



IN THIS EDITION

| | |
|-------------------------------------------------------------|----|
| Introduction | 2 |
| Why teach critical thinking? | 3 |
| What is critical thinking? | 4 |
| Issues and debates about critical thinking | 8 |
| Approaches to teaching and learning critical thinking | 10 |
| Thinking routines | 14 |
| Posing higher-order and critical thinking questions | 16 |
| Critical and creative thinking in the Australian Curriculum | 20 |
| Comment | 22 |
| Useful websites | 23 |
| References | 24 |

The Queensland College of Teachers has commissioned the Australian Council for Educational Research to prepare a series of electronic research digests.

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The Research Digests

This Research Digest is one of a series of periodic digests produced by the Australian Council for Educational Research (ACER) for the Queensland College of Teachers. Each digest focuses on a single topical issue, and provides a review of major messages from research on the issue. A key feature of the digests is an emphasis on what the research means for teachers and teaching. Over the course of several editions, a wide range of issues will be covered, so that teachers from different areas of schooling will find topics of relevance to their needs and interests.

Previous Issues

- 1 – Writing to learn, October 2007
- 2 – Managing student behaviour in the classroom, April 2008
- 3 – Using data to improve learning, October 2008
- 4 – The use of ICT in schools in the digital age: what does the research say? April 2009
- 5 – Talking to learn: Dialogue in the classroom, August 2009
- 6 – Successful professional learning, February 2010
- 7 – Language in the mathematics classroom, June 2010
- 8 – Civics and citizenship education, September 2010

Teaching critical thinking

This edition of *The Research Digest* is focused on theory, research and policy issues related to the teaching of critical thinking. It examines different definitions and views of critical thinking, and different approaches to teaching critical thinking. In particular it examines ways of posing higher-order critical thinking questions and the teaching of routines for critical thinking.

A key feature of this series of research digests is that each edition will focus on the *Australian Professional Standards for Teachers* (AITSL, 2012). This issue makes links to Professional Knowledge, Standard 1, *Know students and how they learn*, and Standard 2, *Know the content and how to teach it*.

There are also clear links to Professional Practice, Standard 3, *Plan for and implement effective teaching and learning*, in relation to the focus areas of establishing challenging learning goals and using teaching strategies.

The research digest draws on searches of a number of data bases and bibliographic resources, including the Australian Education Index, Education Resources Information Center (ERIC), Education Research Complete, British Education Index and Scopus.

A selection of relevant websites is listed and a full reference list provided. Links to those references for which full-text online access is freely available are also included.

Introduction

2

There has been growing interest in Australia and internationally over the last thirty years or so in the cross-curricular or generic skills of literacy, numeracy and thinking. In recent years, a good deal of attention has been given to the development of thinking skills and 'the thinking curriculum'.

The discussion of the teaching of critical thinking in this edition of *The Research Digest* is linked to several of the *Australian Professional Standards for Teachers* (AITSL, 2012). Standards 1 and 2, on Professional Knowledge, include specific reference to *understanding how students learn* (Focus area 1.2), and *the development of literacy and numeracy strategies* (Focus area 2.5).

The teaching of critical thinking is also considered in relation to Standard 3, Professional Practice, *planning for and implementing effective teaching and learning*, in particular through higher-order thinking and metacognition in Focus area 3.1, *establish challenging learning goals*. Focus area 3.3, *use teaching strategies*, refers specifically to problem solving and critical and creative thinking. It relates to the use of teaching strategies and thinking routines for teaching and learning critical thinking.

The *National Goals for Schooling in the Twenty-First Century* identified by the Ministers of Education in Australia in 1999 (MCEETYA, 1999) gave particular emphasis to the generic thinking skills of analysis and problem solving. The *Melbourne Declaration on Educational Goals for Young Australians* (MCEETYA, 2008) recognises that critical and creative thinking are fundamental to students becoming successful learners. According to the *National Goals for Schooling*, thinking that is productive, purposeful and intentional is at the centre of effective learning.

The new Australian curriculum developed by the Australian Curriculum, Assessment and Reporting Authority (ACARA) includes critical and creative thinking in the seven general capabilities that are to be developed across the whole curriculum:

- ▶ Literacy
- ▶ Numeracy
- ▶ Information and communication technology capability
- ▶ Critical and creative thinking
- ▶ Personal and social capability
- ▶ Ethical behaviour
- ▶ Intercultural understanding

Similar interest in generic thinking skills can be seen internationally. A recent national initiative of the American Academy of Sciences in the United States, for instance, called *Partnership for 21st Century Skills*, has drawn attention to the need 'to compete in a global economy that demands innovation' (Partnership for 21st Century Skills, 2013). The Partnership aims to fuse the '3Rs and 4Cs (Critical thinking and problem solving, Communication, Collaboration, and Creativity and innovation)'.



Why teach critical thinking?



The development of critical thinking skills is one of the most commonly identified aims of education at all levels. It is widely recognised that learning how to think underpins learning how to learn.

The world is changing very rapidly, and much of the knowledge of today will soon be history. The importance of developing a flexible capacity to think critically and creatively is crucially important for the future as more will be required of citizens in the 21st century than ever before. Not only will people have to be literate and numerate in the future, they will need well developed thinking skills and to be lifelong learners. Current students need to learn how to gather and critically assess information, how to think and how to learn. There is concern about the generic skill levels of the current population, and some commentators argue that the traditional academic curriculum does not really address the challenges of the future.

It has been argued that there is too much low-level rote learning in current education. According to this view there is too much emphasis on accumulating knowledge, and not

enough emphasis on conceptual understanding and the development of thinking skills in current education. When information is readily accessible from a hand-held device, recall of knowledge is less important than the ability to critically analyse the masses of information that are readily available.

Critical thinking is the most cross-curricular and generic of skill constructs. It takes place in mathematics and science, and it takes place in humanities, the arts and the social sciences. Critical thinking underpins literacy and numeracy. At their higher levels, literacy and numeracy require critical thinking. Focussing on critical thinking has the potential to integrate and deepen the whole school curriculum.

As well as the development of cognitive skills, critical thinking involves the development of attitudes and values. According to many advocates, critical thinking depends on the development of dispositions and intellectual virtues. An emphasis on critical thinking can interrelate and integrate cognitive development with personal and social development.

