CRITICAL THINKING: SKILL DEVELOPMENT FRAMEWORK

Jonathan Heard, Claire Scoular, Daniel Duckworth,
Dara Ramalingam and Ian Teo

CARI

ACER

The Australian Council for Educational Research Ltd
19 Prospect Hill Road
Camberwell VIC 3124
Phone: (03) 9277 5555
ABN 19 004 398 145

www.acer.org

ISBN 978-1-74286-581-2

Recommended APA citation

Heard J., Scoular, C., Duckworth, D., Ramalingam, D., & Teo, I. (2020). *Critical thinking: Skill development framework*. Australian Council for Educational Research. https://research.acer.edu.au/ar_misc/41

CONTENTS

1 CRITICAL THINKING FOR THE 21ST CENTURY

The development of critical thinking as an essential skill in 21st-century learning is uncontested within educational and professional settings. The degree to which it is operationally defined, taught and assessed, however, is not well documented. This complicates efforts to develop critical thinking in learners, as well as devise intervention techniques and assessment tools.

The ACER critical thinking skill development framework has been developed to address the challenges associated with teaching and assessing critical thinking. While there are many definitions of the skill, which are outlined in the first part of this document, few provide a means to operationalise critical thinking in the classroom. This framework outlines critical thinking processes along prescribed *strands* and *aspects* informed by a sound evidentiary basis. The aspects contained within the framework are designed to provide foci for teaching and the basis of assessment.

Aligned with the nature of the classroom, the proposed framework characterises critical thinking as cognitive processes that are ultimately goal directed and purpose driven. Whether that purpose is to solve a problem, support a theory or statement, conduct an experiment, formulate an argument, present an interpretation, undertake a critique, better understand a topic or decide on a course of action, the skills presented assume that critical thinking is not simply reflective thought; it is also applied and generative.

As a teaching and assessment resource, the ACER critical thinking framework seeks to describe critical thinking as a generally applicable set of skills that can be operationalised in classroom practice. The skill can be described and understood in a generalised way that can be applied across disciplines, with this framework providing a consistent terminology in which to do so. The aspects can be used to write or map assessment items, or the aspects can be integrated into lesson plans. The skill needs to be embedded within the methodologies, conventions and 'ways of knowing' of each of the disciplines to give their application context, to ensure they are relevant, and that they can be sustainably integrated.

2 DEFINITIONS AND USES OF CRITICAL THINKING

Within the knowledge economy, the process of developing critical thinkers has become one of the goals of education as this skill is believed to further develop the capabilities and potential of nation states. Accordingly, when individuals are capable of using their critical thinking skills to successfully act on opportunities, it can be expected that growth and benefits for the knowledge economy should follow. Given these benefits for individuals and the broader community, it is no wonder that the development of critical thinking skills is so sought after (Abrami et al., 2008; Penkauskiene et al., 2019; Society for Human Resource Management, 2008; UNESCO, 2019a, 2019b, 2020; World Bank, 2018).

The term 'critical thinking' is reserved by some, particularly from the philosophical tradition, to refer to a form of reflective thinking directed toward the analysis and evaluation of existing communication, information and arguments, particularly through the use of logic and reason (e.g. Beyer, 1985; Browne & Keeley, 2011; Dewey, 1910; Fisher & Scriven, 1997). Dewey's original definition of 'reflective thinking' was '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' (1933, p. 9). This focus on reflective evaluation is captured also in McPeck's description of critical thinking as 'reflective scepticism' (1981). Thus conceived, critical thinking is described by Siegel as an embodiment of rationality and an adherence to principled (non-arbitrary, impartial and objective) thinking (Siegel, 1980). Mathew Lipman's (1988) definition emphasises the evaluative nature of critical thinking in supposing that the outcomes of critical thinking are ultimately judgements; critical thinking is thus 'skilful, responsible thinking that facilitates good judgement because it 1) relies upon criteria, 2) is self-correcting, and 3) is sensitive to context' (1988, p. 39). This may necessitate drawing from logic to inform critical evaluation (Facione, 1990) and conclusions (O'Neill, 1994; Ong et al., 2018; Paul & Elder, 1999a, 1999b). Some definitions from within this philosophical tradition acknowledge the role of critical thinking not only in the analysis and evaluation of arguments but in the formulation of them as well (Epstein, 2005; Facione, 1990; Moore & Parker, 2012).

David Hitchcock notes that while some definitions from within the philosophical tradition 'treat critical thinking as concerned only with the appraisal of already existing intellectual products' (2017, p. 6) others see it as also applying to the generation of new intellectual products. For example, Robert Ennis's seminal definition – 'reasonable reflective thinking focused on deciding what to believe or do' (1985) – extends the outcomes of critical thinking not only to judgements about what to believe but to actions as well. His definition extends to include decision-making, and therefore posits that critical thinking is an activity with practical applications. He offers 'deciding on an action' as one of many abilities of a critical thinker and describes it as being marked by the following skills or stages:

- define problem
- select criteria to judge possible solutions

- formulate alternative solutions
- tentatively decide what to do
- review, taking into account the total situation, and decide
- monitor implementation.

To this end, Ennis's definition appears to straddle something of a divide in the conceptions of critical thinking: between those from the educational philosophy tradition and those within the field of psychology. Reviews of the literature (Lewis & Smith, 1993; Black, 2007; Lai, 2011) point out that psychological conceptions of critical thinking tend to emphasise the application of analysis and evaluation to problem-solving and decision-making situations, rather than to forms of knowledge or argumentation (Kuhn, 1999; Tarricone, 2011). For example, Halpern's definition (1998) emphasises the application of cognitive skills and strategies to increase the likelihood of desirable outcomes, whereby these outcomes are set by individuals and serve to frame critical thinking as being 'purposeful, reasoned and goal directed' (p. 450). Pivotal within this process are the methods by which individuals identify patterns and form connections between information sources to distil meaning: a process that is likely iterative when trying to problem solve (Fisher & Scriven, 1997; Halpern, 1998; Watson & Glaser, 1964).

Associations with other skills

In surveying critical thinking literature, it is clear there are associations and relationships between other skills such as metacognition, problem-solving and information literacy that have contributed to forming definitions of critical thinking. For example, Halpern (1998) views critical thinking as integral to problem-solving, logical inference, calculating probabilities and decision-making. Sternberg (1986) similarly considers critical thinking from the perspective of the mental processes and strategies (metacomponents, performance components and knowledge-acquisition components) used to solve applied problems, make decisions, and adapt and learn new concepts. Indeed, many definitions of critical thinking incorporate an aspect of decision-making or problem-solving within them (Moore, 2010; Willingham, 2007) and emphasise the importance of setting criteria to inform this process (Facione, 1990; Lipman, 1987; Moore, 2010).

Although Sternberg (1986) considers metacomponents as a single entity among the component skills of critical thinking – higher order executive processes used to plan, monitor, and evaluate – Kuhn (1999, pp. 17–18) proposes that the most relevant cognitive competencies to critical thinking are all metacognitive (meta-knowing skills) rather than cognitive skills, and can be broken down into three broad categories:

- metastrategic (e.g. the selection and monitoring of strategies that are applied to procedures)
- metacognitive (e.g. asking 'What do I know, and how do I know it?')
- epistemological (e.g. wondering 'How does anyone know?').

