Developing Curriculum for Deep Thinking by Paul Kirschner et al. (Summary reviewed by Paul Kirschner)

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1. Trigger: There has been a 'curriculum turn' towards teaching generic skills and away from knowledge, OECD reports decline in reading comprehension/science/math. Shared knowledge is the foundation of human education. Knowledge-rich curriculum better for content *and* skills.

2. How Knowledge Matters:

2.1 Knowledge Matters: A Learning Perspective:

2.1.1 A Basic Understanding of Human Cognitive Architecture: Willingham's model of memory is helpful, reading/writing/math etc. knowledge is biologically secondary: consciously taught, effortfully learned (unlike speaking/recognizing faces). Working memory WM (where new information is processed), limited to 4 to 7 novel/new elements, chunking from long-term memory LTM can free-up WM space –more you know, easier to learn. LTM effectively limitless. Sensory memory + WM + LTM + interactions = cognitive architecture, changes over time.

2.1.2 How Can Prior Knowledge Facilitate Learning? Facilitates learning by providing schema on which to build. Building automaticity (e.g., times tables, spelling) helps for acquiring other skills. Need to activate relevant prior knowledge.

2.1.3 Why Complex Cognitive Skills Require Knowledge: Critical thinking, problem solving etc. need domain specific knowledge, cannot be acquired generically, processes intertwined with content.

2.1.4 Reading Comprehension: Reading one of the most cognitively complex processes = word recognition + language comprehension. Research: reading ability AND background knowledge critical for deep reading comprehension.

2.2 Knowledge Matters: A Sociological Perspective:

2.2.1 From Objectivist to Constructivist Thinking: Objectivism = knowledge independent of social/individual contexts, value free. Radical constructivism = knowledge constructed from within individual's social/cultural context. Postmodern = truth is dominant viewpoint of the elite.

2.2.2 Skills for the 21st Century and Neoliberal Influences: By 2000 focus shift to employability/skills, OECD/PISA/WEF reinforced with literacies/competencies, Artificial Intelligence implying no need for domain specific knowledge – not true.

2.2.3 Bringing Knowledge Back In: Social realists assert powerful knowledge downgraded, widening attainment gap. Access to disciplinary knowledge/domain knowledge the right of every child.

2.3 Knowledge Matters: A Democratic Perspective: It enables us to communicate. What knowledge is so important that we don't leave its transmission to chance? Purpose of education: personal empowerment, cultural transmission, preparation for work/citizenship. Cultural literacy = thriving in the modern world – background knowledge crucial to language comprehension, more equitable access. Access to domain knowledge crucial for democracy as allows societies to contemplate the not-yet-thought/unthinkable + ensure social justice/equitable opportunities.

2.4 KM: A Summary: Perspective on knowledge shaped by lens: cogsci/democratic/social.

3. Knowledge and the Curriculum: Knowledge rich curriculum enhances learning through content-richness/coherence/clarity.

3.1. Everything Starts with the Curriculum: Curriculum highly complex concept. Factor 1. Scope: broad or narrow Factor 2. Purpose: depends on your concept of education/learning, involves choices, four fundamental questions re schools – what purposes/ what experiences/how to organize them/how to know if they've been attained. Factor 3. Discrepancies between intended/implemented/ attained + hidden (way things are structured)/null (what is *not* offered) curriculum Factor 4. Organisation at different levels: international (OECD)/national/local (textbooks, exam boards)/schools & teachers/classroom. Impact on student learning through: written/intended/enacted curriculum. Teacher autonomy ranges from none to complete.

3.2 Curriculum as a Pendulum: Highly *visible* vs virtually *invisible* knowledge elements in curricula over the years. 'New curricula' = generic skill oriented + lack of specificity + learner oriented pedagogies + over ambitious thinking targets too early (e.g., thinking scientifically at age 3 – 5 years). Young and Muller (2010) perspectives: Future 1 = list of fixed knowledge based on tradition, Future 2 = associated with societal changes, radical constructivist. Has shifted from future 1 → 2 eliminated + and – aspects of knowledge, *needs to return*.

3.3 Towards the Best of Both Worlds A Knowledge-Rich Curriculum: Aim is deep understanding and application of concepts + complex thinking skills developed through knowledge acquisition. Defined as 'plan for learning over time that is concept-led and knowledge-led (see paper for full extent page 46)'. Not an easy task to build: comprehensive list of principles inclusive but unwieldy – brief list is the opposite.

3.4 On Content-Richness:

3.4.1 The Selection of Content: Not straightforward – questions: Which content/concepts? What can be left out (to chance)? Who decides? Depends on purpose and context, needs societal debate with stakeholders. Healthy and balanced curriculum/diverse range of subjects/experiences. However… time. Avoid mile wide/inch deep and not limited to disciplinary boundaries: interdisciplinary work strengthens schemas in LTM.

