CLINICAL REASONING: A SPECIAL CASE OF SCIENTIFIC REASONING AND ARGUMENTATION?

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There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know.

But there are also unknown unknowns. There are things we don't know we don't know.

Donald Rumsfeld

quoted in *Make it stick – The Science of Successful Learning, Brown, Roediger III & McDaniel, Belknap Harvard 2014*

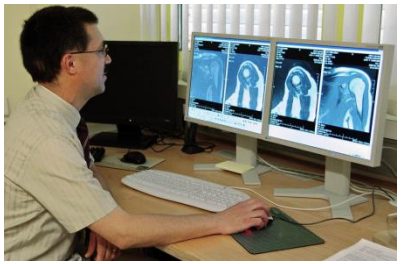
Clinical Reasoning
Clinical Cognition
Diagnostic Reasoning
Clinical Problem Solving
Medical Problem Solving
Clinical Decision Making
...

The thinking and/or decision-making processes that are used in clinical practice

(Higgs and Jones 2000, Edwards et al 2004)


Dräger
127
133/73

Clinical Reasoning – Context Dependence?



individual

certain

fast

slow

uncertain

group

Kiesewetter & Fischer 2014

Mental Processes in Clinical Reasoning: Permanent „dual processing“ of analytical and non-analytica thinking (Systems 1 and 2)

System 1: non-analytical	System 2: analytical
fast, impulsive, unconscious match to prior examples stored in memory (pattern recognition) → Influenced by the representativeness of the new problem and the availability of prior similar cases	slow, logical, conceptual, amounting to the logical application of „rules“ (hypothetical-deductive) → Heavy load on working memory, which has real limitations in speed and size

Eva K Med Edu 2005, Norman G Med Edu 2007, Norman G Med Edu 2010

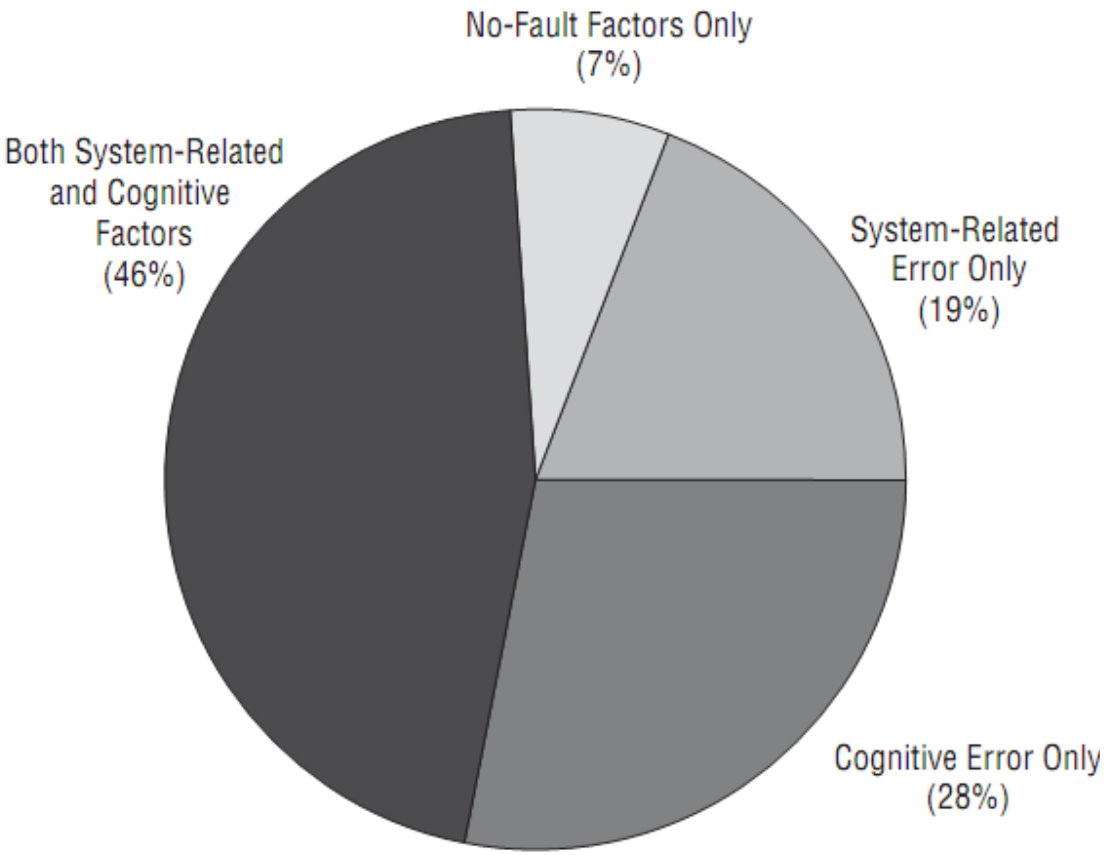
The frequency of diagnostic errors in outpatient care: estimations from three large observational studies involving US adult populations

Hardeep Singh,[1] Ashley N D Meyer,[1] Eric J Thomas[2]

Estimate of Diagnotic errors for Adult Outpatients in the US:
About 5%
or 12 Millons Adults per Year!