While perhaps less problematic within the discipline of psychology, other researchers (Jones et al., 1995) following Kurfiss (1988) have argued for clarification between

critical thinking and problem-solving. While seen as related constructs, they have maintained that problem-solving is more often thought to involve well-defined problems with limited solutions, and is associated with the disciplines of maths and science. In contrast, critical thinking describes processes involving open-ended reasoning about ill-defined problems or questions, and has tended towards being associated with the social and behavioural sciences. Fisher and Scriven (1997) believe the two concepts do overlap but are distinct, as some forms of critical thinking cannot be said to be problem-solving exercises in any commonly-accepted sense of the term, and vice versa. Even ill-structured problems, they argue, may require critical thinking to define, but not to solve. Further confusing the relationship of problem-solving to critical thinking, Ennis treats critical thinking, problem-solving (and creative thinking) as theoretically distinct – yet describes them as 'thoroughly interdependent in practice' (Ennis, 1981, pp. 145–146).

Another field that engages in, and usefully seeks to apply, critical thinking within its definitions and models is that of information literacy. While information literacy entails procedural skills not usually associated with critical thinking, such as the retrieval, management, storage, referencing and communication of information (Chartered Institute of Library and Information Professionals [CILIP], 2018), Paul and Elder suggest information literacy is dependent on critical thinking to 'provide the tools for assessing information', and they account for information literacy as 'an aspect or dimension of critical thinking' (2007, p. 9). From a psychological standpoint, information literacy can be seen at least in part as the exercise of some of the knowledge-acquisition components of critical thinking, such as selective encoding ('screening relevant from irrelevant information'), selective combination ('putting together the relevant information in a coherent and organized way') and selective comparison, ('relating old, previously known information to new, about to be learned information') (Sternberg, 1986, p. 10).

Several writers within the information literacy field emphasise this strong connection between the two constructs. Comparative reviews of the conceptions of information literacy and critical thinking (Allan, 2008; Hollis, 2019; Weiner, 2011) find significant overlap between them. Positive associations between the two constructs have also been found in a correlational analysis of information literacy and critical thinking assessments (Wertz et al., 2013), wherein the authors suggest that while the constructs are not synonymous, there is 'enough commonality to suggest that they are fundamentally connected' (2013, p. 2).

Not surprisingly then, definitions of information literacy commonly share some of the conceptual terrain marked out in definitions of critical thinking, but apply it specifically to thinking about knowledge and information. For example, the American Library Association's oft-cited 1989 definition draws upon ideas of metacognitive knowing about the state of one's knowledge (e.g. Kuhn, 1999) and evaluation of information (e.g. Facione, 1990; Fisher & Scriven, 1997):

> *To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information (American Libraries Association [ALA], 1989).*

Acknowledging the recent change in the information landscape, primarily due to rises in internet use and the susceptibility to manipulation of open-access online information sources, the recent update to the CILIP definition of information literacy more strongly associates it with applied critical thinking focused on evaluation:

> *Information literacy is the ability to think critically and make balanced judgements about any information we find and use. It empowers us as citizens to develop informed views and to engage fully with society (CILIP, 2018).*

Grafstein (2017) further articulates the centrality of critical thinking to conceptions of information literacy, stating that the literature on information literacy most often emphasises 'the ability to 1) identify and articulate an information need for a particular purpose, 2) understand how to find information sources that are appropriate to the information needed, 3) distinguish appropriate from inappropriate sources for a particular purpose, and 4) critically assess the information gathered.' (pp. 4–5). Several models and frameworks of information literacy such as the Big6 (Eisenberg & Berkowitz, 1990), SCONUL Seven Pillars of Information Literacy (Bent & Stubbings, 2011), UNESCO Information Literacy Indicators (Catts & Lau, 2008) and the Standards for the 21st Century Learner (American Association of School Librarians, 2007) share these as assumed core competencies of information literacy and variously present them as necessary skills or stages in the construction of valid knowledge.

Detailed definitions of critical thinking

In an attempt to develop a clear, universally acceptable, interdisciplinary definition of critical thinking, the 1988–1990 American Philosophical Association's (APA) Delphi Project, led by Peter Facione (1990), engaged a panel of 46 experts from a range of disciplines in the humanities, sciences, social sciences, and education. This project was live for two years and the resulting definition determined that critical thinking involves:

> *purposeful, self-regulatory judgement which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or conceptual considerations upon which that judgement is based (Facione, 1990, p. 3).*

The resulting APA framework of critical thinking defines six core skills: interpretation, analysis, inference, evaluation, explanation and self-regulation. Each core skill is supported by a set of subskills, which are presented in Table 1.

The dispositions of a critical thinker

In the process of developing their own operational framework for teaching critical thinking, Thomas and Lok (2015, p. 95) composed a consolidated summary of the critical thinking skills identified across 16 different definitions; they found that some or all of the set of core skills contained within the Delphi Project's definition form the basis of most other definitions they reviewed. This suggests the Delphi definition and framework constitute one of the more comprehensive definitions of critical

thinking. However, in additional to these skills, the Delphi panel identified an additional dimension to critical thinking in the forms of dispositions. This understanding was key for panellists, as they noted that critical thinking skills needed to be paired with complementary dispositions to be 'exercised appropriately' (p. 20) and achieve the goal of being a well-rounded critical thinker (Abrami at al., 2015); see Table 2.

Table 1 Core critical thinking skills

Skill	Experts' consensus description	Subskills
Interpretation	Comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgements, conventions, beliefs, rules, procedures or criteria.	• Categorisation • Decode significance • Clarify meaning
Analysis	Identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other forms of representation intended to express beliefs, judgements, experiences, reasons, information, or opinions.	• Examine ideas • Identify arguments • Identify reasons and claims
Evaluation	Assess the credibility of statements or other representations that are accounts or descriptions of a person's perception, experience, situation, judgement, belief, or opinion; and to assess the logical strength of the actual or intended inferential relationships among statements, descriptions, questions or other forms of representation.	• Query evidence • Conjecture alternatives • Draw logically valid or justified conclusions
Inference	Identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypotheses; to consider relevant information and to reduce the consequences flowing from data, statements, principles, evidence, judgements, beliefs, opinions, concepts, descriptions, questions, or other forms of representation.	• Assess credibility of claims • Assess quality of arguments using inductive and deductive reasoning
Explanation	To state the results of one's reasoning; to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological and contextual considerations upon which one's results were based; and to present one's reasoning in the form of cogent arguments.	• State results • Justify procedures • Present arguments
Self-regulation	Self-consciously to monitor one's cognitive activities, the elements used in those activities, and the results educed, particularly by applying skills in analysis and evaluation to one's own inferential judgements with a view toward questioning, confirming, validating, or correcting either one's reasoning or one's results.	• Self-monitor • Self-correct

Adapted from Facione (1990)

Table 2 Affective dispositions of critical thinking

Approaches to life and living in general	Approaches to specific issues, questions or problems
Inquisitiveness with regard to a wide range of issues	Clarity in stating the question or concern
Concern to become and remain generally well-informed	Orderliness in working with complexity
Alertness to opportunities to use CT	Diligence in seeking relevant information
Trust in the processes of reasoned inquiry	Reasonableness in selecting and applying criteria
Self-confidence in one's own ability to reason	Care in focusing attention on the concern at hand
Open-mindedness regarding divergent world views	Persistence though difficulties are encountered
Flexibility in considering alternatives and opinions	Precision to the degree permitted by subject and circumstances
Understanding of the opinions of other people	
Fair-mindedness in appraising reasoning	
Honesty in facing one's own biases, prejudices, stereotypes, egocentric or sociocentric tendencies	
Prudence in suspending, making or altering judgements	
Willingness to reconsider and revise views where honest reflection suggests that change is warranted	

Adapted from Facione (1990)

Accordingly, dispositions are seen to refer to personal affective attributes[1], while skills refers to a range of cognitive sets that can developed, refined and used to achieve an outcome, much like physical skills (Facione, 2015). Ennis (2011a) has argued that dispositions and abilities are not mutually exclusive components of critical thinking, but are both integrated and operate in parallel. When considering the presentation of ideal critical thinkers, for example, he holds that critical thinking dispositions lead such people to pursue the truth and present it clearly, while their abilities enable them to clarify, negotiate different views, infer, hypothesise, integrate and successfully achieve an end. Ennis's (2011b) own model of critical thinking collapses the disposition–skill dimensions into an alternative (albeit complementary) framework to the Delphi Project (Facione, 1990), and emphasises the employment of *abilities* rather than *skills*. Table 3 provides a description of Ennis's general dispositions–abilities framework.

[1] For example, the 'personal traits, habits of mind, attitudes or affective dispositions … [that] … characterise good critical thinkers' (Facione, 1990, p. 23)

Table 3 Outline of general critical thinking dispositions and abilities

Dispositions **Ideal critical thinkers are disposed to:**	**Abilities** **Ideal critical thinkers have the ability to:**
• Seek and offer clear statements of the conclusion or question • Seek and offer clear reasons, and be clear about their relationships with each other and the conclusion • Try to be well-informed • Use credible sources and observations, and usually mention them • Take into account the total situation • Keep in mind the basic concern in the context • Be alert for alternatives • Be open-minded • Seriously consider other points of view • Withhold judgement when the evidence and reasons are insufficient • Take a position and change a position when the evidence and reasons are sufficient • Seek as much precision as the nature of the subject admits • Seek the truth when it makes sense to do so, and more broadly, try to 'get it right' to the extent possible or feasible • Employ their critical thinking abilities and dispositions	**Basic clarification** • Focus on a question • Analyse arguments • Ask and answer clarification questions • Understand and use elementary graphs and maths **Bases for a decision** • Judge the credibility of a source • Observe, and judge observation reports • Use existing knowledge: - background knowledge, including (with discrimination) internet material - their knowledge of the situation - their previously-established conclusions **Inference** • Deduce and judge deductions • Make and judge inductive inferences and arguments • Enumerative induction • Argument and inference to best explanation • Make and judge value judgements **Advanced clarification** • Define terms and judge definitions • Handle equivocation appropriately • Attribute and judge unstated assumptions • Think suppositionally • Deal with fallacy labels • Be aware of, and check the quality of, their own thinking ('metacognition') • Deal with things in an orderly manner **Non-constitutive, but helpful** Employ rhetorical strategies

Source: Ennis (2018)

Thus, a review of the literature suggests that there may be as many definitions of critical thinking as there are researchers who have attempted to investigate this topic (McCurry et al., 2013). That said, it is generally accepted that critical thinking comprises of at least two interrelated dimensions, these being a range of skills or abilities and dispositions. Both are captured in a particularly detailed, early explication of what critical thinking entails, offered by Edward Glaser:

> *Critical thinking requires ability to recognize problems, to find workable means for meeting those problems, to gather and marshal pertinent information, to recognize unstated assumptions and values, to comprehend and use language with accuracy, clarity, and discrimination, to interpret data, to appraise evidence and evaluate arguments, to recognize the existence (or non-existence) of logical relationships between propositions, to draw warranted conclusions and generalizations, to put to test the conclusions and generalizations at which one arrives, to reconstruct one's patterns of beliefs on the basis of wider experience, and to render accurate judgements about specific things and qualities in everyday life. (1941, p.5)*

In summary, Glaser specified that the ability to think critically involves three things:

1. an attitude of being disposed to consider, in a thoughtful way, the problems and subjects that come within the range of one's experiences
2. knowledge of the methods of logical inquiry and reasoning
3. some skill in applying those methods.

In addition, and though it predates the more recent differences of opinion between educational philosophers and psychologists noted earlier, this definition offers something of a synthesis of many of the component skills that characterise each of their respective views. While clearly privileging Deweyan ideas of reflective thinking and the skills of appraising existing intellectual products (Hitchcock, 2017), Glaser's definition can also can be seen to suggest the generation of solutions and decisions. This comes through its references to recognising, considering and 'find[ing] workable means for meeting' problems, and the implication that we 'marshal information' and 'put to test' our conclusions in some practical and applied way.

The generality of critical thinking

An approach to critical thinking that emphasises the instruction and application of general critical thinking principles and skills is arguably the dominant paradigm within public discourse and research settings (Coney, 2015; Moore, 2004). The main advantages of such practices are assumed to be utility across any subject studied and the ease with which it can be taught. For example, by providing learners with broad questioning techniques[2] for inspection and application in their area of study, 'there is no reason in principle [why] students cannot take the basic tools of thought which they learn in one domain of study and extend it … to all the other domains and subjects which they study' (Paul et al., 1997, p. 4).

[2] For example, 'What is the fundamental question here?', 'Are my assumptions correct?', 'What can I infer from this data?', or 'Is this source credible?'.

Facione's (1990) broad definition and list of core skills and subskills stemming from the Delphi Project, for example, reveal that the panel involved did not regard critical thinking skills as limited to specific contexts and situations, but argued for their application across and within people's personal and civic lives. In particular, the absence of any specified context and situation within the aforementioned definition, reflects the panel's belief that critical thinking skills 'transcend' (p. 10) the need to be associated with situated experiences or practices. That said, this stance was also balanced against an acceptance that the ability to successfully exercise critical thinking may require 'domain-specific knowledge … methods and techniques … to make reasonable judgements in specific contexts' (p. 10). Ennis's (2011b) own model of critical thinking similarly provides a framework of general dispositions and abilities.

Proponents of the argument that critical thinking is context-specific, however, maintain that generalist theories of critical thinking under-appreciate the extent to which it manifests as a negotiated process between one's experiences and critical thinking strategies (McPeck, 1981). The corollary of this negotiated process is that a person's previous experience or degree of expertise in a given context determines their abilities to think critically within that context and, in particular, discriminate among information sources that shape their assumptions (Blum & Spangehl, 1977; Brookfield, 1997; Mezirow, 2009). The degree to which a person is able to engage with a challenge successfully is therefore determined by their past exposure to and engagement with in-context standards and norms, and suggests that increased exposure to such experiences will increase their expertise to critically think and act.

The notion that context-specific critical thinking informs our assumptions and experiences (Brookfield, 1997) (e.g. through formal schooling or tacit learning), also implies a developmental process or hierarchy of cognitive modes (Moore, 2013). In practice, defining critical thinking within situated contexts and accordingly to cognitive modes can be seen in research relating to the following professions:

- nursing (Adib-Hajbaghery & Sharifi, 2017; Oermann et al., 2000; Scheffer & Rubenfeld, 2000)
- medicine (Du et al., 2013; Latif et al., 2018)
- law (James & Burton, 2017; James et al., 2010; Powell et al., 2017)
- teaching and education (Basri et al., 2019; Christie et al., 2016).

