EVAL
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Measuring
21st Century
Skills

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About Evaldesign

Evaldesign is a cutting-edge education research consulting firm set up in 2013 with a focus on designing and evaluating programs. Evaldesign provides research and design inputs that allow programs to capture high quality data for quick feedback and effective implementation. Our goal is to help donors, investors, governments and non-profits working in the education sector improve accountability, efficiency and efficacy of education programs through data-driven insights.

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Introduction

At the start of the 21st century, a number of efforts were undertaken to identify and outline the competencies and skills required for operating in the new millennium, and for facing challenges in the present and the future. These were popularly termed as 21st Century Skills, a nomenclature still in use. These skills were deemed important for thriving in a rapidly changing economy (and world), and it was felt that mainstream school curriculum was not addressing these skills adequately. In order to bring structure to the discourse on 21st Century Skills, many organisations have since developed frameworks that describe, and define, the competencies required for functioning in the 21st century. The key aspects of four well-regarded frameworks are presented in Table 1 (1–6).

When the frameworks outlining 21st Century Skills are examined, it becomes evident that they describe overlapping competencies that are classified in many different ways. Moreover, these competencies comprise of a complex set of sub-skills that are not easily disaggregated (Table 1). For example, the World Economic Forum framework describes creativity and curiosity as separate skills whereas the literature identifies curiosity to be an integral component of creativity. The Definition and Selection of Competencies (DeSeCo) framework defines the ability to 'relate well to others' as an independent skill, whereas

research indicates that it is an essential component of empathy. These differences and overlaps have led to ambiguity in understanding and articulating the exact nature of these skills and competencies. This in turn, has created barriers for debate, discussion, and the development of effective teaching, learning and measurement methods.

This handbook is an effort to unpack the competencies outlined by various 21st Century Skills frameworks, and outline their sub-skills (or constructs) in a granular and mutually exclusive manner. The hope is that the handbook provides a common platform for policymakers, researchers and practitioners to have a meaningful discussion on 21st Century Skills, design effective interventions, and develop better methods for measurement.

DeSeCo (OECD)	World Economic Forum	Partnership for 21st Century	Hilton Pellegrino
Using Tools Interactively • The ability to use language, symbols and text interactively • The ability to use knowledge and information interactively • The ability to use technology interactively	**Foundational Literacies** • Literacy • Numeracy • Scientific Literacy • ICT Literacy • Financial Literacy • Cultural and Civic Literacy	**Learning Skills** • Critical Thinking • Creative Thinking • Collaborating • Communicating	**Cognitive Competencies** • Cognitive Processes • Knowledge • Creativity and Innovation
Interacting in Heterogeneous Groups • The ability to relate well to others • The ability to cooperate • The ability to manage and resolve conflicts	**Competencies** • Critical Thinking, Problem Solving • Creativity • Communication • Collaboration	**Literacy Skills** • Information Literacy • Media Literacy • Technology Literacy	**Intra-personal Competencies** • Work Ethic • Positive • Self-evaluation • Intellectual Openness
Acting Autonomously • The ability to act within the big picture • The ability to form and conduct life plans and personal projects	**Character Qualities** • Curiosity • Initiative • Persistence • Adaptability • Leadership • Social and Cultural Awareness	**Life Skills** • Flexibility • Initiative • Social Skills • Productivity • Leadership	**Inter-personal Competencies** • Teamwork and Collaboration • Leadership

Table 01: Key Frameworks Outlining 21st Century Skills

The development of the handbook began with a substantive classification of skills currently being taught by a number of implementing organisations, as well as those outlined in the major frameworks. Post this classification, five primary skills emerged. These were **Critical Thinking, Creativity, Empathy, Executive Function** and **Leadership** (of which Leadership has not become a part of this handbook due to lack of sufficient literature on this skill outside of the management sphere).[1] A detailed literature review was then conducted for each of these skills to examine how researchers have defined their sub-components or constructs. Subsequently, methods used to measure the identified constructs and the tests associated with these methods were reviewed and aligned with the constructs where available. The emerging review is presented here as the **Handbook on Measuring 21st Century Skills.**

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[1] Due to a strong lack of research on Leadership outside of the management or political context, and the absence of psychometric methods of measuring it, it has not been possible to analyse Leadership in the context of education. Moreover, Leadership research has shown that key leader attributes encompass emotional intelligence or empathy, self-regulation, motivation, creative thinking skills, problem solving skills and self-monitoring (175), all of which have components across Empathy, Creativity, Critical Thinking and Executive Function.

CHAPTER ONE

CREATIVITY

Defining Creativity, Factors Impacting Creativity, Measurement of Creativity

Creativity is the ability to produce, or the process of producing work that is both novel and appropriate.

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Creativity

Creativity is widely thought to be a key 21st Century Skill. The ability to produce something new and useful, and solve problems creatively, is considered a must-have for most careers in today's knowledge economy. Creativity is one of the 4C's of 21st century learning according to the Partnership for the 21st Century's framework for Learning and Innovation (in addition to Communication, Critical thinking and Collaboration) (7). Creativity has been behind the scientific findings that have had global impact, behind the new movements in art and behind the innovations leading to social change (8).

Defining Creativity

Research in the area of Creativity has been sparse (between the 1920s and 1950, Creativity had accounted for fewer than 0.2% of the entries in Psychological Abstracts) (8,9). It was J.P. Guilford's presidential address to the American Psychological Association (APA) in 1950 that spurred scholarly research on Creativity (8).

Creativity has been defined in the literature in a number of different ways. One of the ways it has been defined is in relation to a **creative individual**, and their associated traits and behaviours. Howard Gardner for example, defines Creativity as 'the human capacity [regularly] to solve problems or to fashion products in a way that is initially novel but ultimately acceptable in a culture' (10). Another way in which Creativity has been defined is in terms of the **creative process**, such as the 'process of bringing into being something novel and useful' (11). While the approach to Creativity may vary, most definitions of Creativity tend to have more of an emphasis on the output of Creativity, i.e. the **creative product**. The consensus

is that Creativity involves the creation of products – concrete objects or ideas – that are new and useful. Moreover, for a product to be considered creative, it must be both novel, and have some form of usefulness (social or cultural) or significance (12). There are varying views on whether a product needs to be novel only to the individual or also to society and/or culture in general, in order to be considered creative. Some assert that a thought is creative if it is novel to the one who produced it, irrespective of how many others have arrived at the same thought (13). Others argue differently. Rhodes' (1961) 4P model, divides creativity into 4 categories – Person, Product, Process and Press (or environment), thereby helping to bridge this dichotomy (7).

For the purpose of this handbook, we define Creativity as the ability to produce, or the process of producing 'work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive)' (8,14–19).

Factors Impacting Creativity

A number of factors can impact Creativity. These include motivation, intelligence and an individual's environment.

1. Motivation

Motivation is essentially 'any sort of general drive or inclination to do something' (20). Carl Rogers referred to motivation in Creativity as 'man's tendency to actualize himself, to become his potentialities' (21). It can be intrinsic or extrinsic. **intrinsic motivation** is the ability 'to engage in an activity primarily for its own sake, because the individual perceives the activity as interesting, involving, satisfying or personally challenging. It is marked by a focus on the challenge and the enjoyment of the work itself' (22). Intrinsic motivation has been found to be positively correlated with Creativity more than **extrinsic motivation**, which is the 'motivation to engage in an activity primarily in order to meet some goal external to the work itself, such as attaining an expected reward, winning a competition, or meeting some requirement' (22).

2. Intelligence

The association between the concepts of Creativity and intelligence is not entirely clear (23,24). However, Sternberg and O'Hara (1999) define the following possible relationships between intelligence and Creativity: (a) they can either be seen as subsets of each other, (b) they may be viewed as coincident sets, (c) they can be seen as independent but overlapping sets, and lastly, (d) as completely disjoint sets (11,24).

While some theories posit that a minimum level of intelligence is required for an individual to exhibit Creativity (25,26), others state that although intelligence is not directly related to Creativity, an individual requires the intelligence to attain a certain level of education or work experience, which in turn offers the individual the opportunity to be creative. Some even state that extremely high levels of intelligence may even interfere with Creativity (11,27), although examples of scientists such as Einstein might lead one to question this assertion.

3. Environment

Creative environments and what they are comprised of, are a growing area of research in psychology, education and other social sciences. Environmental variables that are related to creative productivity are currently being studied in order to facilitate the design and implementation of education and business environments that promote higher Creativity (28,29). Different environments can either enhance or inhibit Creativity (30,31). Rogers outlined environmental factors that a parent, teacher, therapist or facilitator could foster, that would maximize the emergence of constructive Creativity.[2] This involves nurturing psychological safety, including unconditional acceptance of the individual as being valuable, responding empathically, removing external evaluation, and fostering psychological freedom and freedom of symbolic expression (21).

Measurement of Creativity

The measurement of Creativity is guided by different conceptual views. One of the most common distinctions is made between **creative potential** and **creative achievement** (24,32). Creative potential refers to the individual's ability to generate something novel and useful (8,24). Whether the individual will actually exhibit Creativity will in turn be dependent on other factors (13). Creative achievement thus refers to the actual realization of this potential in terms of real accomplishments (such as having made a scientific discovery, written a novel etc.) (24,29). A number of different approaches have been used to measure Creativity:

1. Psychometric

The psychometric approach to measuring Creativity has been the predominant means of studying this skill. It is the approach in which Creativity is viewed as a measurable mental trait or human characteristic that can be quantified by appropriate measurement instruments. The measurements are mostly quantitative (12).

The most well regarded psychometric Creativity measures assess creative potential by means of tests that measure divergent thinking abilities (33). Divergent thinking is the ability to generate many different possible responses to an open-ended question (7). Divergent thinking tests are a common method of measuring creative potential. Some prominent divergent thinking tests are the Torrance Test of Creative Thinking (34), the Guilford tests (35), and the Wallach and Kogan tests (36).

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[2] Rogers speaks about encouraging constructive Creativity, and not one which is socially destructive (21).

Self-reported measures such as biographical questionnaires in which participants indicate their achievements across diverse domains (e.g., literature, music, or theatre) (for example, the Creative Achievement Questionnaire), can be used to measure Creative Achievement (29).[3]

2. Experimental

The experimental approach to measuring Creativity is quite similar to the psychometric approach in its choice of instruments, but utilises a controlled environment where the effects of nuisance variables are minimized, and changes in the dependent variables, i.e. the components, traits or indicators of Creativity, are measured (37). Contrary to the psychometric focus on personality and environment however, experimentalists tend to isolate cognitive, problem-solving and product-specific aspects of Creativity for manipulation during experiments (28).

3. Biometric

The biometric approach delves into the relationship between brain function and specific types of cognitive functioning (28). The techniques allow researchers to measure activity in certain areas of the brain during different cognitive tasks (28).

The following table illustrates the constructs of Creativity, and lists the techniques used to measure them.

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[3] The biographical approach is also used to examine those creative individuals whose status as creators is unquestionable and is used to study creativity itself (28,176,177). The historiometric approach is similar, but uses historical documentation (largely quantitative) to understand creative achievement, identify personal traits, social circumstances of the individuals and contexts being studied.

Artistic/ Aesthetic Sense

Image, Barron Welsh Art Scale or Figure Preference Test (44)

Independence of Judgement

Puzzles, drawings & tasks, Elizabeth Starkweather (Psychological Freedom Task) (40)

Associative Thinking

Pen and paper, Mednick's Remote Association (7)
Verbal, Wallach and Kogan Tests of Creativity (Similarities Task) (36)*
Listening, Sounds and Images (38)*
Listening, Onomatopoeia and Images (39)*

Open Mindedness and Flexibility

Verbal, Torrance Tests of Creative Thinking (Verbal) (34)
Play, Playfulness Scale Lieberman (42) | Listening, Sounds and Images (38)* | Listening, Onomatopoeia and Images (39)*

Originality

Verbal, Torrance Tests of Creative Thinking (Verbal) (34)
Drawing, Torrance Tests of Creative Thinking (Figural) (34)
Guilford's Alternative Uses Task (35)
Guilford's Plot Titles Test (43) | Puzzles, drawings & tasks, Elizabeth Starkweather (41)

Humour

Play, Playfulness Scale Lieberman (42)

Attraction to Complexity

Image, Barron Welsh Art Scale or Figure Preference Test (44)

Curiosity

Puzzles, drawings & tasks, Elizabeth Starkweather (Curiosity Task) (41)

Tolerance For Ambiguity

Abstract Thinking

Logical Thinking

Reality Oriented Thinking

Self Confidence

Risk Taking

Personal Energy

Determination

Perseverance

Free Flowing Thinking

Domain Relevant Skills

Analogical Thinking

Table 02 - Creativity Constructs and Measurement Techniques

Legend - ▮ Measures Available ☐ Measures Not Available

Unless otherwise stated, literature aligns to construct. *Evaldesign proposes alignment of test to construct
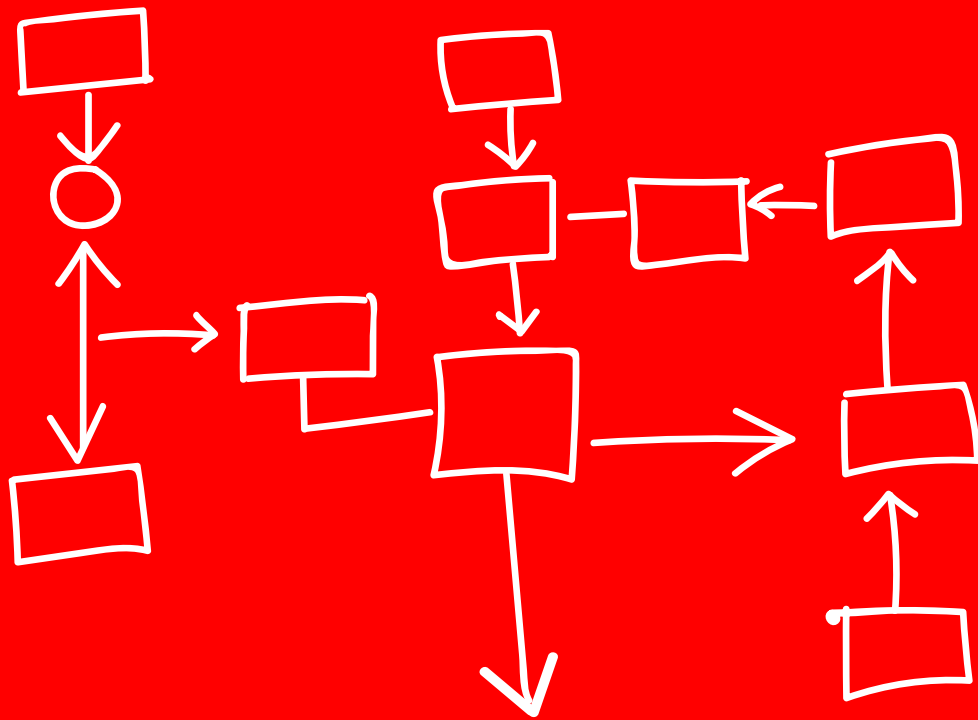
CHAPTER TWO

CRITICAL THINKING

Defining Critical Thinking, Critical Thinking and Related Concepts, Measurement of Critical Thinking

Critical Thinking is goal-directed thinking, which is used to define and solve problems, make decisions or form judgments related to a particular situation or set of circumstances.

02

Critical Thinking[4]

The importance of Critical Thinking skills in student learning has been of significant concern to educators for a long time. The Partnership for 21st Century Skills lists Critical Thinking as one of the essential learning and innovation skills that are necessary to prepare students for complex life and work environments in the 21st century (45). The APA Delphi Report calls for the integration of Critical Thinking skills into education, recommending that 'from early childhood, people should be taught [for example] to reason, to seek relevant facts, to consider options, and to understand the views of others' (46). However, despite the widespread acknowledgement of the importance of Critical Thinking as an outcome of student learning, there is an evident lack of consensus on how to define it (47).

Defining Critical Thinking

Critical Thinking comprises of the mental processes, strategies and representations that are used to solve problems, make decisions, and learn new concepts (48). Historically, the Critical Thinking tradition has existed for over 2000 years with the 'Socratic' tradition of dialogue and learning. Research on Critical Thinking and ways to teach it, however, only began about a century ago with John Dewey's assumption that learning improves and arises from a process of reflection (49,50). In his 1910 book *How We Think*, Dewey called Critical Thinking 'reflective thinking,' and defined it as '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 conditions to which it tends' (51).

A number of definitions followed. Robert Ennis' definition (1989) that 'Critical Thinking is reasonable, reflective thinking that is focused on deciding what to believe or do' is concise and widely used for its contribution to the development of the Critical Thinking tradition (52).