What is critical thinking?

4

It can seem from the literature that there are almost as many definitions of critical thinking as there are writers on the topic, but it has been said that there is a common core to all the different definitions (Crenshaw, Hale, & Harper, 2011). When thinking about issues of definition, it is important to remember that phrases such as 'critical thinking' and 'higher-order thinking' are constructs rather than natural categories. We can, of course, define these concepts in different ways, and there are no essential definitions.

All sorts of skills and sub-skills of critical thinking can be identified, but the main issue of definition is whether critical thinking is seen as all and any kind of good and rational thinking (this might be called 'the global view of critical thinking'), or whether there are any characteristics that distinguish critical thinking from other kinds of good and rational thinking (this might be called 'the judgement view of critical thinking').

The global definitions of critical thinking

According to the global view, critical thinking is good and rational thinking as distinct from mere musings, fantasy and plain irrationality. The philosopher and educator John Dewey gave great emphasis in his seminal writings to a very broad kind of reflective thinking which he saw as the 'active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends'. (Dewey, 1933)

Robert Ennis also takes a very broad view of critical thinking.

Critical thinking is a process, the goal of which is to make reasonable decisions about what to believe and what to do. (Ennis, 1996)

The National Council for the Teaching of English Committee on Critical Thinking and the Language Arts in the United States (NCTE & IRA, 1996) presents a similar view:

Critical thinking is 'a process which stresses an attitude of suspended judgment, incorporates logical inquiry and problem solving, and leads to an evaluative decision or action.

Richard Paul et al. see critical thinking as a kind of meta-thinking.

Critical thinking is the art of thinking about your thinking while you are thinking in order to make your thinking better: more

clear, more accurate, or more defensible. (Paul, Binker, Adamson & Martin, 1989)

According to Paul the critical thinker is 'thinking with the awareness of the systematic nature of high quality thought'.

Critical thinking is a systematic way to form and shape one's thinking. It functions purposefully and exactly. It is thought that is disciplined, comprehensive, based on intellectual standards, and, as a result, well-reasoned. Critical thinking is distinguishable from other thinking because the thinker is thinking with the awareness of the systematic nature of high quality thought, and is continuously checking up on himself or herself, striving to improve the quality of thinking'. (Paul, 1993)

In 1990 the American Philosophical Association produced a consensus position, *Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction*, which states that critical thinking is 'not synonymous with good thinking', but it takes a global view in describing critical thinking as 'purposeful, self-regulatory judgment'. The statement does not offer a definition of judgment as distinct from any other kind of thinking. This view places emphasis on the uses of critical thinking, the ideal critical thinker and thinking dispositions.

We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. Critical Thinking (CT) is essential as a tool of inquiry. As such, CT is a liberating force in education and a powerful resource in one's personal and civic life. While not synonymous with good thinking, CT is a pervasive and self-rectifying human phenomenon. The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. Thus, educating good critical thinkers means working toward this ideal. It combines developing CT skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society. (Facione, 1990)

The judgement in uncertainty view

In their different ways more specific definitions of critical thinking view it as judgement in uncertainty that can be distinguished from some other kinds of thinking. According to this view critical thinking is judgement rather than logical reasoning or problem solving. The judgement view sees critical thinking as involving multiple and conflicting considerations and uncertainty. To this view critical thinking involves the weighing of evidence and the assessment of argument. Critical thinking as judgement often involves making interpretations, uncertain inferences and value judgements. In its more precise versions, the judgement view sees critical thinking as informal and plausible rather than formal and logical reasoning.

Facione gives emphasis to critical thinking as 'the ability to properly construct and evaluate arguments'. (Facione, 1990) Moore and Parker describe critical thinking as 'the ability to judge the plausibility of specific assertions, to weigh evidence, to assess the logical soundness of inferences, to construct counter-arguments and alternative hypotheses (Moore & Parker, 2012). Browne and Keeley present critical thinking as 'systematic evaluation of arguments based on explicit rational criteria'. (Browne & Keeley, 2011) Epstein sees critical thinking as 'evaluating whether we should be convinced that some claim is true or some argument is good, as well as formulating good arguments'. (Epstein, 2005)

While there are some significant differences in the way critical thinking can be defined, there is a certain consensus that is well explained by Jones et al. (Jones et al., 1995). Jones gives comprehensive definitions that distinguished problem solving from critical thinking.

With a consensus among 500 policymakers, employers, and educators, the following definitions were created. **Problem solving** is defined as a step-by-step process of defining the problem, searching for information, and testing hypotheses with the understanding that there are a limited number of solutions. The goal of problem solving is to find and implement a solution, usually to a well-defined and well-structured problem. **Critical thinking** is a broader term describing reasoning in an open-ended manner, with an unlimited number of solutions. The critical thinking process involves constructing the situation and supporting the reasoning behind a solution. Traditionally, critical thinking and problem solving have been associated with different fields: critical thinking is rooted in the behavioral sciences, whereas problem solving is associated with the math and science disciplines. Although a distinction is made between the two concepts, in real life situations the terms critical thinking and problem solving are often used interchangeably. In addition, assessment tests frequently overlap or measure both skills.

According to this view, problem solving is a linear, logico-deductive and sequential processing of information to determine one of a limited number of solutions. On the other hand, the crucial characteristic of critical thinking is that it involves 'reasoning in an open-ended manner, with an unlimited number of solutions'. For this view, critical thinking involves 'constructing the situation and supporting the reasoning behind a solution' rather than determining the correct solution.



Meta-cognition is

- ▶ thinking about thinking;
- ▶ knowledge about the way we know the world;
- ▶ reflecting and thinking about the thinking process itself; and
- ▶ conscious learning behaviour involving planning, monitoring, evaluating and revising learning.

What is Higher-order Thinking?

Higher-order thinking is commonly typified as the three top levels (Analysing, Evaluating, Creating) of Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001). At the higher levels of thinking it is said that students are involved in designing, constructing, planning, producing, inventing, checking, hypothesising, critiquing, experimenting, judging, comparing, organising, deconstructing, interrogating and finding. In a typical statement, Kurwongbah State School in Queensland shows the usefulness of the term higher-order thinking by saying:

Higher-order thinking is not about regurgitation of information, it is not about rote learning or simple remembering or recall of facts. It is about engaging students at the highest levels of thinking to foster exciting learning environments where students become creators of new ideas, analysers of information and generators of knowledge.

In *Education and Learning to Think* Lauren Resnick (Resnick, 1987) characterised higher-order thinking as complex and non-algorithmic thinking involving:

- ▶ multiple solutions;
- ▶ nuanced judgement and interpretation;
- ▶ the application of multiple criteria;
- ▶ uncertainty;
- ▶ self-regulation of the thinking process;
- ▶ imposing meaning, finding structure in apparent disorder; and
- ▶ effort.

Mathew Lipman used the term higher-order thinking to mean 'conceptually rich, coherently organised and persistently exploratory' thinking that is 'critical, creative and caring' (Lipman, 1991).

Australian Professional Standards for Teachers that Reflect Teaching for Thinking and Some Illustrations of Practice – Proficient career stage

<http://www.teacherstandards.aitsl.edu.au/OrganisationStandards/Organisation>

Standard 3: Plan for and implement effective teaching and learning

Focus area 3.1: Establish challenging learning goals

Descriptor: Set explicit, challenging and achievable learning goals for all students.

Focus area 3.2: Plan, structure and sequence learning programs

Descriptor: Plan and implement well-structured learning and teaching programs or lesson sequences that engage students and promote learning.

Focus area 3.3: Use teaching strategies

Descriptor: Select and use relevant teaching strategies to develop knowledge, skills, problem solving and critical and creative thinking.

Focus area 3.4: Select and use resources

Descriptor: Select and/or create and use a range of resources, including ICT, to engage students in their learning.

Standard 2: Know the content and how to teach it

Focus area 2.5: Literacy and numeracy strategies

Descriptor: Apply knowledge and understanding of effective teaching strategies to support students' literacy and numeracy achievement.

Illustrations of Practice

<http://www.teacherstandards.aitsl.edu.au/Illustrations>

An extension activity

<http://www.teacherstandards.aitsl.edu.au/Illustrations/Details/IOP00004>

Sustainable cities

<http://www.teacherstandards.aitsl.edu.au/Illustrations/Details/IOP00134>

Perceptions of reality

<http://www.teacherstandards.aitsl.edu.au/Illustrations/Details/IOP00159>

What makes a good review?

<http://www.teacherstandards.aitsl.edu.au/Illustrations/Details/IOP00090>



Issues and debates about critical thinking

8



A good deal of critical discourse has been generated by the topic of critical thinking itself. Arguments have been made that challenge the notion of generic skills like critical thinking. According to these arguments:

- ▶ learning is specific and contextualised;
- ▶ domain specific knowledge is the crucial characteristic of expert performance;
- ▶ a general notion like critical thinking only has meaning within specific domains of knowledge and skill; and
- ▶ evidence of the transfer of skills taught in one context or domain to another is not strong.

While such arguments were commonly advanced in the 1980s and 1990s, such scepticism has not prevailed and there has been an ongoing and increasing interest in such generic skills as critical thinking.

The Partnership for 21st Century Skills in the United States referred to above is interested in 'problem solving, critical thinking, and communication' (Partnership for 21st Century Skills, 2013), but it sees these notions as only having meaning within specific disciplines.

Educational and business leaders want today's students both to master school subjects and to excel in areas such as problem solving, critical thinking, and communication abilities often referred to by such labels as 'deeper learning' and '21st-century skills'. In contrast to the view that these are general skills that can be applied across a range of tasks in academic, workplace, or family settings, a new report from the National Research Council found that 21st-century skills are specific to content knowledge and performance within a particular subject area. The report describes how this set of key skills relates to learning mathematics, English,

and science as well as to succeeding in education, work, and other areas of life. (National Academies, 2012)

We will see below that some approaches to developing critical thinking skills are based on a certain scepticism about the generic nature of such skills. Whether one sees critical thinking as generic or context-specific shapes the way one sets out to develop critical thinking skills.

The attitudes and values of critical thinking

Another matter of some controversy is how much critical thinking is defined in terms of attitudes and values, and whether and how such attitudes and values can be taught. To what extent is critical thinking a cognitive skill, and how much is it a matter of dispositions or character? The definitions of critical thinking we have seen above and the approaches to teaching critical thinking we will see below give more or less emphasis to the development of habits of mind and intellectual character. Unlike literacy and numeracy, teaching and learning critical thinking has ethical overtones.

The ages and stages for teaching critical thinking

It is sometimes thought that higher-order skills like critical thinking are only appropriate for some age groups and some ability groups. There has been a strong and ongoing interest in critical thinking in tertiary education, and interest in the development of critical thinking skills in vocational education and training is now growing. As we will see below, there is an increasing interest in critical thinking in the primary school and in the middle years of schooling. The Philosophy for Children movement for instance has focussed attention on the critical thinking of primary and junior secondary school students.



Ann Epstein argues for an early start to learning how to think. She sees careful observation and planning as the keys to creating an environment that encourages young children to think critically (Epstein, 2008). According to Epstein, teachers and parents should:

- ▶ provide opportunities for children to plan and reflect;
- ▶ wonder together with children;
- ▶ encourage children to elaborate on their ideas;
- ▶ ask children to solve problems; and
- ▶ use encouragement to think rather than praise.

Direct and separate or integrated?

The major issue in the teaching of critical thinking is whether it should be taught directly or implicitly. Should there be a particular space for teaching critical thinking within a subject or should it be a subject itself? Or should critical thinking be integrated into the subject areas? These questions prompt two further questions.

- ▶ How can critical thinking be integrated into and highlighted in the different subjects?
- ▶ How can critical thinking be taught in itself?

There are roughly three methods of teaching critical thinking. The **infusion method** integrates critical thinking into all topics and every subject. This infusion might be either implicit or explicit. The **stand-alone method** makes critical thinking a specific topic or subject. The stand-alone is a method of explicit teaching. There is also a **hybrid method** in which critical thinking is both infused and stand-alone, and in which teaching critical thinking is both explicit and implicit.

Critical thinking as a separate subject

There are many stand-alone critical thinking courses in the colleges of the United States, and there are some stand-alone critical thinking courses in Australian universities. There is one stand-alone critical thinking study at General Certificate of Education level and two stand-alone critical thinking studies at Advanced level in the United Kingdom. The Victorian Curriculum and Assessment Authority is piloting a self-directed research study called the Extended Investigation for the Victorian Certificate of Education. This study aims to develop independent, critical and reflective learners, and critical thinking is said to be a 'foundation of the study' (VCAA, 2013).

The study requires students to engage with a range of texts that require the application of critical thinking skills, in particular the skills associated with questioning and evidence. Students learn about types of evidence, strong and weak argument and reasoning, the differences between fact and belief, and the kinds of research questions that lead to higher order thinking. This provides the student with the framework for understanding how to undertake an individual investigation.

There has been a good deal of argument about the relative success of infusion and the stand-alone methods of developing critical thinking skills. While different studies have claimed success for the different methods, there has been little systematic testing of one method against the other. The few comparisons there have been between the different methods prompt the conclusion that a hybrid approach with mass action on all fronts is most likely to encourage the greatest development of critical thinking skills. The thinking curriculum movement commonly advocates reorienting all the activity of a school to teaching thinking.

Approaches to teaching and learning critical thinking

10

In the infusion method, teaching critical thinking is good teaching. At this very general level teaching critical thinking is a matter of understanding how students learn best and using strategies that will best encourage critical thinking, deep learning and conceptual understanding.

A pedagogy for teaching critical thinking

The following are some of the principles and approaches that are commonly identified as underpinning successful teaching of critical thinking.

It has been argued that teaching critical thinking should be student-centred rather than content-focussed. Learning to think critically requires active engagement from students and an appropriate climate in the classroom. Teaching critical thinking is cross-curricular learning, and it should involve a process of articulating and integrating the whole school curriculum. Cross-curricular thematic studies and problem-based learning are seen as particularly appropriate for developing critical thinking skills. It is argued that teaching critical thinking involves an emphasis on higher-order thinking rather than facts and basic skills. Teachers should model critical thinking for students, and they should articulate their own thinking processes so as to make thinking visible. Students should be encouraged to examine the thinking of themselves and others.

The strategies used to teach critical-thinking skills include:

- ▶ higher-order questioning;
- ▶ active learning;
- ▶ cooperative learning,
- ▶ modelling;
- ▶ real-life applications and problem solving; and
- ▶ the development of a questioning and thoughtful class and school culture.

In *Testing to Learn - Learning to Test* Joanne Capper identified a range of principles for good teaching and learning (Capper, 1996). According to Capper, curriculum should focus on central ideas, and aim for deep understanding of central ideas rather than wide coverage of topics. The aim should be to promote active learning by having students process and organise ideas and use knowledge in real-life situations. Attention should be focussed on concepts rather than facts. Students should learn key concepts, concepts should be interrelated, and relations should be established between old and new knowledge. Students should be encouraged to reflect on learning, verbalise their understanding, and monitor and manage their own learning.

The literature and research on teaching critical thinking is a provocation to and support for thoughtful and subtle teaching.



Critical thinking in the disciplines

Critical thinking can be implicitly and explicitly integrated into the teaching of subject content. While the way this is done will be different for different topics and subjects, there are some general principles and approaches that will encourage critical thinking about subject content, and such thinking will in turn lead to deeper understanding.

While it can seem to some teachers that there is a conflict between covering the material in a course and teaching students to think, advocates of the infusion method of critical thinking see it as a way of enriching and deepening the learning of subject matter.

As well as his multiple intelligences theory, Howard Gardner has emphasised the importance of understanding academic disciplines. According to Gardner, students need more than a large information base to understand their ever-changing world. They also need to master disciplinary thinking (Gardner, 2006).

While recognising the potential limitations of subject matter learning, Gardner has emphasised the importance of understanding disciplines as such. In *The Disciplined Mind* Gardner identified four discipline-related capacities (Gardner, 1999).

- ▶ Understanding the purpose of disciplinary expertise
- ▶ Understanding an essential knowledge base
- ▶ Understanding inquiry methods
- ▶ Understanding forms of communication

According to Gardner, the mind can be nurtured and disciplined by:

- ▶ identifying the essential topics in a discipline;
- ▶ spending considerable time on these few topics, and studying them deeply;
- ▶ approaching the topic in a number of ways; and
- ▶ developing performances of understandings.

On the other hand, Marion Brady has argued for a 'real and rigorous' curriculum that is oriented towards the real world rather than academic disciplines (Brady, 2008).

A focus on real-world issues can alter the entire culture of a school or school system. It enables students and teachers to experience the 'meatiness' of the direct study of reality. It's unfailingly relevant. It shows respect for students, who become more than mere

candidates for the next higher grade. It levels the playing field by not privileging those with superior symbol manipulation skills. It disregards the arbitrary, artificial boundaries of the academic disciplines. It's easily applicable to the wider world. And it shifts the emphasis from cover-the-material memory work to a full range of thinking skills.

According to Brady:

Trying to make sense of one's own day-to-day experience requires the use of every known thinking skill.

How can critical thinking be taught?

The Philosophy for Children movement is the most global and holistic of the approaches to learning how to think. The doyen of Philosophy for Children, Matthew Lipman, has claimed that judgement and reasoning can be strengthened through critical, creative and caring thinking. Lipman (1990) has identified four major varieties of higher-order thinking:

- ▶ enquiry;
- ▶ reasoning (preserving truth);
- ▶ information-organising; and
- ▶ translation (preserving meaning).

The Philosophy for Children movement (Splitter & Sharpe, 1995):

- ▶ emphasises analytical and conceptual thinking rather than factual knowledge and empirical research;
- ▶ values student initiated and directed thinking;
- ▶ focuses on developing thinking dispositions;
- ▶ is attentive to values and ethics;
- ▶ values dialogue and mutual respect;
- ▶ aims to develop a community of inquiry by developing a classroom climate for higher-order thinking.

Supporters of Philosophy for Children advocate a thinking curriculum and a thinking school. According to Golding, a thinking school (Golding, 2005):

- ▶ ensures that the development of thinking is an explicit aim of the school;
- ▶ creates a school environment that promotes the development of thinking;
- ▶ ensures time is explicitly set aside for thinking;
- ▶ has all teachers model and personally promote the development of thinking;

- ▶ encourages teachers to see themselves as facilitators of thinking;
- ▶ ensures that students see themselves as learners and thinkers;
- ▶ provides time, resources and training to support teachers in developing thinking students; and
- ▶ informs the wider community and involves them in creating a thinking curriculum.