Generalists argue for the utility of broad principles, questions and practices to bring about critical thinking, while those who oppose this maintain that critical thinking can only be meaningfully discussed, instructed and practiced within situated contexts. While one outcome of this debate has been a sizeable body of literature, other outcomes have included sustained dialogues and lines of research that have been myopic and polarising. For example, Moore (2004) has argued that the rigidity of arguments between frameworks has been due, in part, to philosophers and cognitive scientists debating from within their respective fields, with few attempts to engage cross-disciplinary issues. Additionally, Davies (2006) has stated that the often-contested nature of critical thinking has served to present a false dichotomy or 'fallacy of the false alternative' (p. 180) when this need not be the case.

Davies' own view suggests that both approaches may be important for teaching and practicing critical thinking, and might be married by emphasising and situating broad

principles (e.g. identifying sound reasoning, logic and inferences) within contexts. Davies cites Ikuenobe's (2001) efforts, for example, when describing how critical thinking might develop from a mixed approach. In seeking to engender critical thinking abilities to university students taking an Informal Logic course, Ikuenobe proposed a scaffolded pedagogy that involved teaching and reinforcing general principles at the start of students' learning, through to the instruction of more context-specific applications as they gained further expertise in their studies. Davies' and Ikuenobe's arguments for a mixed approach to instruction seem intuitive and progressive, and are echoed by panel findings from the Delphi Project (Facione, 1990) which also acknowledged that while the instruction of critical thinking skills might be suited to stand-alone classes or subjects, it was also likely that such instruction 'can occur in programs rich with discipline-specific content ... [as efforts to learn and apply] … these skills in many contexts requires domain-specific knowledge' (p. 10).

Such perspectives indicate that while there is dependency of discipline-specific knowledge on critical thinking, and that it 'takes on the particularities of the discipline in which it resides', there are nevertheless some identifiable core critical thinking abilities that are both general in nature and generally applicable (Jones, 2015, pp. 169–170).

3 THE ACER CRITICAL THINKING SKILL DEVELOPMENT FRAMEWORK

The ACER critical thinking skill development framework describes critical thinking within strands (core elements) that are then further qualified as aspects (sub-elements). Specifically, a strand refers to the overarching conceptual category for framing the skills and knowledge addressed by critical thinking assessments, while an aspect refers to the specific content category within a strand. Specifically, the ACER framework comprises three strands, with each strand containing three aspects (summarised in Figure 1 and described in detail). The aspects encompass the set of knowledge, skills, and understanding held in common by the range of definitions of critical thinking discussed previously.

Accordingly, the formal definition provided holds that:

> *To think critically is to analyse and evaluate information, reasoning and situations, according to appropriate standards such as truth and logic, for the purpose of constructing sound and insightful new knowledge, understandings, hypotheses and beliefs. Critical thinking encompasses the subject's ability to process and synthesise information in such a way that it enables them to apply it judiciously to tasks for informed decision-making and effective problem-solving.*

An assumption that underpins the ACER framework is that while it may be theoretically possible in definitions of critical thinking to distinguish underlying abstract skills (e.g. Facione, 1990), these skills in practice become operationalised simultaneously, or in a near-simultaneous manner, when authentic critical thinking tasks are performed. Though there is much agreement in the literature that critical thinking comprises at least the abilities of inference and evaluation, as well as analysis, interpretation, explanation and self-regulation (Thomas & Lok, 2015) it is often the case that, in our natural, everyday use of critical thinking, these (and other) skills are employed in

parallel with each other rather than discretely or in isolation. For example, in practice, to evaluate an argument is the near-simultaneous result of reading or listening, interpreting, analysing and inferring from it, while also continually judging it against criteria, and monitoring and self-correcting one's own evaluation. Further to this, it is not necessarily the case that to 'analyse', to 'self-regulate' or to 'evaluate' are the same skill in all applied contexts; being able to evaluate a source of information for reliability is not the same as being able to evaluate the logic of an argument or one's options within a decision. Functionally, the same abstract skill manifests as different skills within different applications. Thus, for the purpose of assessment, the strands are each delineated based upon different applications of critical thinking: to construct knowledge, to evaluate reasoning and to make decisions. Within the aspects of each of these, it is assumed a combination of core critical thinking skills are being applied simultaneously to produce the desired outcome.

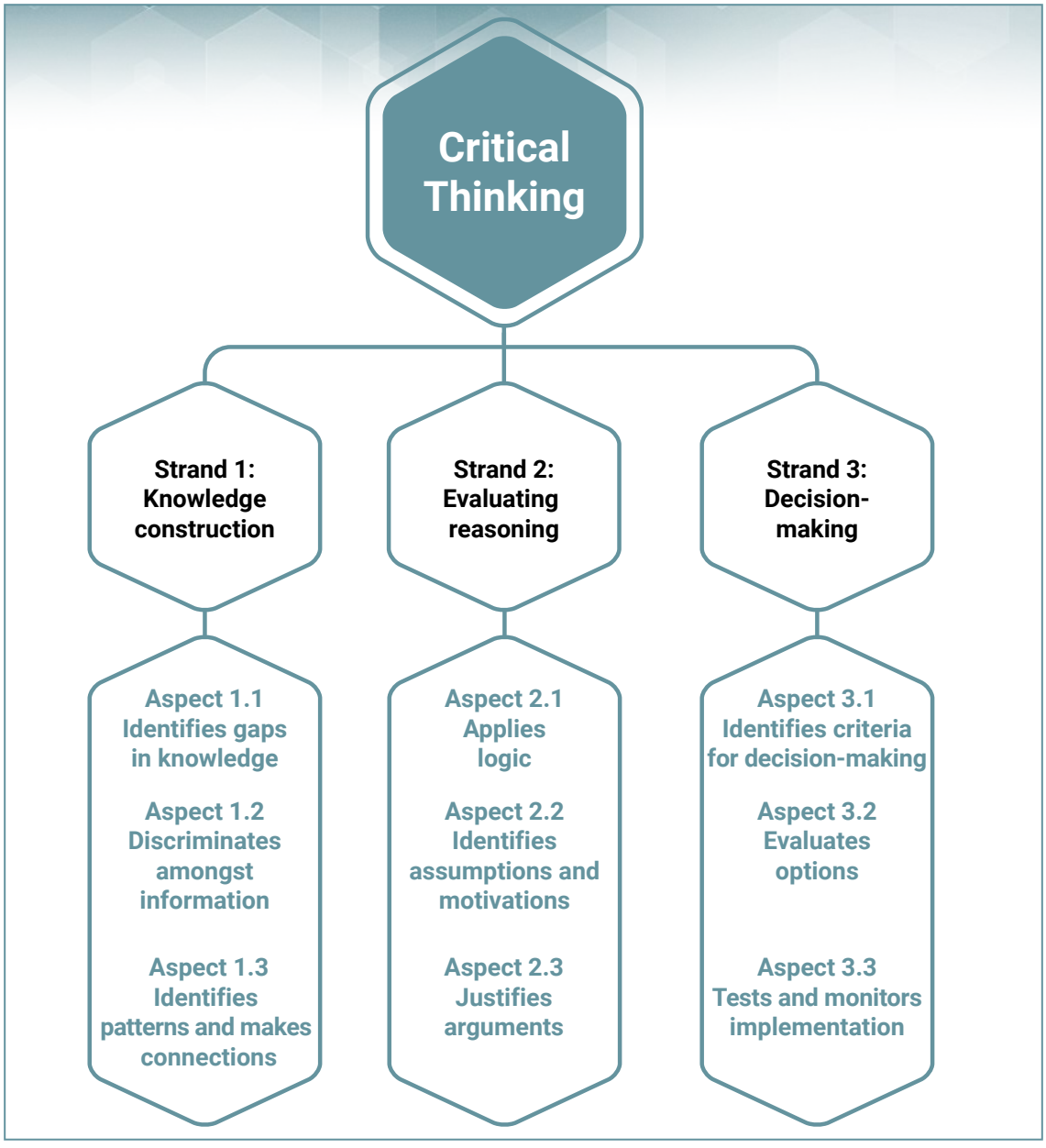

Figure 1 ACER's critical thinking skill development framework

Strand 1 Knowledge construction

Knowledge construction relates to the kind of reflective and evaluative engagement with information that is required to make accurate sense of it. It involves establishing what we know and what we need to know, what information seems plausible, useful and reliable, and how it can best be organised to derive explanatory sense and meaning from it.

Aspect 1.1 Identifies gaps in knowledge

Identifying gaps in knowledge is about discerning what information or evidence one needs in order to know or believe something, to understand an issue, or to address a problem or task (Kuhn, 1999; ALA, 1989). It involves analysing and evaluating what one already knows, and recognising that one may not have all of the information required (Bent & Stubbings, 2011), or that one may be operating under certain misconceptions. Acknowledging possible deficiencies in one's own understanding may take the form of posing questions to prompt further investigation and enquiry (Ennis, 2018). It also involves a disposition towards considering, if not necessarily incorporating, information from different sources or differing perspectives to bridge gaps in understanding and gain a fuller picture of the situation or issue (Facione, 1990; Glaser, 1941).

Aspect 1.2 Discriminates amongst information

Once information has been sourced, collected and read, in order to think critically about its content, it needs to be evaluated through the application of criteria (Grafstein, 2017; Paul & Elder, 2007). Discriminating amongst information and evidence includes identifying and evaluating factors such as the currency, reliability, relevance, authorship, completeness or veracity of it. It may include distinguishing fact from opinion, determining the strength of evidence provided for a given claim and discerning information that is directly useful for one's purposes from that which is not (Brookfield, 1997; Fisher & Scriven, 1997; Sternberg, 1986)

Aspect 1.3 Identifies patterns and makes connections

This aspect refers to the act of reflecting on and organising information such as data, evidence, statements, questions, concepts, opinions, and other forms of representation, in order to create sense and meaning from it (Sternberg, 1986; Watson & Glaser, 1964). It requires the ability to analyse and sort information to find patterns and construct conceptual relationships within it (Fisher & Scriven, 1997). This often leads to the formulation via induction of tentative 'rules' or theories to best explain these patterns, on the basis of generalisations derived from them (Ennis, 2018). It also involves the recognition of exceptions and counter-examples, and the possible significance of these.

Strand 2 Evaluating reasoning

Evaluating reasoning refers to the thinking required to discern the validity of arguments, scientific theories, statements, proofs and other formulations of ideas. It involves analysing and evaluating verbally-constructed arguments, sets of propositions and other non-verbal representations of information and relationships to identify the premises that underpin a conclusion or truth claim, judging the logic of how conclusions are reached, and ensuring one's own arguments or formulations are sound. Reasoning itself can be represented in a variety of forms such as verbal, spatial, abstract, numerical, mechanical, algorithmic and graphical. When working in complex problem-solving contexts, a variety of representations of reasoning may be present.

Aspect 2.1 Applies logic

Applying logic involves being able to reason through sets of propositions, rules, conditions, statements, and premises to arrive at a true or valid conclusion (Dewey, 1933; Ennis, 2018; Facione, 1990; Glaser, 1941). It requires the ability to apply concepts of propositional logic such as inference, causality, contradiction, and consistency. Applying logic can be done reflectively to evaluate the truth or validity of a given conclusion. It can also be applied predictively (i.e. beyond the parameters of a given argument or set of conditions) in order to make sound predictions as to what an argument or set of conditions mean – or whether they are still valid – in a different context (Ong et el., 2018). It entails the ability to identify fallacies and technical flaws in various representations of reasoning (Paul & Elder, 1999a; 1999b).

Aspect 2.2 Identifies assumptions and motivations

Beyond evaluating the technical aspects of an argument (or other representations of reasoning) as it is presented, critical thinking also requires the ability to identify and evaluate the un-presented elements that operate within one's own – or someone else's – reasoning. It involves identifying where certain conclusions are predicated on assumptions, what assumptions these are, and whether they are reasonable (Ennis, 2018; Glaser, 1941). Related to this, it entails the ability to think sceptically about opinions, explanations or propositions made, in order to identify possible biases that may be governing the line of reasoning presented, and the values or beliefs that may be motivating these (McPeck, 1981; Mezirow, 2009).

Aspect 2.3 Justifies arguments

Justifying arguments involves the ability to formulate one's ideas, and hold one's own claims and opinions to account by supporting them with evidence and sound reasoning, and avoid biases in one's own reasoning (Fisher & Scriven, 1997). It also demands the ability to predict, both accurately and logically, the consequences of what one is proposing. It requires an ability to explain the evidence and reasoning that leads one to make a claim (Newmann, 1990) and includes the capacity to rebut challenges to one's argument, but also to acknowledge the potential limitations of it (Siegel, 1980).

Strand 3 Decision-making

While related to problem-solving, decision-making is distinct in that it only necessarily requires the analytical and evaluative – rather than the generative or creative – aspects of problem-solving, thus aligning more neatly within a framework of critical thinking.

Aspect 3.1 Identifies criteria for decision-making

To make an effective decision, one first needs to understand the problem or situation about which a decision needs to be made, in order to derive criteria for judging the decision (Ennis, 1985; Moore, 2010). Understanding the criteria for a decision, therefore, requires not only the analysis of the current situation in terms of constraints and demands but the ability to recognise what would constitute an ideal outcome (Facione, 1990; Lipman, 1987).

Aspect 3.2 Evaluates options

Having established, or been given, criteria against which to judge possible conclusions, an ability to analyse and evaluate the strengths and limitations of each possible course of action is fundamental to decision-making (Ennis, 1985) and an aspect of applied critical thinking (Glaser, 1941). It involves assessing how well certain options will satisfy the demands of a given challenge or problem while still operating within the conditions or constraints imposed by the situation (Jimenez-Aleixandre & Puig, 2012). Even when all available options have been evaluated, an ideal solution may still not emerge; a crucial aspect of evaluating options, therefore, is determining which option will 'increase the probability of a desirable outcome' (Halpern, 1998).

Aspect 3.3 Tests and monitors implementation

Having made a decision, or come to a conclusion, after formulating a sound theoretical justification for it (see Aspect 2.3: Justifying arguments), a critical thinker tests the effectiveness of their decision, by monitoring its actual impacts and implications (Ennis, 1985; Glaser, 1941; Sternberg, 1986). This requires the ability to analyse objectively and accurately the positive and negative effects of a decision or conclusion, comparing these results or feedback against the intended outcomes, fairly identifying factors that may be causing any unintended and/or undesirable outcomes, and re-evaluating the decision or conclusion, making adjustments where possible.

4 SKILL DEVELOPMENT LEVELS

ACER's perspective of skills in the application of knowledge is centred on and emphasises the notion of growth. Skills can be defined from a growth aspect, can be improved through teaching and intervention, and can be measured.

Levels of skill development are used to describe how growth in a particular area can be demonstrated, and how learners move from early, to more advanced application and understandings. These levels of skill development are focused on assessing and monitoring learner growth over time, and are underpinned by an understanding that learners of the same age and in the same year of school can be at very different points in their learning and development. Therefore, they are not linked to specific years of schooling. When assessments provide information about where learners are in their understanding at the time of assessment, they also provide a basis for monitoring individual progress over time. Assessments of progress are an alternative to judging success only in terms of year-level standards.

While progress can be described in a general way – what a highly proficient critical thinker demonstrates compared to a less proficient critical thinker for example – the application of the skill is still dependent on the domain context. The level of application in one learning area will not necessarily transfer equally to another learning area.

The ACER skill development levels for critical thinking are provided below for each strand (Tables 4, 5 and 6). The levels of skill development are intended to support understanding of the skills and how they develop. They can also support teachers to identify gaps in a learning area, where some learners may require further assistance. To ensure an evidence-based approach, these levels have been, and continue to be validated and corroborated through comparison of assessment data.

Table 4 Levels of skill development for Strand 1: Knowledge construction

Strand 1: Knowledge construction			
	Aspect 1.1 Identifies gaps in knowledge	**Aspect 1.2** Discriminates information	**Aspect 1.3** Identifies patterns and makes connections
High	Learners identify the knowledge requirements necessary to solve a problem, understand an issue or answer a question, and accurately evaluate the limits of their existing knowledge in relation to it. They can formulate and articulate their information needs as precise statements or questions for investigation. Learners can consider possible misconceptions in their understanding and can recognise possible benefits of considering information from a diverse range of sources and perspectives.	Learners selectively apply the most pertinent criteria to evaluate sources of information depending on the information needed. They accurately compare the relative strength of different information as evidence for a given claim, and can identify multiple valid reasons to accept or reject information. Learners can distinguish factual information from opinions and assertions, while recognising the potential value of each. They can accurately describe how elements of texts and information can have a persuasive effect.	Learners identify logical patterns and subtle connections within and across data and information from a range of sources. They find rational and useful ways of conceptually organising information from different sources. Learners associate and integrate new and potentially conflicting information with their previous understanding. They form reasonable generalisations or hypotheses based on patterns in information. Learners recognise and consider the significance of data or information that does not conform to identified patterns or conceptual categories.
Medium	Learners are able to identify some of the limits of their existing knowledge relating to a problem, issue or question, with topics both familiar and unfamiliar to them. Within a constrained or familiar context, they can identify and distinguish pertinent from less-pertinent questions or information needs for a given inquiry purpose. In less constrained or familiar problems or contexts, they can articulate deficiencies in knowledge only in broad terms when undertaking investigation. Learners can recognise the benefit of investigating information from within the most salient fields, or range of perspectives, related to the problem, issue or question.	In familiar, constrained contexts, learners can distinguish more reliable from less reliable information using objective criteria that are about evaluating quality. In less familiar contexts, learners rely on established reliable sources. They are aware of and apply – perhaps indiscriminately or rigidly – general criteria for judging the reliability or usefulness of sources. They can distinguish statements of fact from statements of opinion, and favour facts. Learners have an awareness that information may be biased, hyperbolic or misrepresent opinion as fact.	Learners identify plausible patterns and connections in data and information that are not obvious, and can do this using information from different sources. They can identify when new information confirms or accords with prior knowledge. Learners can form simplistic generalisations based on recognised patterns in information. They can recognise data or information that does not conform to identified patterns or conceptual categories.
Low	Learners are able to identify their existing knowledge relating to a problem, issue or question. With topics unfamiliar to them they acknowledge their existing understanding is insufficient. They can ask questions to gain information that will be useful within a simple, constrained problem.	Learners discriminate between information sources using subjective criteria such as familiarity, accessibility or alignment with their own views. In simple and familiar contexts, they can identify information inconsistent with other information and question its veracity and reliability. Learners can distinguish obvious or common knowledge facts from obvious statements of opinion.	Learners make simple connections or recognise obvious patterns within data and information from a single source. They can derive inferences in the context of scaffolded tasks or content with obvious and explicit connections. Learners can organise explicitly stated information or data into simple categories.

Table 5 Levels of skill development for Strand 2: Evaluating reasoning

Strand 2: Evaluating reasoning			
	Aspect 2.1 Applies logic	**Aspect 2.2** Identifies assumptions and motivations	**Aspect 2.3** Justifies arguments
High	Learners can use deduction from premises to distinguish valid from invalid conclusions in arguments, or other deductive representations of reasoning. They can do so with arguments that may have the appearance of being sound. They use logic to identify subtle and unstated, or problematic and unintended, conclusions in arguments. They can apply logical deduction to complex, multi-faceted problems to arrive at correct solutions. Learners can distinguish correlation from causation and apply concepts of causality, contradiction and consistency as well as use prior knowledge to evaluate complex situations with conflicting or incomplete evidence, generate alternative explanations and make predictions about hypothetical situations.	Learners identify the assumptions that invalidate conclusions in arguments dealing with unfamiliar contexts. They can identify opaque, implied conclusions from sets of propositions. Learners can deliberately employ assumptions when required to progress an argument or problem-solving activity. They can identify when their own motivations cause bias in arguments and can identify the subtle (e.g. ideological/identity-related) motivations of others as potential bias.	Learners can construct cogent arguments for and against a proposition – or for competing propositions – with explanations, supporting evidence, rebuttal and counter rebuttal. They can use inference to develop multiple plausible interpretations.
Medium	Learners can identify valid arguments, or other deductive conclusions, even when they may be unsound. They can identify obvious implied conclusions from sets of propositions. They make and explain logical deductions used to identify a correct solution to a constrained problem with limited complexity. Within constrained contexts, they can apply concepts of causality, contradiction and consistency to evaluate situations with conflicting evidence.	Learners identify reasonable, common sense assumptions that underpin claims. They recognise logically invalid conclusions in arguments dealing with conventional wisdom when caused by a suppressed premise. They can identify the motivation for other's reasoning as bias when it reflects less-obvious (e.g. indirectly beneficial) self-interest.	Learners develop structured arguments for or against a proposition with some reasons and explanation. They use inference to develop a plausible interpretation. They can reflect on and explain their reasoning for claims they make.
Low	Learners can identify and explain when simple deductive arguments or other deductive conclusions, dealing with familiar, real-world contexts, are sound or unsound. Learners can develop basic strategies in problem-solving contexts that have simple objectives and limited variables.	Learners struggle to articulate the assumptions that underpin simple claims or arguments. Learners can identify the motivation for others' reasoning or actions – or understand these motivations as bias – when it reflects obvious (e.g. directly material) self-interest.	Learners construct simple arguments supported by subjective reasoning, or plausible reasoning, in familiar, concrete contexts. They tend to use induction from experience of the world rather than deduction from rules, conditions or premises, and reach naïve conclusions. They use circular logic to articulate an argument in more abstract contexts.

Table 6 Levels of skill development for Strand 3: Decision-making

Strand 3: Decision-making			
	Aspect 3.3: Identifies criteria for decision-making	**Aspect 3.2:** Evaluates options	**Aspect 3.3:** Tests and monitors implementation
High	Learners identify multiple criteria, across several different, and potentially competing, categories (e.g. time, costs, impact, effectiveness, reach, capacity, etc.), for a decision in a given problem context. They can prioritise criteria based upon relative importance to achieving the desired outcome.	Learners evaluate each option against the full range of identified criteria. They can identify and compare multiple pros and cons of options against each other to determine which will – or is most likely to – deliver the most-desired outcome and most-satisfy the criteria as prioritised.	Learners apply fair and reasonable measures of the success of a decision to evaluate it. They can distinguish those results/outcomes – both positive and negative – that are a direct effect of the decision as implemented, versus those caused by unforeseen other conditions or circumstances. Learners can identify which conditions to adjust to improve the outcome.
Medium	Learners identify several criteria against which to make a decision or conclusion in a given problem context. They can justify their choice of a most important criterion.	Learners evaluate each option and identify which options best satisfy each of the criteria. They can identify whether any of the criteria are unsatisfied by the options given. Learners are able to identify strengths and limitations of solution ideas specific to the features or the outcomes of those solutions.	Learners can explain through observation or data analysis whether a decision led to a desired or anticipated outcome. They can identify plausible explanations for why a desired or anticipated outcome was not achieved.
Low	Learners generate a simple criterion against which to justify their decisions. They can identify an appropriate single criterion from a range provided against which to make a decision in a problem context.	Learners rank solutions from best to worst against a given, singular criteria. They select an appropriate solution or simple conclusion that satisfies a singular criteria. Learners can identify a plausible strength and/or limitation of a solution at a generic level (i.e. that has limited specificity to the solution).	Learners correctly identify, from data or from observation of the decision being implemented, whether or not a desired outcome has been achieved.

5 REFERENCES

Abrami, P. C., Bernard, R. M., Borokhovski, E., Wade, A., Surkes, M. A., Tamim, R., & Zhang, D. (2008). Instructional interventions affecting critical thinking skills and dispositions: A stage 1 meta-analysis. *Review of Educational Research, 78*(4), 1102–1134.

Abrami, P. C., Bernard, R. M., Borokhovski, E., Waddington, D.I., Wade, A., & Persson, T. (2015). Strategies for teaching students to think critically: A meta-analysis. *Review of Educational Research, 85*(2), 275–314.

Adib-Hajbaghery, M., & Sharifi, N. (2017). Effect of simulation training on the development of nurses and nursing students' critical thinking: A systematic literature review. *Nurse Education Today, 50, 17–24*.

American Libraries Association. (2000). *Information literacy competency standards for higher education.*

Basri, H., Purwanto, As'ari, A. R., Sisworo, S. (2019). Investigating critical thinking skill of junior high school in solving mathematical problem. *International Journal of Instruction, 12*(3), 745–758.

Bent, M., & Stubbings, R. (2011). The SCONUL seven pillars of information literacy: The core *Investigating critical thinking skill of junior high school* model. In *SCONUL (Ed.), SCONUL Working Group on Information Literacy*. SCONUL.

Beyer, B. K. (1985). Critical thinking: What is it? *Social Education, 49,* 270–276.

Black, B. (2007). Critical thinking – A tangible construct? *Research Matters, 3*. Cambridge Assessment.

Blum, M. E., & Spangehl, S. (1977). *Ideas and research: A course introducing inquiry in the social sciences and humanities [and] summary*. https://files.eric.ed.gov/fulltext/ED157812.pdf

Brookfield, S. D. (1997). Assessing critical thinking. *New Directions for Adult and Continuing Education. 75* (Fall), 17–29.

Browne, N.M., & Keeley, S.M. (2011). *Asking the right questions: A guide to critical thinking* (10th ed.). Pearson.

Catts, R., & Lau, J. (2008). *Towards information literacy indicators*. UNESCO.

Christie, B., Beames, S., & Higgins, P. (2016). Context, culture and critical thinking: Scottish secondary school teachers' and pupils' experiences of outdoor learning. *British Educational Research Journal, 42*(3), 417–437.

Chartered Institute of Library and Information Professionals. (2018). *CILIP definition of information literacy 2018*. https://infolit.org.uk/ILdefinitionCILIP2018.pdf

Coney, C. L. (2015). Critical thinking in its contexts and in itself. *Education Philosophy and Theory, 47*(5), 515–528.

Davies, W. M. (2006). An 'infusion' approach to critical thinking: Moore on the critical thinking debate. *Higher Education Research & Development, 25*(2), 179–193.

Dewey, J. (1910). *'What is thought?' How we think*. D.C. Heath.

Dewey, J. (1933). *How we think. A restatement of the relation of reflective thinking to the educative process* (Rev. ed.). D. C. Heath.

Du, X. Y., Emmersen, J., Toft, E., & Sun, B. (2013). PBL and critical thinking disposition in Chinese medical students--A randomized cross-sectional study. *Journal of Problem Based Learning in Higher Education*, *1*(1), 72–83.

Eisenberg, M. B., & Berkowitz, R. E. (1990). *Information problem-solving: The big six skills approach to library & information skills instruction*. Ablex Publishing.

Ennis, R. H. (1981). Rational thinking and educational practice. In Soltis, J. (Ed.), *Philosophy of education*, (Eightieth Yearbook of the National Society for the Study of Education, Part I, 1964, pp. 143–183). The National Society for the Study of Education.

Ennis, R. H. (1985). A logical basis for measuring critical thinking skills. E*ducational Leadership, 43*(2), 44–48.

Ennis, R. H. (1989). Critical thinking and subject specificity: Clarification and research. *Educational Researcher, 18*(3), 4–10.

Ennis, R. H. (2011a). The nature of critical thinking: An outline of critical thinking dispositions and abilities. https://education.illinois.edu/docs/default-source/faculty-documents/robert-ennis/thenatureofcriticalthinking_51711_000.pdf

Ennis, R. H. (2011b). Critical thinking: Reflection and perspective Part I. *Inquiry: Critical Thinking Across The Disciplines, 26*(1), 4–18.

Ennis, R. H. (2018). Critical thinking across the curriculum: A vision. *Topoi, 37*, 165–184.

Epstein, R. L. (2005). *Critical thinking*. Wadsworth.

Facione, P. A. (1990). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction*. California Academic Press.

Facione, P. (2015). 2015 *Update on the critical thinking mindset from Delphi Report principle investigator, Dr. Peter Facione*. https://insightassessment.com/wp-content/uploads/ia/pdf/Delphi-Research-Table-1-Ideal-Critical-Thinker.pdf

Fisher, A., & Scriven, M. (1997). *Critical thinking: Its definition and assessment*. Edgepress and Centre for Research in Critical Thinking, University of East Anglia.

Glaser, E. M. (1941). *An experiment in the development of critical thinking*. Columbia University Teachers College.

Grafstein, A. (2017). Information literacy and critical thinking. In D. Sales & M. Pinto (Eds.), *Pathways into information literacy and communities of practice* (pp. 3–28). https://doi.org/10.1016/B978-0-08-100673-3.00001-0

Halpern, D. F. (1998). Teaching critical thinking for transfer across domains: Dispositions, skills, structure training, and metacognitive monitoring. *American Psychologist, 53*(4), 449–455.

Hitchcock, David. (2017). *Critical thinking as an educational ideal*. Retrived from https://www.researchgate.net/publication/315852948_Critical_Thinking_as_an_Educational_Ideal.

Hollis, H. (2019). Information literacy and critical thinking: Different concepts, shared conceptions. *Information Research, 24*(4). http://www.informationr.net/ir/24-4/colis/colis1921.html

Ikuenobe, P. (2001). Teaching and assessing critical thinking abilities as outcomes in an information logic course. *Teaching in Higher Education, 6*(1), 19–32.

James, N., Hughes, C., & Cappa, C. (2010). Conceptualising, developing and assessing critical thinking in law. *Teaching in Higher Education, 15*(3), 285–297.