Singh H, et al. BMJ Qual Saf 2014

Diagnostic Errors in Internal Medicine:



Graber ML Arch Int Med 2005

228 system related factors

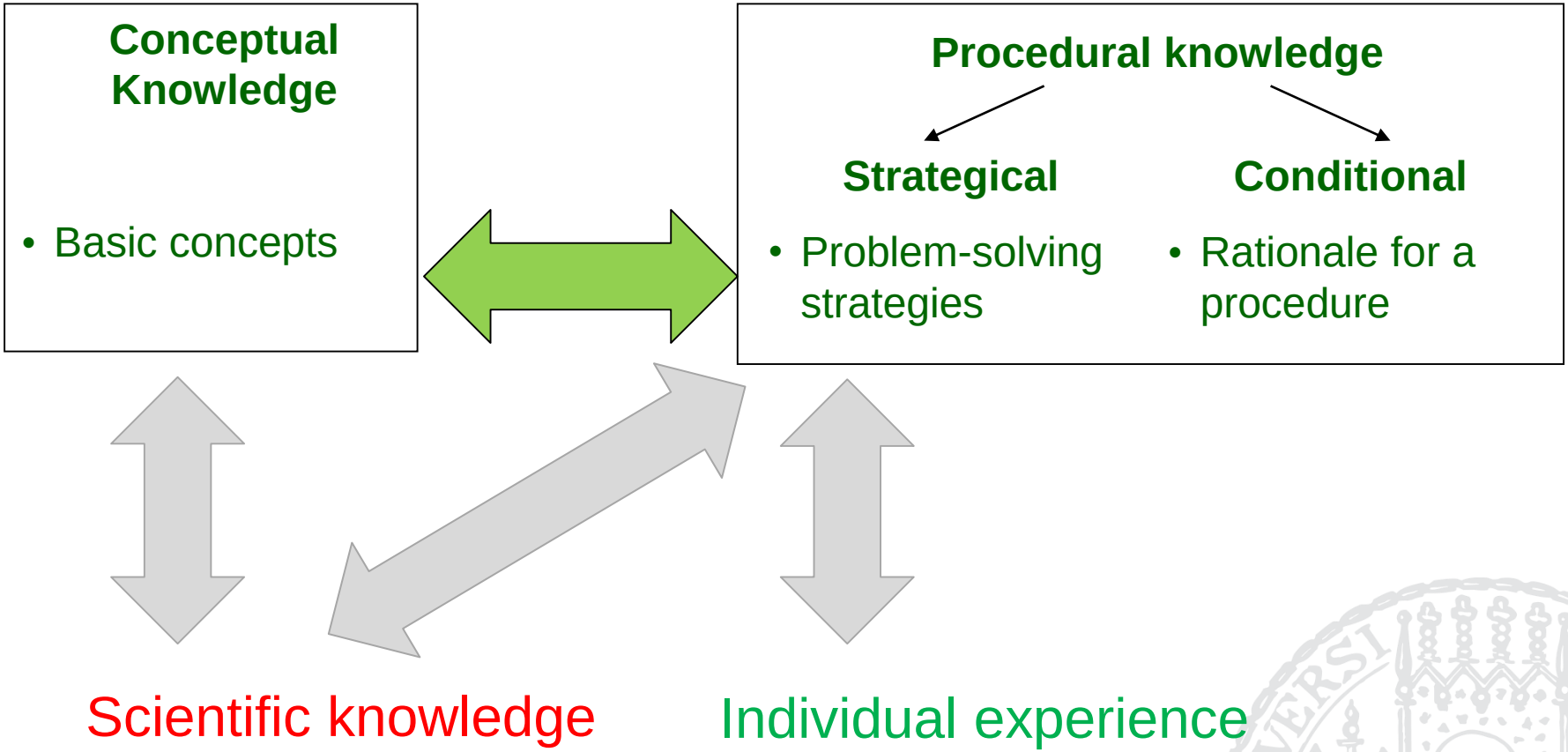
technical failure, equipment problems, teamwork, supervision, management, coordination of care, expertise unavailable, policy/procedures, …

