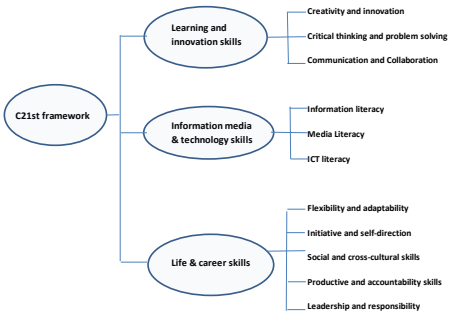
SCIENCE OF LEARNING RESEARCH CENTRE

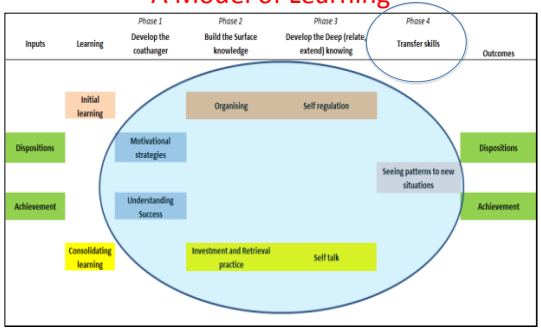
Can we teach strategies for learning"
What evidence does the Science of Learning provide?

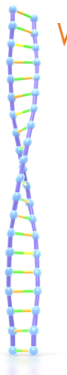


The search for strategies = 400+

Brain Gym	Mindfulness
Collaborative problem solving	Mnemonics
Comprehension Monitoring	Monitoring
Concept Mapping	Note taking
Critical thinking techniques	Planning
Discussion groups	Practice / Rehearsal
Distributed Practice	Practice Testing
Elaborative Interrogation	Re-reading
Environmental structuring	Retrieval cueing
Error monitoring	Selecting Main Idea
Examination skills	Self-monitoring
Help-seeking	Self-questioning
Highlighting/Underlining	Self-regulation
Interleaved Practice	Sleep
Keeping records & monitoring	Summarization
Learning Styles	Think Aloud
Listening & Notetaking	Time Management
Memorisation	Underlining/Highlighting

A Model of Learning





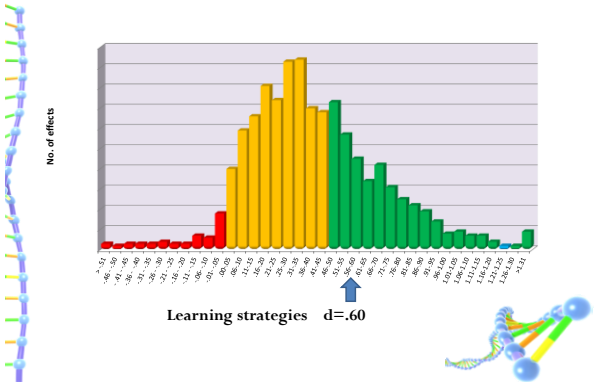
What is learning?

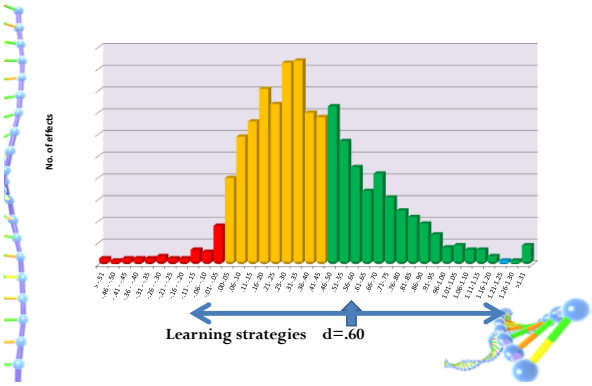
The *process* of developing sufficient surface knowledge to then move to deeper understanding such that one can appropriately transfer this learning to new tasks & situations

The Evidence

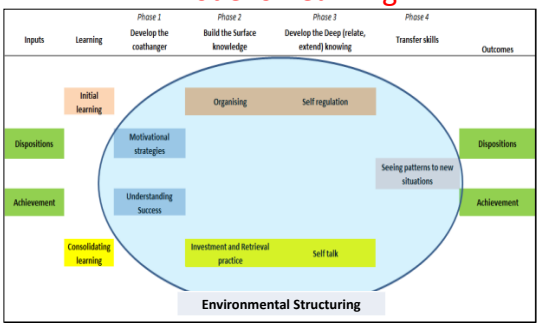
1. Visible Learning
2. Lavery, 2009
3. Dutch team
   - Dignath, Buettner & Langfeldt (2008)
   - Donker, de Boer, Dignath, Kostons &Werf (2013)
4. Dunlosky, Rawson, Marsh, Nathan & Willingham (2013)
5. Hattie, Biggs, & Purdie (1996)
6. Our SLRC meta-analysis