For the purpose of this handbook, Critical Thinking is defined as goal-directed thinking, which is used to define and solve problems, make decisions or form judgments related to a particular situation or set of circumstances.

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[4] In collaboration with Jennifer Kobrin, Edynn Sato, Emily Lai, Daeryong Seo, Kimberly O'Malley, Pearson Research and Innovation Network

Bloom's Taxonomy and Critical Thinking

In 1956, Benjamin Bloom et al. published a framework, familiarly known as Bloom's Taxonomy, for categorizing educational goals. The framework, elaborated by Bloom and his collaborators, consisted of six major categories: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. Here are the authors' brief explanations of these main categories from Taxonomy of Educational Objectives (53).

1. **Knowledge** involves the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting.

2. **Comprehension** refers to a type of understanding or apprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.

3. **Application** refers to the use of abstractions in particular and concrete situations.

4. **Analysis** represents the breakdown of a communication into its constituent elements or parts such that the relative hierarchy of ideas is made clear and/or the relations between ideas expressed are made explicit.

5. **Synthesis** involves the putting together of elements and parts so as to form a whole.

6. **Evaluation** includes making judgments about the value of material and methods for given purposes.

The last three levels of Benjamin Bloom's Taxonomy of educational objectives (analysis, synthesis and evaluation) are aligned with various definitions of Critical Thinking (53,54).

Critical Thinking and Related Concepts

1. Domain Specificity

Domain specificity refers to whether Critical Thinking skills can be generalized across different contexts and domains or whether they are specific to a domain (47). It is a concept central to Critical Thinking, has been, and continues to be highly debated in literature. While some researchers argue that Critical Thinking skills are 'intrinsically general' in nature, and can be applied to a wide range of domains and contexts (55,56) others posit that anything an individual hears or reads is automatically interpreted in light of what they already know about similar subjects. The latter perspective argues that while students can be taught the maxims of how to think, they will be unable to apply those maxims unless they possess background knowledge in the domain (57).

2. Metacognition

Metacognition has been defined in different ways, including 'thinking about thinking' (47) and 'the knowledge and control children have over their thinking and learning activities' (58). It involves an individual's 'self-assessment of how well they are comprehending, acquiring certain knowledge, and thinking' (59). While some of the newer definitions of Critical Thinking emphasize metacognition or thinking about one's thinking as a way to develop one's Critical Thinking (60), others argue that Critical Thinking and metacognition are two distinct constructs. Thinking about one's thought need not be reflective and one may engage in metacognition without thinking critically at all (61). While the nature of the relationship between metacognition and Critical Thinking remains debated, metacognition at the very least is a supporting condition for Critical Thinking, as monitoring the quality of one's thoughts increases the likelihood of engaging in high-quality thinking (47).

3. Critical Thinking and Creativity

There exist two contradictory streams of thought on the relationship between Critical Thinking and Creativity. Several scholars are of the view that the two skills are independent of each other (62–65). Others argue that Creativity and Critical Thinking are inseparable, and that a certain amount of Creativity is essential for Critical Thinking (56,66).

Creativity and Critical Thinking have been described as being two sides of the same coin with the argument that 'Critical Thinking, without Creativity, reduces to mere scepticism and negativity, and Creativity, without critical thought, reduces to mere novelty' (67).

4. Motivation and Dispositions

A number of scholars consider motivation an integral factor for Critical Thinking. The causal link between Critical Thinking and motivation is stated to function bi-directionally. Just as one needs to be motivated to engage in Critical Thinking, one is also likely to find themselves motivated by a difficult or challenging activity that requires Critical Thinking skills (47,68). 'Consistent internal motivations to act toward or respond to persons, events, or circumstances in

habitual, yet potentially malleable ways' are known as dispositions. Dispositions are seen as attitudes or habits of the mind. The dispositions of Critical Thinking are identified as follows (46,69–72):

- Persistence
- Open-mindedness and flexibility
- Tolerance of ambiguity
- Inquisitiveness
- Willingness to suspend judgment
- Sensitivity to others

Critical Thinking abilities refer to the cognitive components of Critical Thinking (46). The Critical Thinking construct thus includes both Critical Thinking abilities and dispositions (and motivation) as its essential components.

Measurement of Critical Thinking

There are a number of challenges in adequately measuring Critical Thinking. A significant hurdle to assessing Critical Thinking is the unresolved issue of the degree to which Critical Thinking can be generalized across different contexts and domains. As a result, the type of inferences that researchers are trying to make remain unclear as there is no consensus on whether Critical Thinking is being viewed as general or domain-specific. Furthermore, the issue of how one measures the transfer of Critical Thinking skills from one domain to another without

confounding it with domain-specific knowledge remains unresolved (73). To date, Critical Thinking has largely been measured using psychometric techniques (47,74–76). A number of the tests deploy these techniques, such as the California Critical Thinking Skills Test, the Ennis-Weir Critical Thinking Essay Test. The following table illustrates the existing measurement techniques for each of the components of Critical Thinking.

Making Decisions [Explaining Evidential, Conceptual, Methodological Considerations for a Judgement]

Pen and paper, California Critical Thinking Skills Test (78) | Open-ended questions, CWRA (Performance Task) (74)

Cognitive Regulation [Evaluation and appraisal, revisiting and revising goals]

Pen and paper, California Critical Thinking Skills Test (78)

Scientific and Quant Reasoning, CWRA (Selected-Response Test) (74)*

Analysing Arguments [Seeking Evidence and Criteria]

Open-ended questions, CWRA (Performance Task) (74)* | Critique an argument, CWRA (Selected-Response Questions) (74)* | Pen and paper, California Critical Thinking Skills Test (78)*

Analysing Arguments [Differentiating opinion from Evidence]

Pen and paper, California Critical Thinking Skills Test (78)* | Response to argument, Ennis-Weir Essay Test (79) | Open-ended questions, CWRA (Performance Task) (74)*

Defining a Problem [Recognizing Important Relationships]

Pen and paper, California Critical Thinking Skills Test (78) | Scientific and Quant Reasoning; Critical Reading and Evaluation, CWRA (Selected-Response Test) (74)

Defining a Problem [Identifying Central Issues and Assumptions]

Pen and paper, Cornell Critical Thinking Test (77) Open-ended questions, College and Work Readiness Assessment (CWRA) (Performance Task) (74) | Pen and paper, California Critical Thinking Skills Test (78)* | Response to argument, Ennis-Weir Essay Test (79)*

Analysing Arguments [Making Counter Arguments]

Response to essay, Ennis-Weir Essay Test (79) Pen and paper, California Critical Thinking Skills Test (78)*

Cognitive Knowledge [Knowledge about why and when to use a given strategy]

Open-ended questions, CWRA (Performance Task) (74) Scientific and Quant Reasoning, CWRA (Selected-Response Questions) (74)

Analysing Arguments [Avoiding Biased Reasoning]

Pen and paper, California Critical Thinking Skills Test (78)*

Analysing Arguments

Pen and paper, California Critical Thinking Skills Test (78) Response to argument, Ennis-Weir Essay Test (79) | Critical Reading and Evaluation; Critique an Argument, CWRA (Selected-Response Questions) (74) Pen and paper, Halpern Critical Thinking Assessment (HCTA) (80)

Analysing Arguments [Weighing Evidence]

Open-ended questions, CWRA (Performance Task) (74)

Cognitive Regulation [Self-regulation (Attending to and being aware of comprehension and task performance)]

Response to essay, Ennis-Weir Essay Test (79)

Making Decisions [Using Criteria to Make Judgements]

Pen and paper, California Critical Thinking Skills Test (78)* | Pen and paper, HCTA (80)

Cognitive Knowledge [Awareness and Management of Cognition, Including Knowledge About Strategies]

Open-ended questions, CWRA (Performance Task) (74)* Scientific and Quant Reasoning, Critical Reading and Evaluation, Critique an Argument, CWRA (Selected-Response Questions) (74)*

Cognitive Regulation [Planning (ID and selection of appropriate strategies and allocation of resources)]

Open-ended questions, CWRA (Performance Task) (74)*

Analysing Arguments [Making Inferences (Deductive/Inductive)]

Pen and paper, California Critical Thinking Skills Test (78) | Pen and paper, Cornell Critical Thinking Test (77) | Response to argument, Ennis-Weir Essay Test (79)*

Analysing Arguments [Considering Alternative Opinions/Theories]

Response to essay, Ennis-Weir Essay Test (79)
Pen and paper, HCTA (80)*
Pen and paper, California Critical Thinking Skills Test (78)*
Scientific and Quant Reasoning; Critique an Argument, CWRA (Selected-Response Questions) (74)

Critical Thinking Dispositions [Persistence]

Cognitive Knowledge [Knowledge of Oneself as a Learner and what Factors Might Influence One's Performance (Self-Appraisal)]

Critical Thinking Dispositions [Inquisitiveness]

Critical Thinking Dispositions [Open-mindedness and Flexibility]

Critical Thinking Dispositions [Tolerance for Ambiguity]

Critical Thinking Dispositions [Willingness to Suspend Judgement]

Critical Thinking Dispositions [Sensitivity to others (social aspect)]

Defining a Problem [Forming Hypotheses]

Analysing Arguments [Asking Clarifying Questions]

Table 03 - Critical Thinking Constructs and Measurement Techniques

Legend - ▮ Measures Available ▯ Measures Not Available

Unless otherwise stated, literature aligns to construct. *Evaldesign proposes alignment of test to construct

CHAPTER THREE

EMPATHY

Defining Empathy, Factors Impacting Empathy,
Measurement of Empathy

*Empathy is an individual's ability to detect what
another individual is feeling, and experience an
emotion that is consistent with that feeling.*

03

Empathy

Empathy refers to an individual's ability to experience and match a range of emotions consistent with those of others. Empathy can help individuals understand others who may be different from themselves, improving social interactions such as in instances of ethnic or cultural diversity (81). The importance of Empathy in leadership has been recognized, with it relating positively to effective leadership, as well as assisting in developing effective communication, problem-solving, decision-making, and ultimately performance (82). In the work place, the development of Empathy is recognized as being fundamental to successful teamwork, communication and management skills (83), and is said to represent the foundational skill necessary for all social competencies important in the workplace (83,84).

Defining Empathy

The definition of Empathy has evolved over time and has been viewed from multiple perspectives (85). The earliest studies of Empathy viewed it primarily through an emotional lens. The focus then was on understanding how an individual's ability to share the emotions of another comes about (86). The emotional component of Empathy refers to the experience of feeling what another is feeling (87,88) and is the subjective 'reflection' of another person's observable experience (89). In the 1930s, a new research tradition adopted a cognitive approach to Empathy, focusing mainly on an individual's ability to imagine or know what they would feel in a given situation (86,90) without actually experiencing the other person's feelings themselves (91). Cognitive components, such as self-other awareness, mental flexibility and perspective-taking, are required to effectively imagine what it would be like to face the world from the other person's position (85,89).

The currently prevailing view of Empathy takes an integrative approach. This approach defines Empathy as 'the capacity to think and feel oneself into the inner life of another person' (92), or the 'tendency to vicariously experience other individuals' emotional states' (93). Under this approach, Empathy is viewed as a multidimensional construct, with two major components – the emotional and the cognitive. The former refers to the emotional experience of feeling what another is feeling (87), and the latter refers to the cognitive processing of those feelings (94). There is growing support for the view that both, the emotional and cognitive components are essential to defining Empathy. Both are also required to facilitate empathic accuracy (the ability to accurately detect emotional information transmitted by another person), which is one of the key components of Empathy (95).

For the purpose of this handbook, we define Empathy as an individual's ability to detect what another individual is feeling, and experience an emotion that is consistent with that feeling (92,96).

Factors Impacting Empathy

A number of factors can impact Empathy. These include age, sex, and parental relationships.

Age: The potential for Empathy increases with age. Infants largely exhibit only the emotional component of Empathy, often crying when seeing another infant cry, or developing emotional connections with their caregivers. As they grow older, they develop the ability to distinguish between the self and the other, and engage in basic perspective-taking (97). Distinguishing between the self and other includes regulating one's emotions in response to another's, not getting distressed oneself and recognizing the uniqueness of another. Perspective-taking refers to the ability to take on someone's perspective and imagine what they would feel like in a given situation. During late childhood and adolescence, individuals further develop Empathy towards people's immediate distress as well as their general life conditions, due to advances in perspective-taking (94). Empathy is believed to reach its highest developmental stage during late adolescence (98).

Sex: Empathy has been seen to vary with the sex of the individual. While males and females are equally adept at perspective-taking, females have been observed to be more empathic in their responses (88,99–103).[5] Males and females aged 6-7 years have been found to be more empathic toward their respective sexes (104). With an increase in age, while female empathic response for other females increases further, male Empathy towards other males decreases. Empathy toward the opposite sex is also seen to vary with age (99).