3.4.2 The Basis of the Selection Process: Selection should consider disciplinary knowledge unlikely to be acquired by everyday experience.

3.4.3 The Impact of Hierarchy and Structure in Knowledge and Sequence: A learning plan must be determined within and across subjects, each concept examined for prerequisite knowledge + checked it is included; most important factor in learning is what the learner already knows. Content not restricted by age. Knowledge-rich curriculum can complement play-learning in early years, pre-schoolers more knowledge-ready than commonly thought. Bruner (1960) 'Each subject can be taught effectively in some intellectually honest way to any child at any stage of development'.

3.4.4 The Relation Between Knowledge and Skills: Knowledge OR skills a false dichotomy but complex cognitive skills need sufficient domain specific knowledge but not disconnected facts. Useful for some skills to be automated before moving on (multiplication tables, welding). Placement of skills will depend on sequence of concepts and knowledge.

3.5 On Coherence: Curriculum coherence a precise technical term that means arranging content so it supports age-related progression AND aligns all components of the educational system so they work together to meet objectives.

*3.5.1 **Horizontal** Coherence*:= Organisation of content across topics, subject, and domains; subjects are not isolated bodies of knowledge. Need to make connections explicit; students rarely make them themselves. Themes can work, but learning within a discipline is powerful, unlikely to happen unless taught.

*3.5.2 **Vertical** Coherence*: = progression over time, based on prior knowledge, a roadmap to guide from what they know to what is to be learned. Sequencing complex, seldom linear, avoids fragmentation/not episodic. Meaningful learning (Ausebel, 1968) needs depth for future learning, carefully timed revisiting /intro of new material.

3.5.3 Coherence and Disciplinary Knowledge: consider structure of knowledge itself, reflect it in curriculum structure for coherence, use 'Big Ideas' to start, break them down to what they need to know, start with evidence we'd need to show they understood. Curriculum Design Coherence Model CDCM (Rata, 2019) = 1.Select and sequence concepts 2. Connect concepts to content (knowledge-that), 3. Connect knowledge-that to knowledge-how-to, 4. Evaluation knowledge-that/how-to.

3.6 On Clarity: Tension between clarity and autonomy. Can be unclear what should/should not be included. Avoided by setting clear expectations.

3.6.1 The Importance of Clear Learning Goals: Teachers should know what has previously been learned, draw on collective knowledge as foundation + use goals to aim for common knowledge base for all (societal/democratic perspective). Level of specificity might vary between subjects/levels.

3.6.2 The Interpretation of Learning Goals: Discrepancy between 'intended' and 'enacted' avoided if some 'non-negotiables' for specific understanding + some degrees of freedom for local contextual nuances.

3.6.3 The Importance of Good Alignment: Discrepancy between 'intended' and 'achieved' depends on teacher quality and materials. Clear learning goals mitigate against problems due to quality of resources/guide appropriate activities/aid meaningful assessment. Spectrum of overly generic-overly specific, both problematic. Learning goals = Goldilocks (not too big/small). Curriculum impacts other aspects: teacher educations/prof. development/autonomy. 'A curriculum is transformed when it enters the classroom' – teacher quality is paramount.

3.7 A Knowledge-Rich Curriculum and Student Achievement: PISA and TIMSS assess across countries. Correlational but seem to corroborate positive impact of knowledge-rich curricula e.g. Portugal. Very limited data on primary, focusing on interventions for reading comprehension; when implementation focused on building domain/topic knowledge early over long enough there are significant gains. May aid learning in other areas as reading/verbal comprehension essential. Profound analysis of effect of knowledge-rich curriculum including effect of implementation/ enactment/intermediate factors now needed.

4 Concluding remarks: Position of knowledge in curriculum has fluctuated. Cogsci (WM/LTM/schemas/importance of knowledge in LTM in complex skill acquisition) + sociological/democratic perspective (knowledge as social justice issue/equity) = reevaluation of role of knowledge – it is central. Past curriculum models (knowledge tick box/knowledge free competency statements) can be replaced by knowledge-guided-curriculum that values knowledge and domain-specific skills (that build to complex skills which cannot be generically taught). Knowledge building + complex thinking by engaging deeply with the knowledge. Teaching and support need scaffolding. Implications: 1. curriculum to no longer be political football, focused on structure/qualifications/ governance, seeking consensus or solution to societal problems. 2. Coherence in all aspects with a knowledge-rich curriculum at the heart produced by arms-length curriculum body. 3. Needs extensive programme of teacher education/CPD so all teachers clear about coherence, progression, processes that build students' cognitive architecture.

Further notes/questions/comments: