Cognitive Load Theory (2023) by *Greg Ashman*

Planning Summary by Helen Reynolds https://itsalearningcurve.education/

Content	Do This/Remember This
1. Why Cognitive Load Theory: Dylan Wiliam (2017) said "Cognitive Load Theory (CLT) is the MOST important thing for teachers to know". Sweller's original (1982) observations with maths problems: means-ends analysis (MEA) is taxing = no resources to find patterns → can happen a lot (e.g science expts). Zeroth Law of CLT: activity/engagement may/may not → learning. Original research (replicated): worked example + problems = better transfer/more guidance better than less guidance, worked examples (WE) extremely effective.	• Worked example = math(s) problem, concept, writing a paragraph • Create pairs of similar problems – hard – better to do so collectively. • It's it a 'great' activity if they learn – check it's not zeroth law
2. Models of the Mind: Geary (1995) – biologically primary (BP) = language, facial recognition (effort-less, need no instruction), biologically secondary (BS) = math, science, reading, writing (effortful, needs instruction). CLT about BS, involve simple model of mind: working memory (WM) (limited, about 4 elements at a time), long-term memory (LTM) (effectively infinite, huge web of connections = schemas, schemas direct attention → what goes in WM, LTM interacts to affect WM/cognitive load. Depends on 'element interactivity' (EI)– what you need to hold in WM to solve problem. If large EI we can chunk or increase guidance/scaffolding, reduce extraneous load (ECL) (presented info not related to learning). Study showed pupil size correlates with CL. MEA seems BP; problem-solving skills/critical thinking are both BS and domain specific.	• Just because we learn language easily does NOT mean we learn maths easily • WM limited, LTM limitless • Brain is not a computer • Avoid extraneous CL • Separate 'cute' material from content you want them to learn • Improve problem solving/critical thinking skills by increasing material in LTM
3. Simple Cognitive Load Theory Effects and How To Use Them: Lots of studies show a CLT Effect 3.1. Goal Free Effect (Sweller & Levine 1982): Removing goal shuts down MEA, reduces CL, increases learning BUT only small set of problems work/in humanities possibilities can be huge. 3.2. Worked Example Effect: Novices learn better from WE than by solving problems but needs structuring: same/similar → slightly different → very different = develops *ability to transfer*. 3.3. Completion Problem Effect: leaving gaps for them to fill in can help transition after basics. 3.4. Split-Attention Effect: Ss *have to integrate* different info from 2 or more sources = high CL. 3.5. Redundancy Effect: Ss given 2 or more sources of *same* info simultaneously = high CL. 3.6. Modality Effect: WM has two channels: verbally + pictorially – can circumvent limits of WM. 3.7. Variability Effect: CLE *NOT* just about reducing CL; about optimizing use of WM. If CL low due to WE can increase safely by increased variability.	• Problem can mean math/interpret text/ write paragraph/ construct argument • Watch for means-ends analysis – try goal free where possible. [1] • Worked examples work in all subjects [2] • Integrate info into diagrams [4] • Don't read from slides [5] • Use audio/verbal channel alongside images to reduce CL [6] • Learning happens when WM is optimized but not overloaded [7]
4. Complex Cognitive Load Theory Effects and How To Use Them: … but effects not that simple! 4.1. Element Interactivity Effect: Low EI = parts *can* be understood in isolation e.g. learning a word, high EI = *can't*, e.g. solving algebra problem. Holding in WM + manipulating = higher CL. 4.2. Expertise Reversal Effect: (extends 3.2) More expert students: hold whole schema in LTM/frees up WM, WE become redundant/can impede learning, need more varied problems. 4.3. Guidance Fading Effect: as per 4.2 go from WE to problem solving. 4.4. Transient Information Effect: (adds to 3.6) Info that needed but will be gone has to be held in WM = CL, mitigated by having notes/on screen 4.5 Self-Management Effect: can help them by teaching about CL + 3.4. 4.6 Self-Explanation Effect: (adds to 3.2) prompts to self-explain → more processing as long as WM not overloaded. 4.7 Imagination Effect: (adds to 4.2) Pausing to imagine solution effective for those with well developed schema, otherwise WE better. 4.8 Isolated Elements Effect: If EI + ECL v. high task must be broken down, then elements brought back together. 4.9 Collective WM Effect: Group work prone to 'social loafing', can increase 'working memory space'	• CL not just about the no. of elements but whether they interact [1] • What works for novices won't work for more expert students [2] • Can't *just* do WE [2/3] • Be mindful of ALL the transient info; novices will need help to keep in WM [4] • Knowing about CL/explanation/ imagination can help them work independently [5] • Break down tasks with high EI, then build back up [8] • Think collective WM for group work
5. A Case Study of Productive Failure: Constructivism; Ss DO need to link new learning to existing schemas, DO NOT have to construct knowledge. Kirschner & Sweller (2006) inquiry/ PBL etc don't work, CL too high for novices who need all the info + worked e.gs. etc. Push back: debate narrowed to not 'if' but 'when' → Productive Failure (PF). Kapur (2014) Ss given problems before instruction did better than vice versa. Possible mechanisms: priming, shows limits, showing deep structure. Author's PhD research: test predictions of PF vs CLT. Problems must be: accessible to novices, allow for multiple solution strategies, active PK, allow for direct instruction (DI) that builds on their strategies. Result: DI first scores better than PF	• Beware constructivist teaching fallacy = they need to discovery it all themselves • Minimal guidance for novices doesn't work • Productive failure aka productive struggle • Approach teaching strategies that are at odds with CLT with caution
6. Bringing Cognitive Load Theory to Your Classroom: CLT applies to BS knowledge – need to be clear WHAT you want them to learn. What to do: remove ECL from all materials, review materials in terms of their EI, use formative assessment often if not sure of CL, consider what *you* the teacher has to process in *your* WM. What to avoid: spending too long adapting lesson plans/ materials– suboptimal materials delivered well will be fine, talking about CL to people not into it, burnout (!) – sometimes a project/motivational 'history' day etc. is fine. CLT relevant when goal is to maximise learning: motivation and achievement positively linked. CLT is for life, not just a new fad, need to understand the original research to avoid oversimplistic mutations and apply strategies that benefit students.	• CLT v. useful when goals clearly defined • Mini-whiteboards very useful form of formative assessment • A teachers WM can be overloaded too • Change/try one thing at a time ↑ • Can't separate motivation from achievement – don't try • Use CLT to maximise use of WM, not just reduce CL.