320 cognitive factors

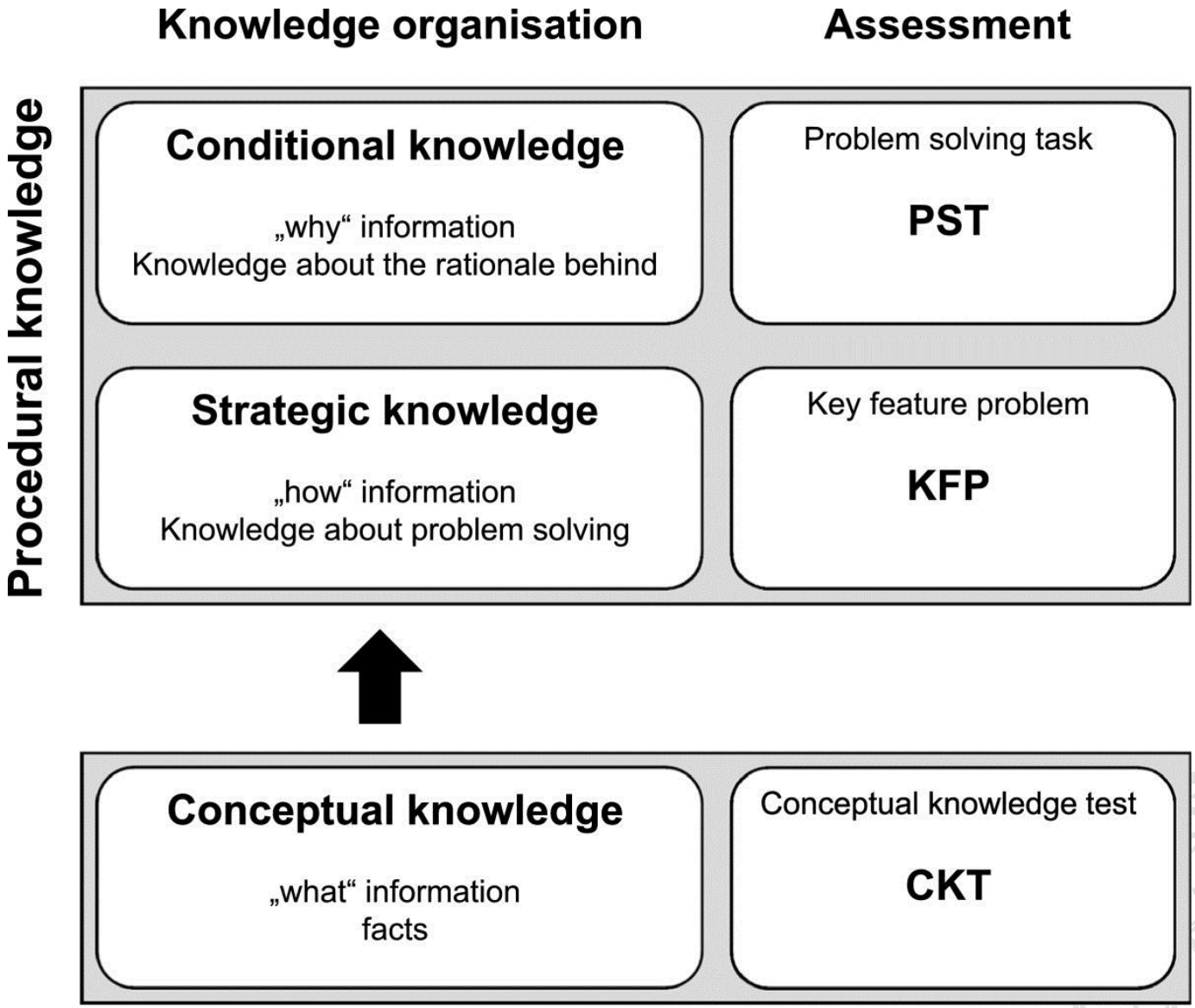
11	faulty knowledge
45	faulty data gathering
159	faulty information processing
106	faulty verification
39	premature closure (most frequent cognitive error)

How could we better understand and operationalize diagnostic competence to design educational interventions and ultimately reduce errors?