The thought-filled curriculum and developing habits of mind

According to Arthur Costa, while thinking is innate and spontaneous, skilful thinking must be cultivated. Costa's approach to thinking skills (Costa, 2008) emphasises:

- ▶ learning to think;
- ▶ thinking to learn;
- ▶ thinking together;
- ▶ thinking about our own thinking; and
- ▶ thinking big.

Costa sees content learning as only one of the aims of instruction, and he advocates the selection of relevant, generative and wondrous content to serve as the vehicle for learning. Costa thinks teachers should equip the vehicle for learning by:

- ▶ posing challenging, content-embedded questions and problems that tax the imagination and stimulate inquiry;
- ▶ inviting students to assess their own learning;
- ▶ urging students to question their own and others' assumptions; and
- ▶ valuing students' viewpoints by maintaining a safe, nonjudgmental classroom atmosphere.

The 'thought-filled curriculum' proposed by Costa involves:

- ▶ focusing mental energy on understanding others;
- ▶ summarizing and paraphrasing others' thoughts;
- ▶ empathizing;
- ▶ monitoring clarity in communication; and
- ▶ setting aside judgments, solutions, and autobiographical responses.

Costa envisages students developing habits of mindful probing by using self-reflective questions such as the following:

- ▶ How can I draw on my past successes to solve this new problem?

- ▶ What do I already know about the problem, and what resources do I have available or need to generate?
- ▶ How can I approach this problem flexibly?
- ▶ How might I look at the situation from a fresh perspective?
- ▶ Am I remaining open to new possibilities?
- ▶ How can I make this problem clearer, more precise, and more detailed?
- ▶ Do I need to check out my data sources?
- ▶ How might I break this problem down into its component parts and develop a strategy for approaching each step?
- ▶ What do I know or not know?
- ▶ What might I be missing, and what questions do I need to ask?
- ▶ What strategies are in my mind now?
- ▶ What values, beliefs, and intentions are influencing my approach?
- ▶ What emotions might be blocking or enhancing my progress?
- ▶ How is this problem affecting others?
- ▶ How might we solve it together; and what can I learn from others that would help me become a better problem solver?

The 'thinking teacher' is described as designing lessons expressing a large vision by asking themselves the following questions:

- ▶ Are these learnings essential?
- ▶ How do they contribute to building more thoughtful classrooms, schools, and communities, and a more thoughtful world?

Thinking teachers encourage students to 'think big' by leading them to inquire into moral, ethical, and philosophical questions.

- ▶ What makes human beings human?
- ▶ What is beauty?
- ▶ What is justice?
- ▶ How can we learn to unite and not divide?

With his co-worker Bena Kallick, Costa has identified a set of problem solving, life-related skills that are necessary to effectively operate in society, and that will promote strategic reasoning, insightfulness, perseverance, creativity and craftsmanship. Costa and Kallick define these skills through the following 'habits of mind' (Costa & Kallick, 2001).

- ▶ Persisting
- ▶ Managing impulsivity
- ▶ Listening with understanding and empathy
- ▶ Thinking flexibly
- ▶ Thinking about thinking (meta-cognition)
- ▶ Striving for accuracy
- ▶ Questioning and posing problems
- ▶ Applying past knowledge to new situations
- ▶ Thinking and communicating with clarity and precision
- ▶ Gathering data through all senses
- ▶ Creating, imagining, innovating
- ▶ Responding with wonderment and awe
- ▶ Taking responsible risks
- ▶ Finding humour
- ▶ Thinking interdependently
- ▶ Remaining open to continuous learning



Thinking routines

14

While some have argued that there is no quick fix for teaching the higher-order skills of critical thinking, there has also been a good deal of attention to strategies for teaching critical thinking as such. A number of procedures or routines for learning critical thinking will be reviewed below.

In *Intellectual Character: What It Is, Why It Matters, And How to Get It*, Ron Ritchhart, writes of developing explicit and goal-driven routines for thinking in classrooms (Ritchhart, 2002).

For these routines to be effective, they usually consist of only a few steps, are easy to learn and teach, can be scaffolded or supported by others, and get used over and over again in the classroom. ... Many familiar classroom practices and instructional strategies can be thought of as thinking routines if they are used over and over again in a way that makes them a core practice of the classroom. For example, KWL (What do you know? What do you want to know? What did you learn?), brainstorming, pushing students to give evidence and to reason by asking them 'Why?', classroom arguments or debates, journal writing, questioning techniques or patterns that are used repeatedly, and so on.

Ritchhart also sees routines as a major enculturating force communicating expectations for thinking as well as providing students with the tools they need to engage in that thinking.

Thinking routines help students answer questions they have: How are ideas discussed and explored within this class? How are ideas, thinking, and learning managed and documented here? How do we find out new things and come to know in this class? As educators, we need to uncover the various thinking routines that will support students as they go about this kind of intellectual work or enact new ones if such routines are not readily present in our practice.

Many more or less specific routines have been identified for teaching and learning critical thinking.

Edward De Bono's Six Thinking Hats

Among his many ideas about lateral, parallel and creative thinking, Edward de Bono developed the idea of Six Thinking Hats® to be used as a tool for group discussion and individual thinking (de Bono, 1985). Six kinds of, or directions for, thinking are identified and assigned a colour in the Thinking Hat process.

The White Hat calls for information known or needed. 'The facts, just the facts.'

The Yellow Hat symbolizes brightness and optimism. Under this hat you explore the positives and probe for value and benefit.

The Black Hat is judgment, the devil's advocate or why something may not work. Spot the difficulties and dangers; where things might go wrong. Probably the most powerful and useful of the hats but a problem if overused.

The Red Hat signifies feelings, hunches and intuition. When using this hat you can express emotions and feelings and share fears, likes, dislikes, loves, and hates.

The Green Hat focuses on creativity - the possibilities, alternatives, and new ideas. It's an opportunity to express new concepts and new perceptions.

The Blue Hat is used to manage the thinking process. It's the control mechanism that ensures the Six Thinking Hats guidelines are observed.