10,000+ studies, 43,157 effects from about 12-16m students





A model of learning



Inputs	Learning	Phase 1 Develop the Coathanger	Phase 2 Build the Surface knowledge	Phase 3 Develop the Deep (relate, extend) knowing	Phase 4 Transfer Skills	Outcomes

Dispositions	No. metas	No. effects	ES
Self-efficacy	**11**	**2678**	**.63**
Task Value	1		.46
Reducing anxiety	8	1305	.45
Attitude to content	4	782	.35
Learning styles	5	943	.23
Growth vs. Fixed thinking	1	113	.19

Inputs	Learning	Phase 1 Develop the Coathanger	Phase 2 Build the Surface knowledge	Phase 3 Develop the Deep (relate, extend) knowing	Phase 4 Transfer Skills	Outcomes

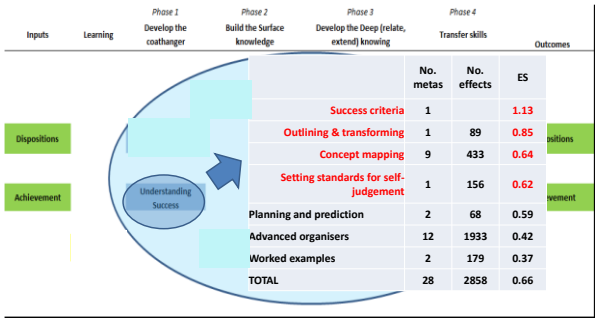
	No. metas	No. effects	ES
Prior Achievement	**9**	**8014**	**.77**

A model of learning

Inputs	Learning	Phase 1 Develop the coathanger	Phase 2 Build the Surface	Phase 3 Develop the Deep (relate,	Phase 4 Transfer skills

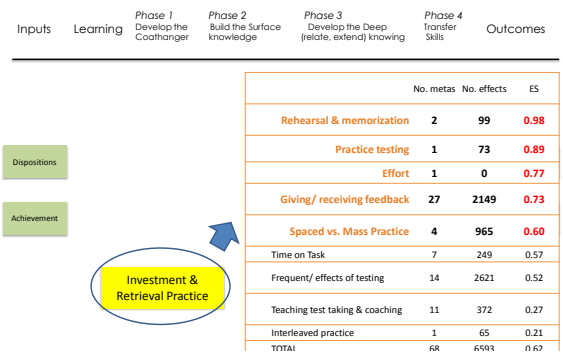
Motivational strategies	No. metas	No. effects	ES
Deep motivation	1	72	0.75
Achieving approach	1	95	0.70
Goal intentions	2	190	0.68
Deep approach	1	38	0.63
Goal difficulty	7	526	0.60
Goals (Mastery, performance, social)	**11**	**3531**	**0.48**
Commitment to Goals	2	104	0.41
Mastery goals (general)	3	163	0.19
Achieving motivation	1	18	0.18
Surface approach	2	344	0.11
Surface motivation	2	58	-0.38
TOTAL	33	5139	0.39

A model of learning

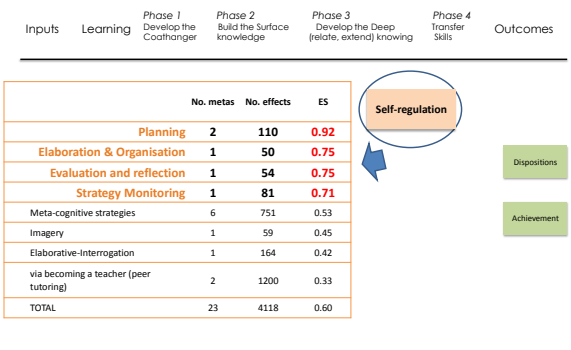


	No. metas	No. effects	ES
Success criteria	1		1.13
Outlining & transforming	1	89	0.85
Concept mapping	9	433	0.64
Setting standards for self-judgement	1	156	0.62
Planning and prediction	2	68	0.59
Advanced organisers	12	1933	0.42
Worked examples	2	179	0.37
TOTAL	28	2858	0.66

	No. metas	No. effects	ES
Strategy to integrate with prior knowledge	1	12	0.93
Summarization	2	207	0.66
Organising	3	32	0.60
Record keeping	2	177	0.54
Underlining & Highlighting	1	44	0.50
Reviewing records	1	84	0.49
Note taking	5	205	0.49
Engagement	5	587	0.48
Mnemonics	3	152	0.48
Memorisation	2	943	0.16
TOTAL	25	2443	0.53

