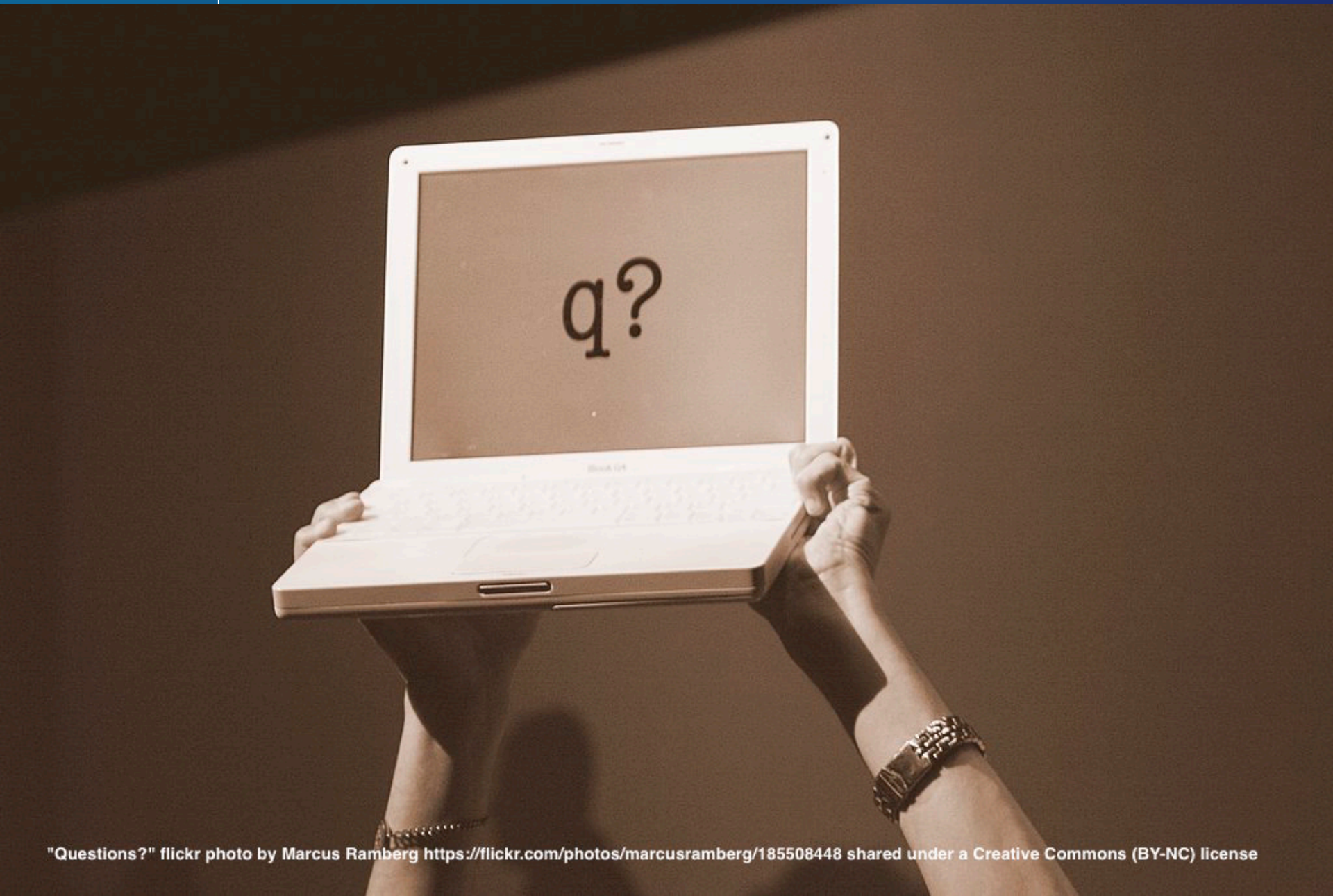

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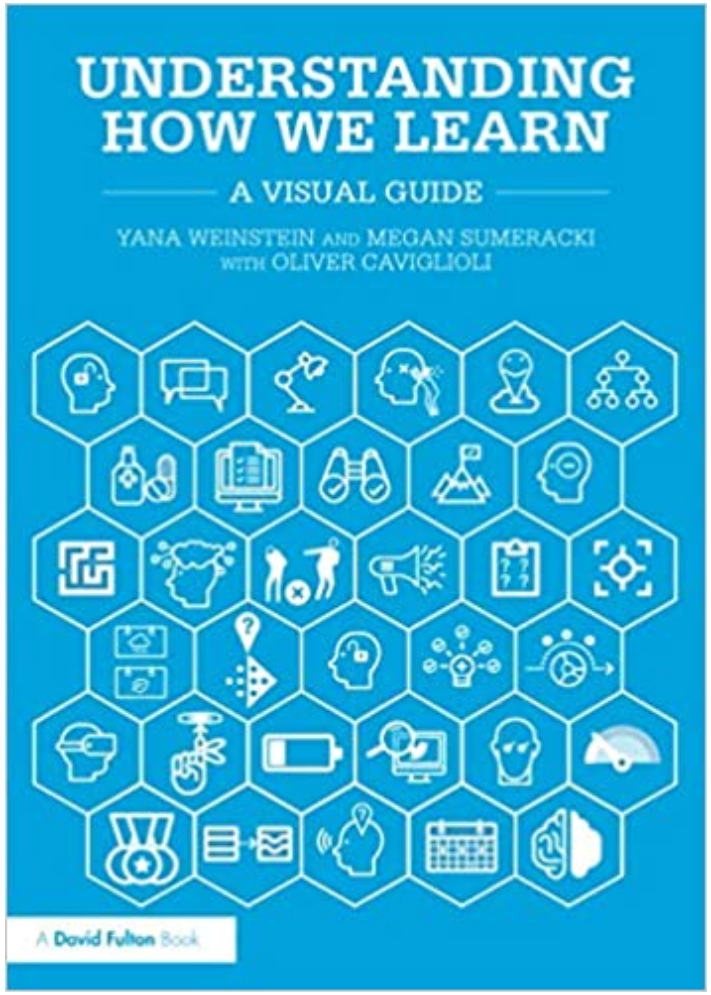


www.learningscientists.org

Strategies that build understanding

(Meaningful information is easier to retain and recall)

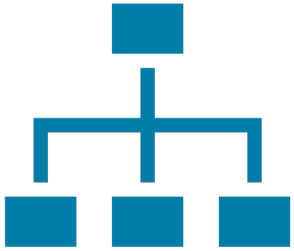
- Self-explanation
- Elaboration
- Explaining abstract concepts with concrete examples
- Understanding basic science mechanisms

Strategies that employ structured reflection

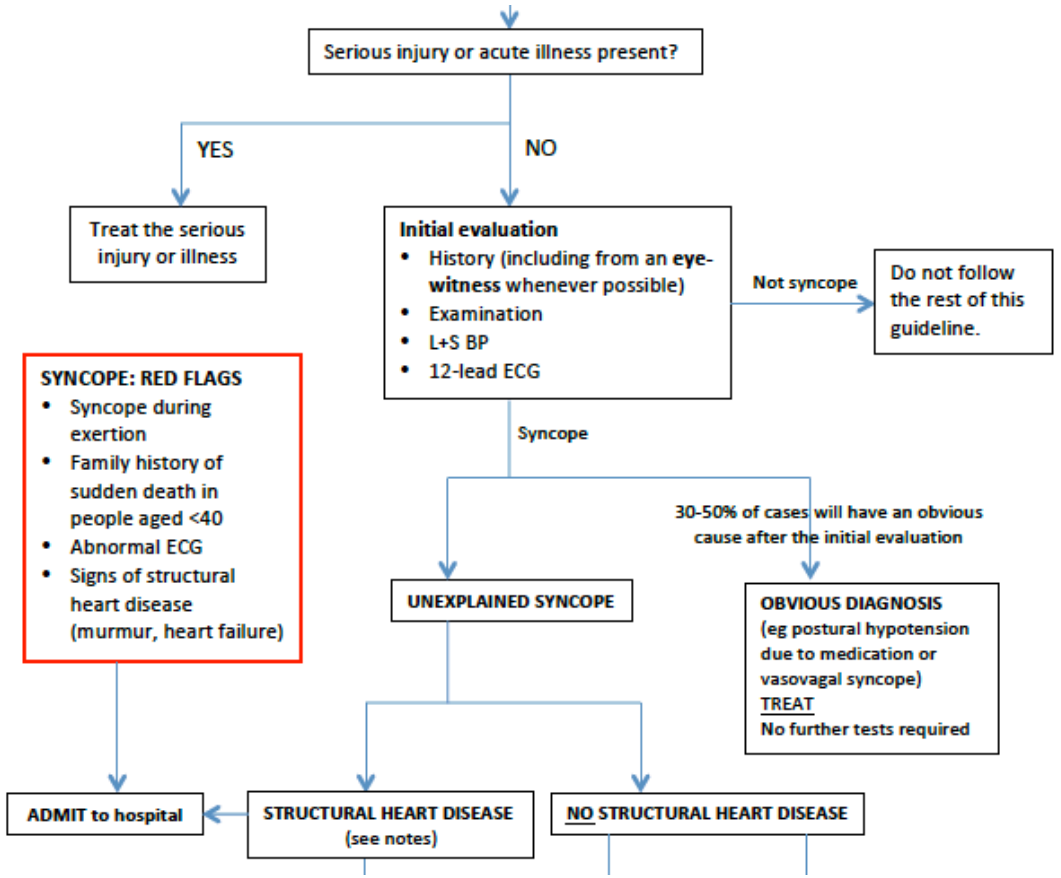
- Listing findings you would expect to find in one diagnosis compared with another that presents in a similar way (‘contrastive learning’)
- What is the evidence for this? What else could it be?

Practice with cases and corrective feedback

- As many different cases as possible in as many different contexts as possible
- Effort, coaching and corrective feedback are necessary
- Mistakes = learning
- Whole case approach for novices

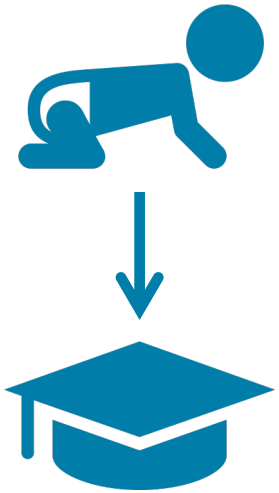


Structuring knowledge around problem-specific concepts



Strategies that employ retrieval practice

- Solving/explaining/recalling a topic before being told the answer
- Low stakes quizzing
- Structured reflection
- Contrastive learning



Strategies that differ according to stage of learning

- Cognitive load
- High support in low complexity, low fidelity tasks
  to
- Low support in high complexity, high fidelity tasks

Van MerrienboerJJ, SwellerJ. 2010. Cognitive load theory in health professional education: design principles and strategies. Med Educ. 44(1):85–93.

“But we don’t have time!”

‘While all medical schools teach knowledge, skills and behaviours, there is good evidence that careful attention to what is taught, how it is taught, and when it is taught can facilitate clinical reasoning development more effectively, through purposeful curriculum design.

This does not necessarily require additional teaching time. Instead, a specific approach to teaching is envisaged and recommended, and this is likely to require a programme of faculty development.’

The challenge for teachers

The Sutton Report: What makes great teaching?

The two factors with the strongest evidence of improving student attainment are:

- Teachers' **content knowledge**, including their ability to understand how students think about a subject and identify common misconceptions
- The **quality of instruction**, which includes the use of effective strategies

The Sutton Trust. (2014). What makes great teaching? Review of the underpinning research. https://www.suttontrust.com/our-research/great-teaching

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