Tools for making thinking visible

David Perkins and other Harvard researchers have given particular attention to 'making thinking visible' and developing thinking routines. The Project Zero website presents a 'thinking routine of the month'.

In the *Visible Thinking teachers' toolkits* Perkins identified a set of core routines that target different types of thinking (Project Zero, n.d.).

- ▶ What Makes You Say That? - interpretation with justification routine
- ▶ Think Puzzle Explore - a routine that sets the stage for deeper inquiry
- ▶ Think Pair Share - a routine for active reasoning and explanation
- ▶ Circle of Viewpoints - a routine for exploring diverse perspectives
- ▶ I used to Think... Now I think - a routine for reflecting on how and why our thinking has changed
- ▶ See Think Wonder - a routine for exploring works of art and other interesting things
- ▶ Compass Points - a routine for examining propositions

According to Ritchhart and Perkins, six key principles anchor and characterize the visible thinking approach (Ritchhart & Perkins, 2008).

- ▶ Learning is a consequence of thinking.
- ▶ Good thinking is not only a matter of skills, but also a matter of dispositions.

- ▶ The development of thinking is a social endeavour.
- ▶ Fostering thinking requires making thinking visible.
- ▶ Classroom culture sets the tone for learning and shapes what is learned.
- ▶ Schools must be cultures of thinking for teachers.
- ▶ Thinking routines jump-start thinking and make it visible.

Project Zero researchers have developed more than 30 thinking routines in collaboration with K-12 teachers. Below are some typical and popular routines for critical thinking developed by Project Zero.

Headlines

Newspaper headlines can be used to capture the essence of an event, idea, concept, or topic. It works especially well at the end of a class discussion in which students have explored a topic and gathered new information and opinions. Ask students these questions.

- ▶ If you were to write a headline for this topic or issue right now that captured the most important aspect to remember, what would that headline be?

If you ask the first question at the beginning of the discussion, follow up with these questions:

- ▶ How would your headline change after today's discussion?
- ▶ How does it differ from what you would have said yesterday?

Connect-Extend-Challenge

This routine helps students make connections. Ask students these three questions.

- ▶ How are the ideas and information presented?
- ▶ How are the ideas and information connected to what you know and have studied?
- ▶ What new ideas extended or pushed your thinking in new directions?

Clearly posing questions and class discussion are fundamental to these visible thinking routines. Posing questions is seen as central to eliciting critical and higher-order thinking from students by most advocates of the critical thinking curriculum.

Posing higher-order and critical thinking questions

Mathies' Full Spectrum Questioning for Critical Thinking

The Concord Consortium adapted the work of Dennis Mathies to identify a spectrum of leading questions (Mathies, 1991).

Full-Spectrum Questioning

Who? What? When? Where? Why?

There are five categories for full-spectrum questioning.

- ▶ 'So what?' questions
- ▶ Questions that clarify meaning
- ▶ Questions that explore assumptions and sources
- ▶ Questions that identify cause and effect
- ▶ Questions that plan a course of action

Paul's Taxonomy of Socratic Questions

Richard Paul of the Critical Thinking Community has developed a taxonomy of Socratic questions that can be used by students to organise their thinking, and used by teachers (as did Socrates) to guide student learning. Paul identifies questions of clarification, questions that probe assumptions, questions that probe reasons and evidence, questions about viewpoints or perspectives, questions that probe implications and consequences, and questions about the question (Paul, 1992; Paul & Elder, 2008).

The ProCon analysis: A simple structure for concept mapping

Concept mapping is a very attractive routine for critical thinking because it can give a diagrammatic representation of such things as the relationship between cause and effect, and the dialectical process of thesis and antithesis (McCurry, 2012). While the value of concept maps is widely recognised, it is less widely recognised that concept maps are difficult to do and difficult to teach. Imagine how hard it would be to represent the issues discussed here in a concept map. Other than placing the topic at the centre of the diagram (and that is not mandatory), a real concept map does not have a standardised structure. To develop a real concept map is to develop a (more or less unique) structure for an issue or argument. Real concept maps are not a matter of routine.

The simplest structure for a concept map of critical thinking is for and against, positive and negative. This structure for a concept map of critical thinking can be formalised as a ProCon table. A ProCon table is a simple, intuitive structure that identifies a proposition in the top row of a table and then outlines different arguments for or against that proposition in the rows below.

| The Proposition to be Analysed | | |
|--------------------------------|----------------------------|------------------------------|
| 1 | Pro | Con |
| 2 | Pro argument 1 | ← Rebuttal of Pro argument 1 |
| 3 | Rebuttal of Con argument 1 | → Con argument 1 |
| 4 | Pro argument 2 | ← Rebuttal of Pro argument 2 |
| 5 | Rebuttal of Con argument 2 | → Con argument 2 |

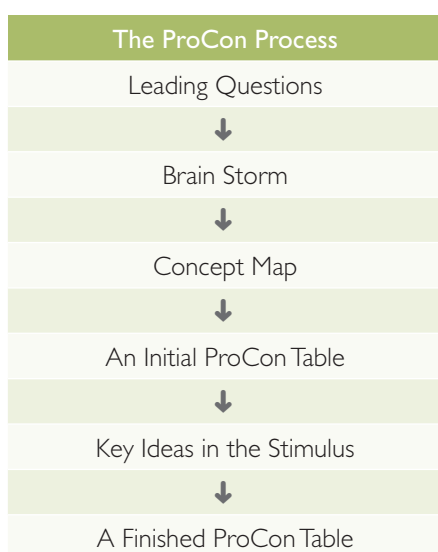
The ProCon table assumes that critical thinking involves exploring at least two sides of an issue, and it assumes that every pro and con argument is subject to counter argument. A process for developing and using a ProCon table is sketched below.

An initial introductory discussion can be used to encourage the interests of students in an issue. Some leading questions can be used to introduce the issue. This initial discussion might lead on to a brain storming process to generate concepts related to the issue. The material produced in the brain storm can be organised in a concept map and an initial ProCon table. Students might then undertake some data gathering and research as evidence for further analysis. The evidence can be analysed and compared in the following terms.

How does this material relate to the issue?

What line of reasoning does this material suggest about the issue?