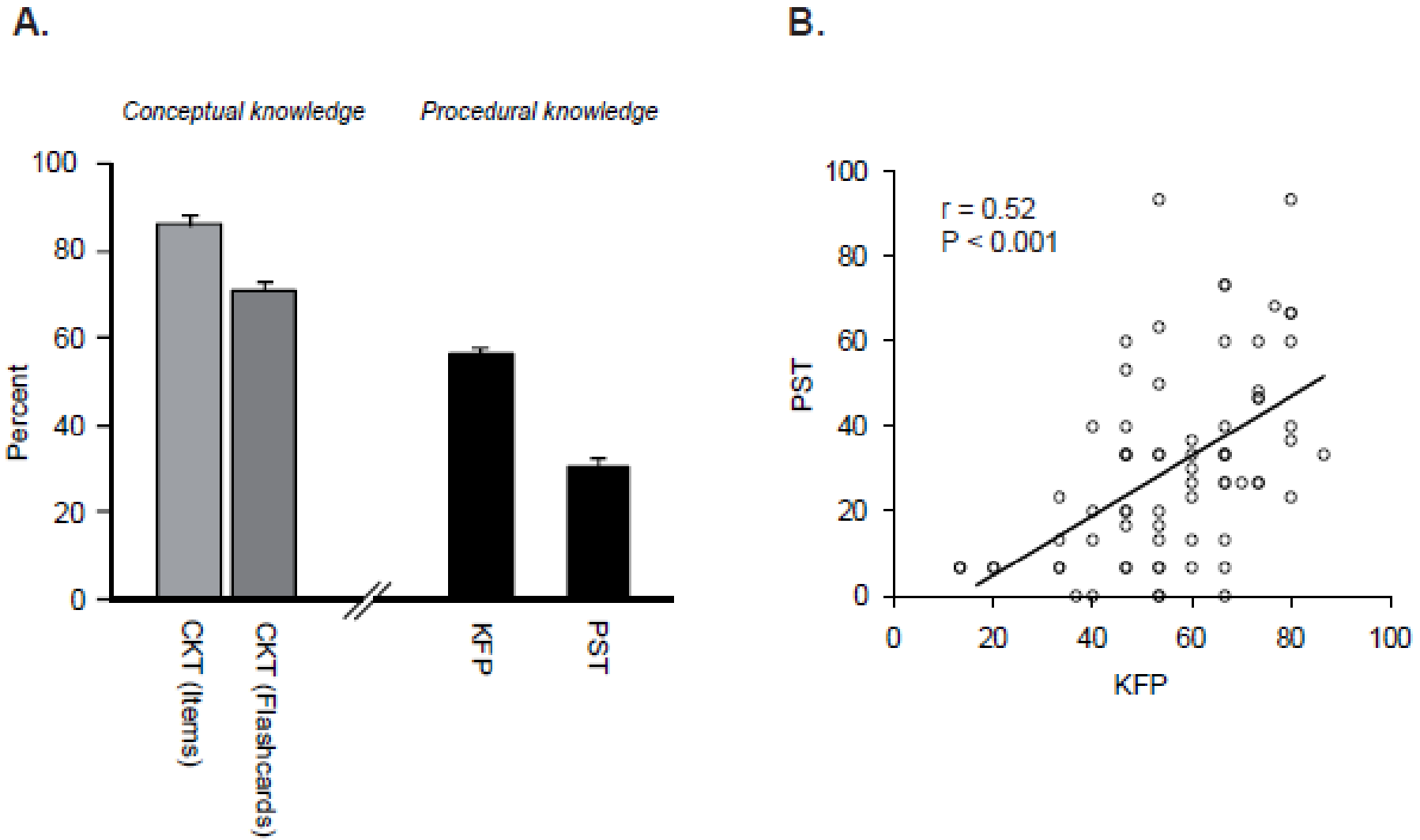
Operationalizing Diagnostic Competence



(Paris, Lipson, & Wixson, 1983; van Gog, Paas, & van Merrienboer, 2004) (Stark, Kopp, & Fischer M., 2011)



Schmidmaier et al. BMC Med Edu 2013



Schmidmaier et al. BMC Med Edu 2013

CASUS® ?Hilfe ×Beenden

Experte | Clipboard | ← Zurück | → Weiter | Karte 1 von 222 | Patientenvorstellung

Frau Monika Bittler, eine 28-jährige Krankenschwester, kommt zum ersten Mal in Ihre allgemeinmedizinische Praxis.

Sie berichtet: "Vor etwa 6 Wochen habe ich mich wahrscheinlich bei einem Patienten mit Grippe angesteckt und lag eine Woche mit Fieber, Gliederschmerzen und Schüttelfrost im Bett. Danach ging es mir zwar wieder besser, aber ich bin weiterhin etwas müde und fühle mich abgeschlagen. Vor einer Woche sind starke rechtsseitige Halsschmerzen, die bis in den Kiefer hochziehen, hinzugekommen. Gestern habe ich dann Fieber gemessen und hatte 37,8°C."

Die Patientin berichtet auf Ihre Frage hin, dass sie in den letzten drei Wochen etwa 4 kg Gewicht abgenommen habe, obwohl sie nicht weniger als sonst esse. Außerdem sei sie innerlich unruhig und schlafe schlecht. Sie habe diese Symptome auf die Nachwirkungen der Grippe geschoben.

Es sind keine relevanten Vorerkrankungen bekannt. Frau Bittler nimmt außer der Pille keine regelmäßigen Medikamente ein, sie raucht nicht, nimmt keine Drogen und trinkt keinen Alkohol.

i | Bild 1 von 1 | ← | →

Online Learning Environment: Case Example

CASUS ? Hilfe × Beenden

Experte | Clipboard | ← Zurück | → Weiter | Karte 1 von 223 | Erklärung

Sie denken an alle wahrscheinlichen Differentialdiagnosen.

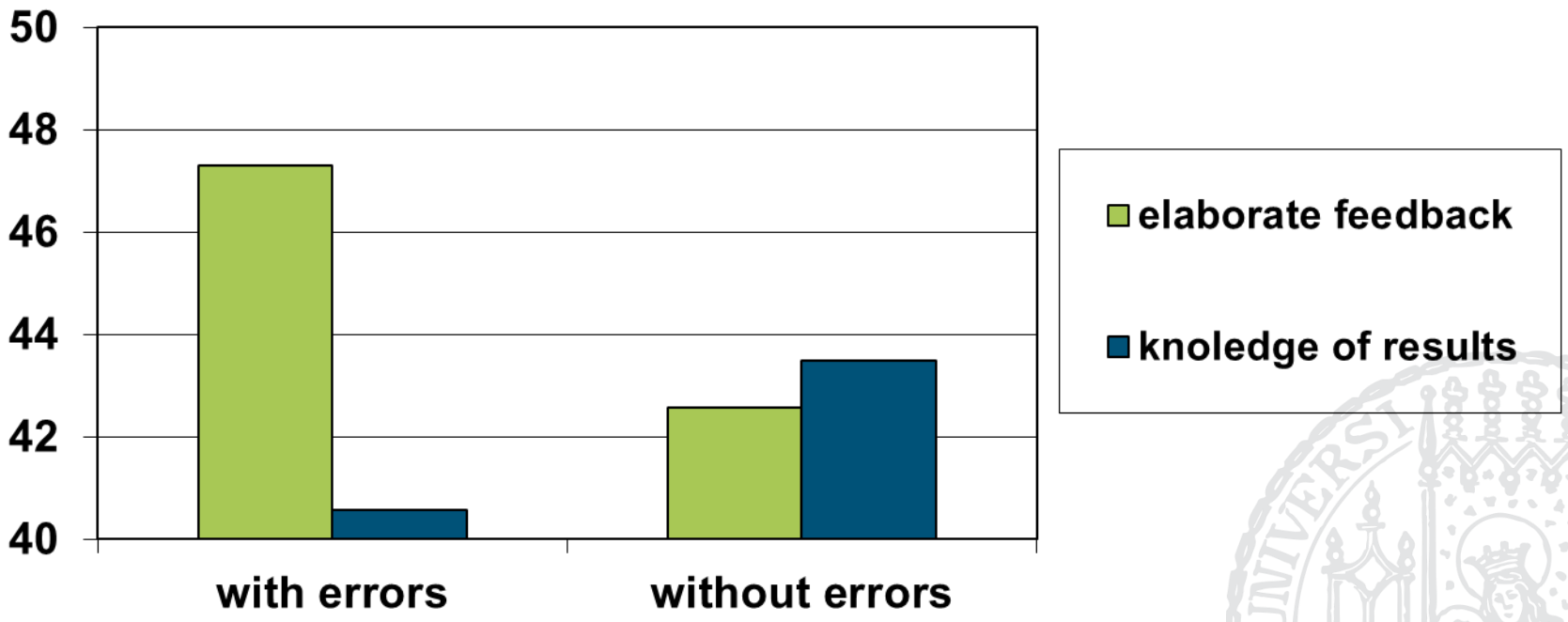
Die Symptome innere Unruhe und Gewichtsabnahme sind typische vegetative Symptome für eine Schilddrüsenüberfunktion, für die zusätzlich das Alter und das Geschlecht der Patientin sprechen. Schmerzhafte sog. subakute Thyreoiditiden de Quervain treten gehäuft nach viralen Infekten auf und können schmerzhaft sein. Deshalb sollte bei dieser Kombination von Symptomen auch an diese Schilddrüsenerkrankung gedacht werden. Patienten mit einer Schilddrüsenüberfunktion können auch eine verminderte Leistungsfähigkeit entwickeln.
Die übrigen von Ihnen genannten Differentialdiagnosen (bakterielle Superinfektion nach Virusinfekt, eine Speicheldrüsenentzündung oder ein dentogenes Geschehen) können zu dem jetzigen Zeitpunkt noch nicht ausgeschlossen werden.

i | Bild 1 von 1 | ← | →

Example without error and elaborate feedback from expert

Fostering diagnostic knowledge through computer-supported, case-based worked examples: effects of erroneous examples and feedback

Veronika Kopp,[1] Robin Stark[2] & Martin R Fischer[1]



OPEN ACCESS Freely a

PLOS ONE

Cognitive … l Students Correlate … utions

Jan Kiesewetter[1]*, … ier[1],
Ralf Schmidmaier[2]

1 Lehrstuhl für Didaktik und … -University, Munich, Germany,
2 Medizinische Klinik und Polik

Standardized introduction of participants (N=23), questionnaire

↓

Content specific **knowledge training and test**: factual knowledge learning phase and assessment of knowledge acquisition (nephrourogential system)