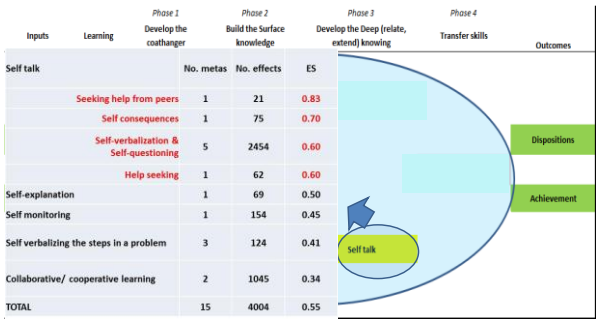


	No. metas	No. effects	ES
Rehearsal & memorization	2	99	0.98
Practice testing	1	73	0.89
Effort	1	0	0.77
Giving/ receiving feedback	27	2149	0.73
Spaced vs. Mass Practice	4	965	0.60
Time on Task	7	249	0.57
Frequent/ effects of testing	14	2621	0.52
Teaching test taking & coaching	11	372	0.27
Interleaved practice	1	65	0.21
TOTAL	68	6593	0.62

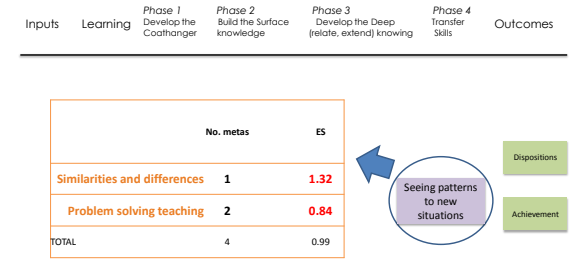


	No. metas	No. effects	ES
Planning	2	110	0.92
Elaboration & Organisation	1	50	0.75
Evaluation and reflection	1	54	0.75
Strategy Monitoring	1	81	0.71
Meta-cognitive strategies	6	751	0.53
Imagery	1	59	0.45
Elaborative-Interrogation	1	164	0.42
via becoming a teacher (peer tutoring)	2	1200	0.33
TOTAL	23	4118	0.60

A model of learning



Self talk	No. metas	No. effects	ES
Seeking help from peers	1	21	0.83
Self consequences	1	75	0.70
Self-verbalization & Self-questioning	5	2454	0.60
Help seeking	1	62	0.60
Self-explanation	1	69	0.50
Self monitoring	1	154	0.45
Self verbalizing the steps in a problem	3	124	0.41
Collaborative/ cooperative learning	2	1045	0.34
TOTAL	15	4004	0.55



	No. metas	ES
Similarities and differences	1	1.32
Problem solving teaching	2	0.84
TOTAL	4	0.99

	No. metas	No. effects	ES
Time Management	1	8	0.44
Environmental structuring	2	10	0.41
Working memory	1	30	0.35
Exercise	7	2325	0.22
Social support	1	33	0.12
Sleep	2	78	0.07
Student control over learning	3	132	0.01
TOTAL	23	2865	0.28

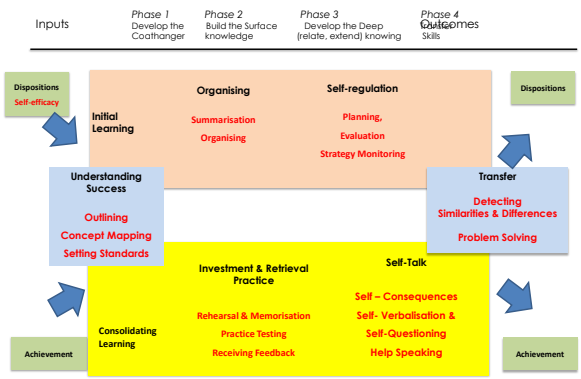
Dispositions

Achievement

Dispositions

Achievement

Environmental Structuring



Deep programs ?????

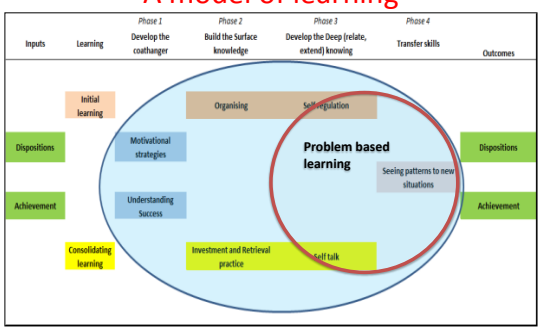
Rank	Influence	Effect-size
91	Inquiry based methods	
143	Individualized instruction	
144	Visual/Audio-visual methods	
168	Problem based learning	
184	Whole language	

Deep programs ?????

Rank	Influence	Effect-size
91	Inquiry based methods	0.31
143	Individualized instruction	0.22
144	Visual/Audio-visual methods	0.22
168	Problem based learning	0.15
184	Whole language	0.06

Problem based Learning	*Year*	*No studies*	*No effects*	*ES*	
Albanese & Mitchell	1993	11	66	0.27	PBL in medicine
Vernon & Blake	1993	8	28	-0.18	PBL in college level
Dochy, Segers, Van den Bossche & Gijbels	2003	43	35	0.12	PBL on knowledge and skills
Smith	2003	82	121	0.31	PBL in medicine
Newman	2004	12	12	-0.30	PBL in medicine
Haas	2005	7	34	0.52	Teaching methods in algebra
Gijbels, Dochy, Van den Bossche & Segers	2005	40	49	0.32	PBL on assessment outcomes
Walker & Leary	2008	82	201	0.13	PBL in all subjects
Walker	2008	82	201	0.13	PBL across disciplines
Schmidt, van der Molen, Te Winkel, & Wijnen	2009	10	90	-0.18	Constructivist problem based learning on medical knowledge
Leary, Walker, Shelton & Fitt	2013	94	213	0.24	PBL
TOTAL		509	1125	0.15	

A model of learning



The Major Messages from this Meta-Synthesis of Learning Strategies

A. An over emphasis on surface knowing

B. The mantra should be "surface to deep to transfer"

C. The importance of the skill and the will (as both input and outputs)

D. The underestimation of skills of transfer

E. The difference between initial and consolidating learning

G. Strategies taught in context

H. All strategies are teachable

I. The role of measurement

Feedback feeds on error

- Reframing errors
- Error management
- Productive failure
- Desirable difficulties
- Impasse driven
- The Pit of Confusion
- Reframing errors

Errors are a natural by-product of exploratory learning

Meta-analysis --- Keith and Frese (2008)

- **Within training – Surface learning -.15**

Surface learning to familiar tasks .20

Errors are a natural by-product of exploratory learning

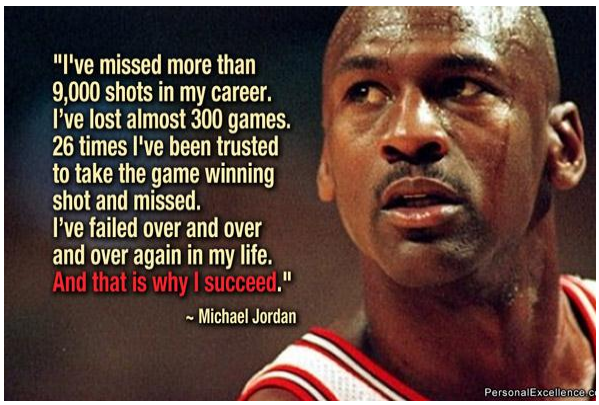
Meta-analysis --- Keith and Frese (2008)

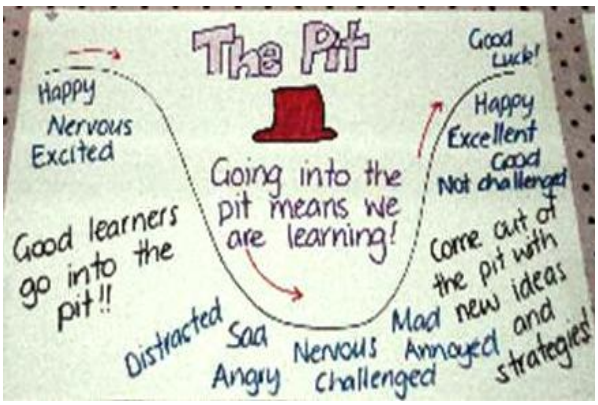
- **Within training – Surface learning -.15**

– deep learning .56

- **Surface learning to familiar tasks .20**
- **Far transfer to (new problems)**

– deep learning .80





A learning heat map

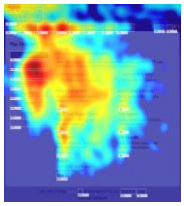
Visible Learning in the

Visible Classroom aiming for

Surface, Deep & Transfer

based on

A learning heat map



Thank you

jhattie@unimelb.edu.au