What might each piece contribute to a ProCon table of the issue?



Such an elaborate process need not be used for examining all issues, but it may be of value to work through such an elaborate process for students in some instances. The aim would be to give students a clear and definite process they can use to analyse an issue for themselves. Five critical thinking exercises related to the ProCon process are sketched below.

Task 1: How might we describe a strong and weak piece of thinking or argument? (construct a glossary)

Task 2: Find examples of strong or weak pieces of argument. (any topic or subject, no more than 200 words)

Task 3: Find or write two pieces of material arguing for and against a proposition. (no more than 200 words)

Task 4: Find a piece of material for or against a specified proposition. (no more than 200 words)

Task 5: Construct a ProCon table for an issue. Compose a proposition or question. Map arguments for and against the proposition.



Key questions for critical thinking

The following general guide questions can be used for exploring the evidence and arguments developed about an issue.

25 Key Questions for Critical Thinking

1. What do these texts suggest about the issue?
2. How are the texts similar and different?
3. Which texts are most informative and convincing?

4. What does the data show?
5. What conclusions can be drawn from the data?
6. What are the strengths and weaknesses of the data?
7. How conclusive is the data?
8. What data is missing?
9. What data might challenge or contradict this data?
10. What other data is needed?

11. What claims are made in the text?
12. Is there a line of logical reasoning?
13. What generalisations can be made from these claims?
14. Are these claims reasonable or true?
15. What can be deduced from these claims?
16. What is assumed by this line of reasoning?

17. What view is presented in the text?
18. What is the purpose of the creator?
19. What basis or support is offered for the view presented?
20. What values are explicit or implicit in the text?
21. How is the text structured?
22. Why is the text structured as it is?
23. How does the text position the interpreter?
24. How do my views and values relate to those of the text?
25. What are the explicit and implicit values of the creator?

(McCurry 2012)

The Toulmin Model of Argument

The philosopher Stephen Toulmin developed the idea of what he called 'practical arguments' as a description of the dialectical process of substantiating conclusions (Toulmin, 1958). The Toulmin model sketches the relationship between a claim, the grounds offered for the claim, and the extent to which the linking of the two is warranted. It has been widely used as a model for writing arguments in opposition to the three or five paragraph 'essay' of introduction, body and conclusion.

| The Toulmin Model of Argument | |
|-------------------------------|------------------------------------------------------------------|
| Claim | A conclusion whose merit is to be established |
| Ground (Evidence, Data) | Fact or evidence offered as a foundation for the claim |
| Warrant | A statement authorizing the relation of the claim and the ground |
| Backing | Reasons offered to justify the warrant for a claim |
| Rebuttal | A consideration of possible challenges or counter claims |
| Qualifier | An indication of a degree of strength or certainty |

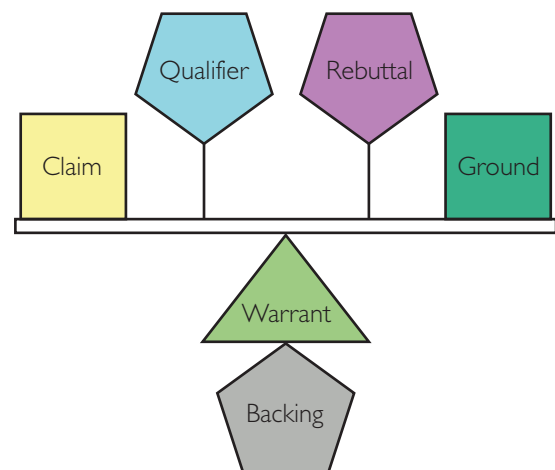


Figure The Toulmin Model of Argument



Critical and creative thinking in the Australian Curriculum

The idea that thinking skills are essential learnings has been given a good deal of attention in the curriculum documents of various Australian states and territories in recent years. The key features of this emphasis on thinking skills might be summarised as follows.

- ▶ Explicit attention should be given to the development of thinking skills.
- ▶ Students should be encouraged to think about thinking and to develop meta-cognitive skills.
- ▶ Learning to think involves the investigation of discipline-based methodologies and reflection on their usefulness in different contexts and for different issues.
- ▶ Discriminating thinking about controversial and complex issues is at the centre of learning to think.
- ▶ Learning to think involves students reflecting on their own and other people's values.
- ▶ The teaching of thinking can play a central role in educational programs by integrating different learning areas and integrating the development of cognitive skills with the development of personal values.

The Australian Curriculum developed by the ACARA envisages students developing critical and creative thinking as they learn to generate and evaluate knowledge, ideas and possibilities, and use such skills when seeking new pathways or solutions. In learning to think broadly and deeply students learn to use reason and imagination to direct their thinking for different purposes. In the context of schooling, critical and creative thinking are integral to activities that require reason, logic, imagination and innovation.

As they develop critical and creative thinking the Australian Curriculum envisages students learning to:

- ▶ pose insightful and purposeful questions;
- ▶ apply logic and strategies to uncover meaning and make reasoned judgments;
- ▶ think beyond the immediate situation to consider the 'big picture' before focussing on the detail;
- ▶ suspend judgment about a situation to consider alternative pathways;
- ▶ reflect on thinking, actions and processes;

- ▶ generate and develop ideas and possibilities;
- ▶ analyse information logically and make reasoned judgments;
- ▶ evaluate ideas, create solutions and draw conclusions;
- ▶ assess the feasibility, possible risks and benefits in the implementation of their ideas; and
- ▶ transfer their knowledge to new situations.

The table (opposite) shows Level 6 of ACARA's critical and creative thinking learning continuum. It is based on the same four areas of activity as Levels 1 to 5:

- ▶ inquiring – identifying, exploring and organising information and ideas;
- ▶ generating ideas, possibilities and actions;
- ▶ reflecting on thinking and processes; and
- ▶ analysing, synthesising and evaluating reasoning and procedures.

There are twelve activities envisaged under these headings.