↓

Each participant working on three clinical case scenarios:
Think-aloud method

↓

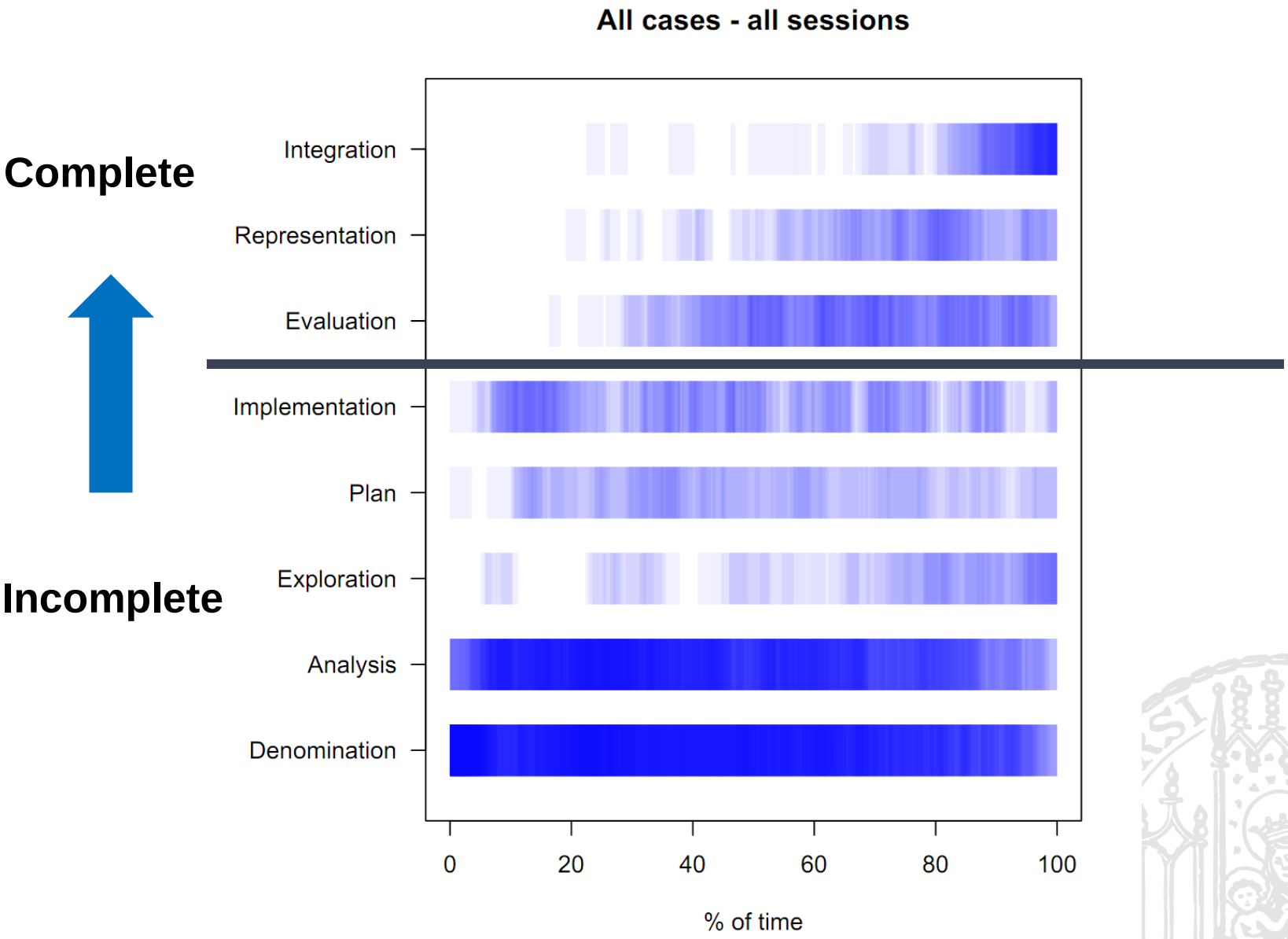
Coding of cognitive actions: time-based coding of the transcribed cases according to the „modified Schoenfeld model for complex problem solving"

Kiesewetter et al. PLOSone 2013

Model für complex problem-solving in Medicine
(modified from Schoenfeld)

Cognitive Action	Operationalised definition
Denomination	Retrieve information; read
Analysis	Analyse information; generate differential diagnostic ideas
Exploration	Associate, compare, vaguely propose strategies how to understand the problem
Plan	Generate plans, weigh up these plans against each other, decide on a plan
Implementation	State and justify one definite plan; request certain additional information and/or examinations
Evaluation	Verify or dismiss hypotheses with regard to new information or examination results; evaluative thinking
Representation	Inner representation of the case; statement of the situation as far as it is summarized in the mind of the student
Integration	Decision for one working diagnosis, differential diagnoses and/or therapy

Kiesewetter et al. PLOSone 2013

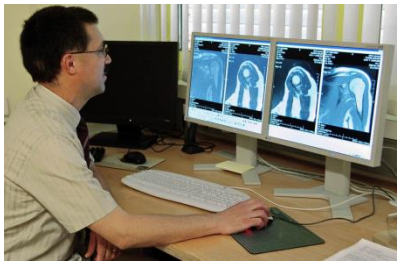


Kiesewetter et al. PLOSone 2013

	Incorrect solution	Correct solution	
Incomplete model	26/29; 90%	3/29; 10%	**29 cases; 44%**
Complete model	13/37; 35%	**24/37; 65%**	**37 cases; 56%**
	39/66; 59%	**27/66; 41%**	

Kiesewetter et al. PLOSone 2013

Clinical Reasoning – a Special Case of Scientific Reasoning and Argumentation?



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„**Scienfic reasoning** (…) includes the thinking and reasoning skills involved in inquiry, experimentation, evidence evaluation, inference, and argumentation that supports the formation and modification of concepts and theories about the natural and social world.“

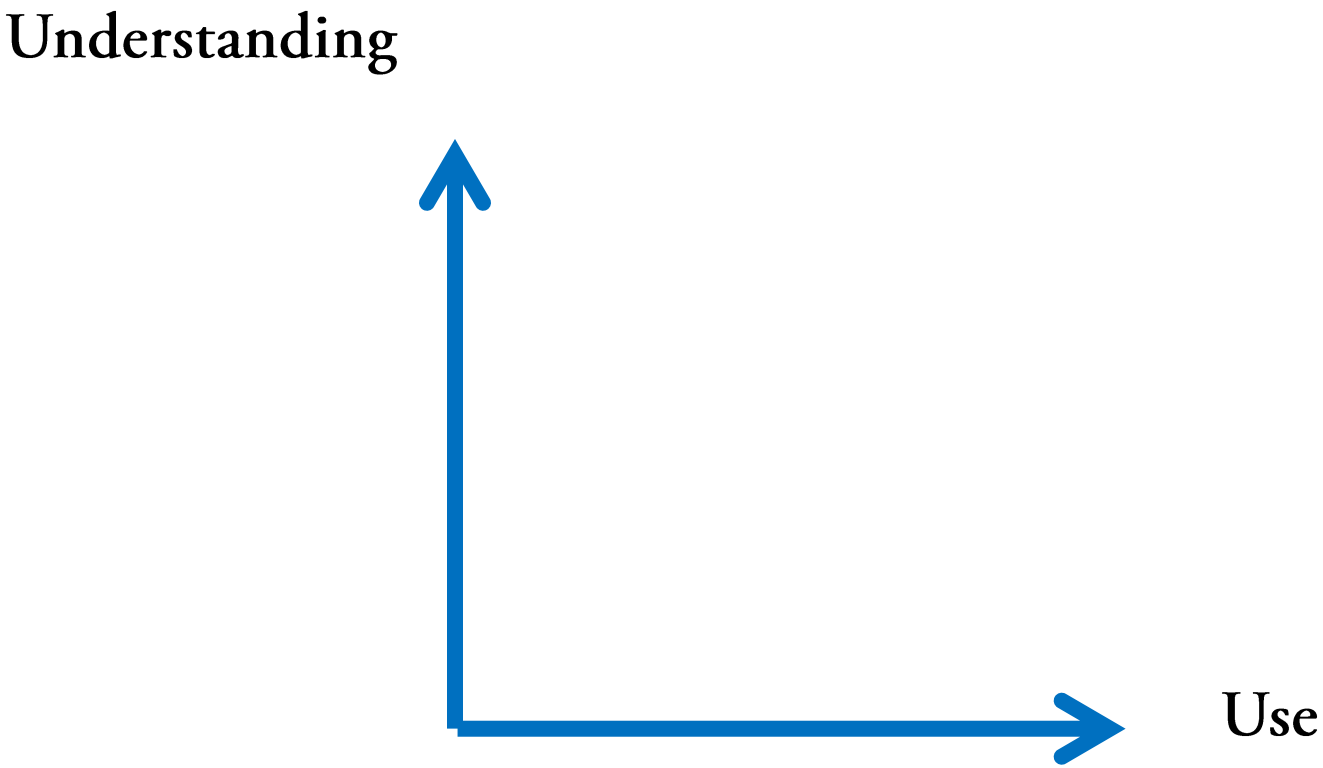
Bao et al., 2009, *Science*

One-dimensional Model

Understanding

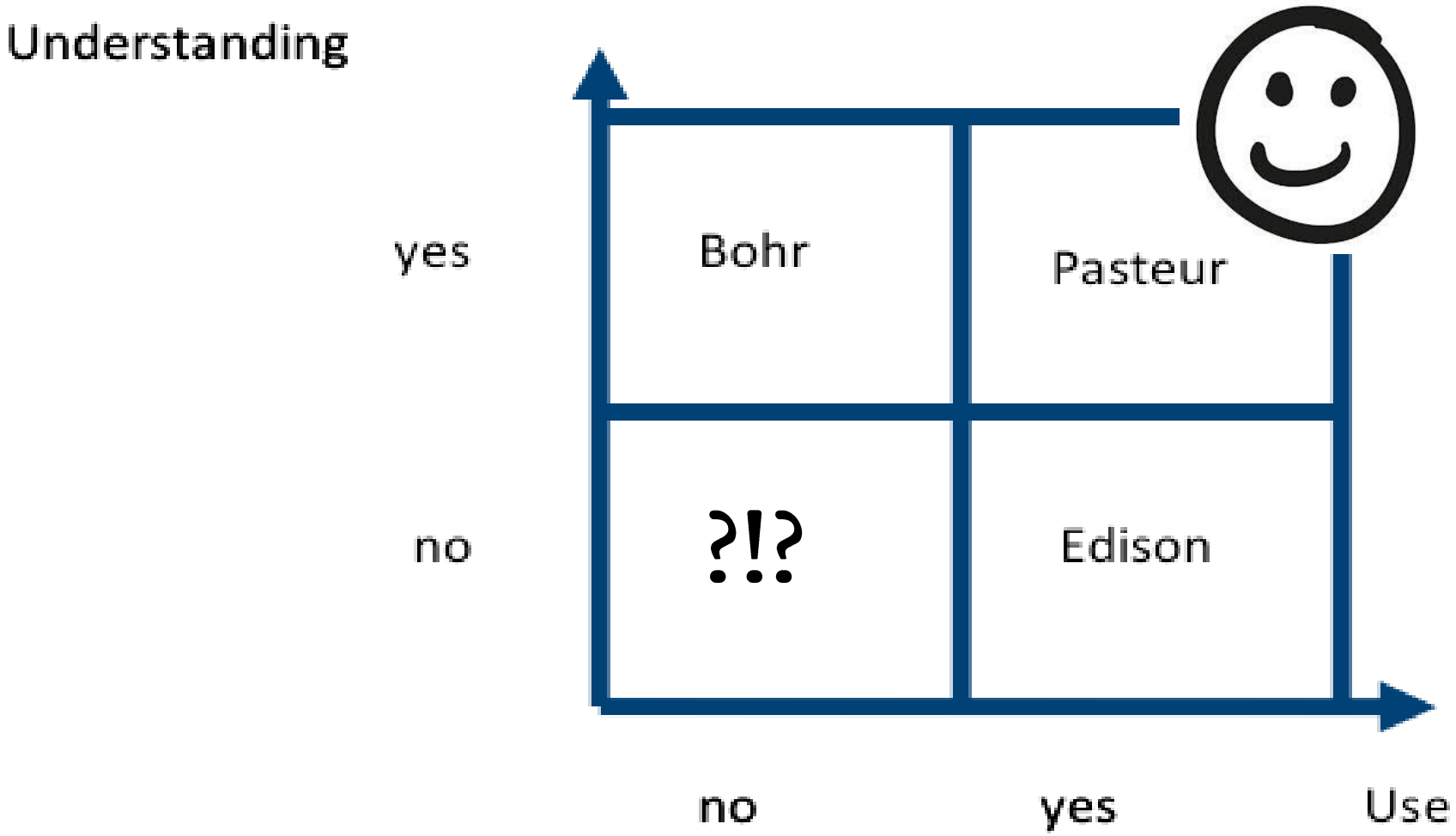
Use

Two-dimensional Model



Donald E. Stokes, Pasteur's Quadrant – Basic Science and Technological Innovation, Brookings Institution Press, 1997

Two-dimensional Model: Four Quadrants



Donald E. Stokes, Pasteur's Quadrant – Basic Science and Technological Innovation, Brookings Institution Press, 1997

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Scientific Reasoning and Argumentation: Advancing an Interdisciplinary Research Agenda in Education

Frank Fischer[a], Ingo Kollar[a], Stefan Ufer[b], Beate Sodian[a], Heinrich Hussmann[c], Reinhard Pekrun[a], Birgit Neuhaus[d], Birgit Dorner[e], Sabine Pankofer[e], Martin Fischer[f], Jan-Willem Strijbos[a], Moritz Heene[a] & Julia Eberle[a,d]

Epistemic activities for reasoning

1. Problem Identification
2. Questioning
3. Hypothesis generation
4. Construction of artefacts
5. Evidence generation
6. Evidence evaluation
7. Drawing conlcusions
8. Communcation/Scrutinizing

Advancing theory-building about natural phenom
(Bohr's
of basic research)

Artefact-centered scientific Reasoning
(Pasteur's
of use-insp
basic research)

Science-based reasoning in practice
(Edison's quadrant of applied research)

individual

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slow

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uncertain

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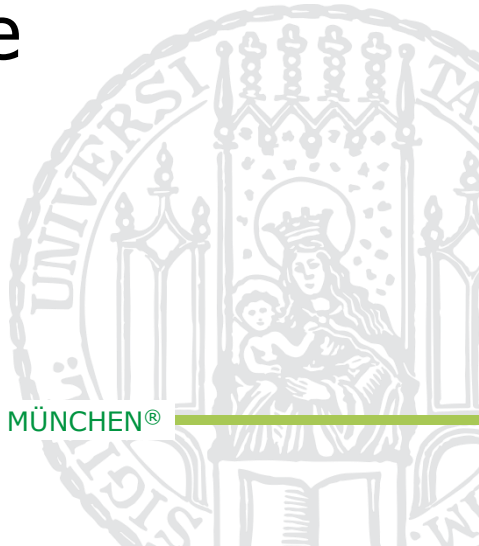
Summary (1)

- Clinical reasoning is multi-contextual and multifacetted
- Diagnostic competence is a relevant part and measurable contruct of clinical reasoning
- Erroneous case examples and elaborate feedback have potential to improve diagnostic competence



Summary (2)

- The cognitive part of clinical reasoning is a form of problem-solving
- The completeness of a problem-solving process predicts diagnostic accuracy
- Clinical reasoning may ideally be an example of science-based reasoning in practice (Edison's quadrant of applied research)

Many thanks for your attention!

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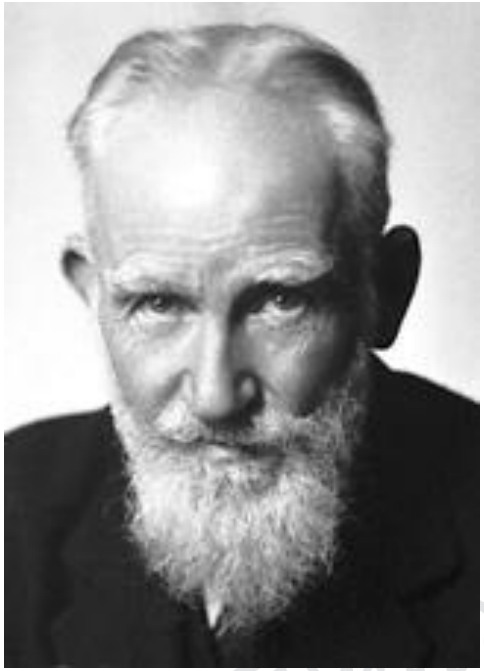
Those who can´t do teach.

Those who can´t teach teach how to teach.

Those who can´t teach how to teach do research on teaching.



adapted from Bernhard Shaw
The doctor's Dilemma 1906