James, N., & Burton, K. (2017). Measuring the critical thinking skills of law students using a whole-of-curriculum approach. *Legal Education Review, 27*(1), 1–22.

Jimenez-Aleixandre, M. P., & Puig, B. (2012). Argumentation, evidence and critical thinking. In B. Fraser, K. Tobin & C. McRobbie (Eds.), *Second International Handbook for Science Education Vol 2* (pp. 1001–1017). Springer.

Jones, A. (2015). A disciplined approach to critical thinking. In M. Davies & R. M. Barnett (Eds.), *The Palgrave handbook of critical thinking in higher education* (pp. 169–182). Palgrave Macmillan US.

Jones, E. A., Hoffman, S., Moore, L. M., Ratcliff, G., Tibbetts, S. & Click, B. A. (1995). *National assessment of college student learning: Identifying college graduates' essential skills in writing, speech and listening, and critical thinking. Final project report*. U.S. Government Printing Office. https://files.eric.ed.gov/fulltext/ED383255.pdf

Kuhn, D. (1999). A developmental model of critical thinking. *Educational Researcher, 28*(2), 218–239.

Kurfiss, J. G. (1988). *Critical thinking: Theory, research, practice, and possibilities*. ASHE-ERIC Higher Education Report *Number 2*. Association for the Study of Higher Education.

Lai, E. R. (2011). *Critical thinking: A literature review*. Pearson Publishing.

Latif, R., Burton, S., Mumtaz, R., & Hussain, A. (2018). A comparison of debate and role play in enhancing critical thinking and communication skills of medical students during problem based learning. *Biochemistry and Molecular Biology Education, 46*(4), 336–342.

Lipman, M. (1987). Critical thinking: What can it be? *Analytic Thinking, 8*(1), 5–12.

Lipman, M. (1988) Critical thinking: What can it be? *Educational Leadership, 46*(1), 38–43.

Lewis, A., & Smith, D. (1993). Defining higher order thinking. *Theory into Practice, 32*(3), 131–137.

McCurry, D., Knight, P., & Meiers, M. (2013). Teaching critical thinking. *Queensland College of Teachers Research Digest, 9* (April), 1–24.

McPeck, J. E. (1981). *Critical thinking and education*. Routledge.

Mezirow, J. (2009). Transformative learning theory. In J. Mezirow & E. W. Taylor & (Eds.), *Transformative learning in practice: Insights from community, workplace, and higher education* (pp. 18–32). Jossey-Bass.

Moore, B. N. & Parker, R. (2012). *Critical thinking* (10th ed.). McGraw-Hill.

Moore, K. (2010). The three-part harmony of adult learning, critical thinking, and decision-making. *Journal of Adult Education, 39*(1), 1–10.

Moore, T. (2004). The critical thinking debate: How general are general thinking skills? *Higher Education Research and Development, 23*(1), 3–18.

Moore, T. (2013). Critical thinking: Seven definitions in search of a concept. *Studies in Higher Education, 38*(4), 506–522.

Newmann, F. M. (1990). Higher order thinking in teaching social studies: A rationale for the assessment of classroom thoughtfulness. *Journal of Curriculum Studies, 22*(1), 41–56.

Oermann, M., Truesdell, S., & Ziolkowski, L. (2000). Strategy to assess, develop and evaluate critical thinking. *The Journal of Continuing Education in Nursing, 31*(4), 155–160.

O'Neill, D. (1994, April 28–May 1). *Teaching speech communication from a critical thinking perspective* [Paper presentation]. Annual Meeting of the Eastern Communication Association, Washington, DC, United States. URL: https://files.eric.ed.gov/fulltext/ED376521.pdf

Ong, T., Normand, M.P., & Merritt, S.J. (2018). Using equivalence-based instruction to teach college students to identify logical fallacies. *Behavioural Interventions*, *33*(2), 122–135.

Paul, R. W., & Elder, L. (1999a). Critical thinking: Teaching students to seek the logic of things. *Journal of Developmental Education, 23*(1), 34–35.

Paul, R. W., & Elder, L. (1999b). Critical thinking: Teaching students to seek the logic of things, Part 2. *Journal of Developmental Education, 23*(2), 34–35.

Paul, R. W. & Elder, L. (2007). *Critical thinking competency standards: Standards, principles, performance indicators, and outcomes with a critical thinking master rubric.* http://www.criticalthinking.org/files/SAM_Comp%20Stand_07opt.pdf

Paul, R. W., Elder, L., Bartell, T. (1997). *A brief history of the idea of critical thinking.* https://www.kwelangatraining.co.za/wordpress/wp-content/uploads/pdf/A-Brief-History-of-the-Idea-of-Critical-Thinking.pdf

Penkauskiene, D., Railiene, A., & Goncalo, C. (2019). How is critical thinking valued by the labour market? Employer perspectives from different European countries. *Studies in Higher Education, 44*(5), 804–815.

Powell, J., Parker, C., & Kilcoyne, M. (2017). Cyber business law and project-based learning. *International Journal for Innovation Education and Research, 5*(11), 62–73.

Scheffer, B. K., & Rubenfeld, M. G. (2000). A consensus statement on critical thinking in nursing. *Journal of Nursing Education*, *39*, 352–359.

Siegel, H. (1980). Critical thinking as an educational ideal. *The Educational Forum, 45*(1), 7–23.

Society for Human Resource Management. (2008). *A history of human resources: SHRM's 60-year journey*. Society for Human Resource Management.

Sternberg, R. J. (1986). *Critical thinking: Its nature, measurement, and improvement*. National Institution of Education. https://files.eric.ed.gov/fulltext/ED272882.pdf

Tarricone, P. (2011). *The taxonomy of metacognition*. Taylor & Francis Group.

Thomas, K., & Lok, B. (2015). Teaching critical thinking: An operational framework. In M. Davies & R. Barnett (Eds.), *The Palgrave handbook of critical thinking in higher education* (pp. 93–105). Palgrave Macmillan US.

UNESCO. (2019a). *Exploring STEM competencies for the 21st century*. https://unesdoc.unesco.org/ark:/48223/pf0000368485?posInSet=9&queryId=1c679667-ef01-4e11-a405-2a0f4cd8e18b

UNESCO. (2019b) *Right to education handbook*. https://unesdoc.unesco.org/search/1c679667-ef01-4e11-a405-2a0f4cd8e18b

UNESCO. (2020). *Manual for developing intercultural competencies: Story circles.* https://unesdoc.unesco.org/ark:/48223/pf0000370336?posInSet=1&queryId=1c679667-ef01-4e11-a405-2a0f4cd8e18b

Watson, G. & Glaser, E. M. (1964). *Watson-Glaser critical thinking appraisal manual*. Psychological Corporation.

Weiner, J. M. (2011). Is there a difference between critical thinking and information literacy? *Journal of Information Literacy, 5*(2), 81–92. https://doi.org/10.11645/5.2.1600

Wertz, R. E. H., & Fosmire, M., Purzer, S., Saragih, A. I., Van Epps, A., Sapp Nelson, M., & Dillman, B. G. (2013, June 23–26). *Work in progress: Critical thinking and information literacy: Assessing student performance*. [Paper presentation]. ASEE Annual Conference and Exposition, Atlanta, GA, United States.

Willingham, D. T. (2007). Critical thinking: Why is it so hard to teach? *American Educator* (Summer), 8–19.

World Bank. (2018). *World development report 2019: The changing nature of work*. https://elibrary.worldbank.org/doi/full/10.1596/978-1-4648-1328-3_ch4