- ▶ Pose questions
- ▶ Identify and clarify information and ideas
- ▶ Organise and process information
- ▶ Imagine possibilities and connect ideas
- ▶ Consider alternatives
- ▶ Seek solutions and put ideas into action
- ▶ Think about thinking (meta-cognition)
- ▶ Reflect on processes
- ▶ Transfer knowledge into new contexts
- ▶ Apply logic and reasoning
- ▶ Draw conclusions and design a course of action
- ▶ Evaluate procedures and outcomes

The table is offered as a one-page overview of the ACARA critical and creative thinking continuum by showing where it is intended students will travel over the compulsory years of schooling. The ACARA curriculum for critical and creative thinking:

- ▶ assumes and depends on active engagement by students;
- ▶ endorses a positively reflective and critical stance;
- ▶ encourages a process of inquiry and rational analysis;
- ▶ sees value in realistic problem solving involving action;
- ▶ values reasonableness and rationality; and
- ▶ aims to encourage a broad and responsible world view.

Level six of the ACARA critical and creative thinking learning continuum

| Inquiring – identifying, exploring and organising information and ideas | |
|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pose questions | pose questions to critically analyse complex issues and abstract ideas <ul style="list-style-type: none"> questioning to uncover assumptions and inferences and provoke debate about global events |
| Identify and clarify information and ideas | clarify complex information and ideas drawn from a range of sources <ul style="list-style-type: none"> scrutinising contrasting positions offered about events or findings |
| Organise and process information | critically analyse independently sourced information to determine bias and reliability <ul style="list-style-type: none"> critiquing data from known and unknown sources |
| Generating ideas, possibilities and actions | |
| Imagine possibilities and connect ideas | create and connect complex ideas using imagery, analogies and symbolism <ul style="list-style-type: none"> developing hypotheses based on known and invented models and theories |
| Consider alternatives | speculate on creative options to modify ideas when circumstances change <ul style="list-style-type: none"> submitting designed and developed ideas or products for further investigation |
| Seek solutions and put ideas into action | assess risks and explain contingencies, taking account of a range of perspectives, when seeking solutions and putting complex ideas into action <ul style="list-style-type: none"> expressing difficult concepts digitally, kinaesthetically or spatially |
| Reflecting on thinking and processes | |
| Think about thinking (meta-cognition) | give reasons to support their thinking, and address opposing viewpoints and possible weaknesses in their own positions <ul style="list-style-type: none"> reflecting on justifications for approaching problems in certain ways |
| Reflect on processes | balance rational and irrational components of a complex or ambiguous problem to evaluate evidence <ul style="list-style-type: none"> exploring reasons for selecting or rejecting patterns or groupings to represent an idea |
| Transfer knowledge into new contexts | identify, plan and justify transference of knowledge to new contexts <ul style="list-style-type: none"> demonstrating ways ideas gained in an historical or literary context could be applied in a different scenario |
| Analysing, synthesising and evaluating reasoning and procedures | |
| Apply logic and reasoning | analyse reasoning used in finding and applying solutions, and in choice of resources <ul style="list-style-type: none"> testing propositions to identify reliability of data and faulty reasoning when designing new products |
| Draw conclusions and design a course of action | use logical and abstract thinking to analyse and synthesise complex information to inform a course of action <ul style="list-style-type: none"> using primary or secondary evidence to support or refute a conclusion |
| Evaluate procedures and outcomes | evaluate the effectiveness of ideas, products and performances and implement courses of action to achieve desired outcomes against criteria they have identified <ul style="list-style-type: none"> strengthening a conclusion, identifying alternative solutions to an investigation |

Comment

22

In summary we have seen an emphasis on critical thinking and the thinking curriculum discourages rote learning and recognises the limitations of discipline areas and the danger of reducing education to literacy and numeracy. Developing a thinking curriculum can improve teaching and learning at a fundamental level. According to the critical thinking movement, subject content has to be seen as a way of learning how to think, and the climate of a class and a whole school has to encourage and value critical and creative thinking.

Two main threads run through the discussion above. The first is whether the development of critical thinking skills is to be a study in itself, and this issue has been settled in Australia by ACARA making 'Critical and creative thinking' a general capability. The second thread is how critical thinking is to be integrated into the learning areas and subjects.

Some proponents of the 'thinking curriculum' would integrate and organise the whole school program around learning to think. But such a radical reorientation is not obligatory for giving explicit attention to the development of critical thinking skills. An individual teacher as well as a faculty or a whole school can set out to make thinking visible and to teach higher-order thinking in the learning areas.

While developing the thinking skills of students is a matter establishing a climate and culture, we have seen above that there are many specific and concrete routines for critical thinking that can be taught and learned. Because critical thinking is more a skill that involves attitudes and dispositions than a body of knowledge, it is beneficial to deliberately and explicitly cultivate higher-order thinking skills, meta-cognitive thinking and a questioning and critical stance in students.



Project Zero

For more information on Project Zero's practice and research, visit the website.

<http://www.pz.harvard.edu/>

Cognitive Research Trust

The CoRT Thinking Programme of Edward de Bono.

<http://edwarddebonofoundation.com/index.php/cort/>

http://www.debonogroup.com/six_thinking_hats.php

The Critical Thinking Community

Richard Paul and Linda Elder

<http://www.criticalthinking.org/>

<http://www.criticalthinking.org/pages/critical-thinking-where-to-begin/796>

The Critical Thinking Consortium

Roland Case

<http://tc2.ca/teaching-resources/online-resource-collections/tools-for-thought.php>

Cognitive acceleration

Philip Adey and Michael Shayer

<http://www.cognitiveacceleration.co.uk/>

Thinking Through Series

<http://www.teachingexpertise.com/publications/thinking-through-school-1220>

Debatepedia

<http://dbp.idebate.org/en/index.php/Debatepedia:Contents>

A note on further reading

There is a voluminous body of articles and books on critical thinking. There are no unarguably crucial or central texts for the critical thinking movement. The most important advocates of critical thinking and approaches to critical thinking are outlined above, and they may be followed from the internet links and references below.

Two books and one magazine are worthy of particular attention. *Teaching for Better Thinking: The Classroom Community of Inquiry* by Laurance Splitter and Ann Sharp is a valuable overview of thinking issues from a Philosophy for Children perspective (Splitter, 1995). A similar perspective is found in the eclectic and practical chapters of *Designing a Thinking Curriculum* edited by Sue Wilks (Wilks, 2005). The American magazine *Educational Leadership* of February 2008 has an excellent set of articles that offer an overview of key issues in the teaching and learning of critical thinking.

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