Parental Relationships: Studies show that an individual's Empathy is likely to be impacted by their relationship with their parents. When parents are warm, encourage emotional expressiveness and show sensitive and empathic concern for the child's feelings, the child is likely to exhibit the same Empathy towards others. Parents can also help their children to regulate their anger, and provide them with opportunities to engage in sympathetic action such as charity. Correspondingly, parents who lack Empathy are likely to hinder the sympathy[6] and Empathy of their child from an early age (97).

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[5] According to Albiero (166), Empathy involves an emotional response that is focused more on another person's situation or emotion than on one's own (94). This type of emotional response can be either identical to or congruent with that of the other person involved (178).

[6] Eisenberg defines sympathy as 'an emotional response stemming from another's emotional state or condition that is not identical to the other's emotion, but consists of feelings of sorrow or concern for another's welfare'(96).

Measurement of Empathy

There are several techniques used to measure Empathy. These include self-reported (verbal, non-verbal or qualitative) responses, ratings of observed facial expressions/gestures (under experimentally simulated conditions), and physiological measurements, including brain imaging (85).

1. Psychometric Methods

Most psychometric methods used to measure Empathy comprise of self-reported measures based on the Likert scale.[7] While these methods are favoured because of their logistical and economic expediency, they are based on self-assessment, and hence, do not provide much certainty of empathic accuracy. Self-reported measures need to be validated through other means such as a comparison with video assessments, response to vignettes, observations etc. They also tend to address either only the emotional component or the cognitive component of Empathy (85). Where psychometric instruments do take both components into consideration, one overall Empathy score is calculated, masking the individual contribution of each component (86).

2. Observations

Observations of verbal and/or non-verbal behaviour of a subject are an alternative method of measuring Empathy. The observations are recorded as qualitative statements or subjective ratings. For example, the Carkhuff Empathy Scale and Empathy Understanding Subscale have been used by patients to rate therapists' empathic understanding and accuracy. However, these scales are used less frequently as compared to self-reported measures (85).

3. Physiological Techniques

Physiological measures of Empathy monitor participants' heart rates, skin conductance, general somatic activity, pulse transmission time to finger, and finger pulse amplitude to assess whether an individual is matching their affective state to another's (95). Literature on these studies is sparse, as they require more resources and logistical support to be conducted.

The following table illustrates the Empathy construct, as well as existing psychometric techniques that measure each component.

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[7] 'A set of items, composed of approximately an equal number of favourable and unfavourable statements concerning the attitude object, is given to a group of subjects. They are asked to respond to each statement in terms of their own degree of agreement or disagreement. Typically, they are instructed to select one of five responses: strongly agree, agree, undecided, disagree, or strongly disagree' (179).

Mental Flexibility and Perspective Taking
[Ability to take on someone else's perspective, Imagine what someone might feel in a given situation, Assess whether this is a positive or negative emotion, Assess this without judgement, Apply knowledge]

IRI Davis Scale (86)
Pen and paper, Basic Empathy Scale (105)*
Empathy Quotient (106)* | Bryant's Index of Empathy for children and adolescents (99)* | Verbal/Non-verbal, Feshbach and Roe Affective Situations Test for Empathy (FASTE) (104)*

Self-Other Awareness
[Differentiating between self and the other, Regulating own emotions in response to another's, Not getting distressed oneself, Recognizing uniqueness of another, Mirroring others' facial or other expressions]

Pen and paper, Basic Empathy Scale (105)*
IRI Davis Scale (86)*
Empathy Quotient (106)*
Bryant's Index of Empathy for children and adolescents (99)*

Empathic Understanding
[Recognizing what another feels, Feeling what another feels, Evaluating own motive and behaviour, Evaluating other's motive and behaviour]

Verbal/ Non-Verbal, Feshbach and Roe Affective Situations Test for Empathy (FASTE) (104)
Pen and paper, Basic Empathy Scale (105)*
IRI Davis Scale (86)*
Empathy Quotient (106)*
Bryant's Index of Empathy for children and adolescents (99)*

Imaginative/Pretend Play

Sense of Humour

Ability to Act for Another's Benefit

Tolerance

Low Aggression Levels

Ability to Mirror Emotions

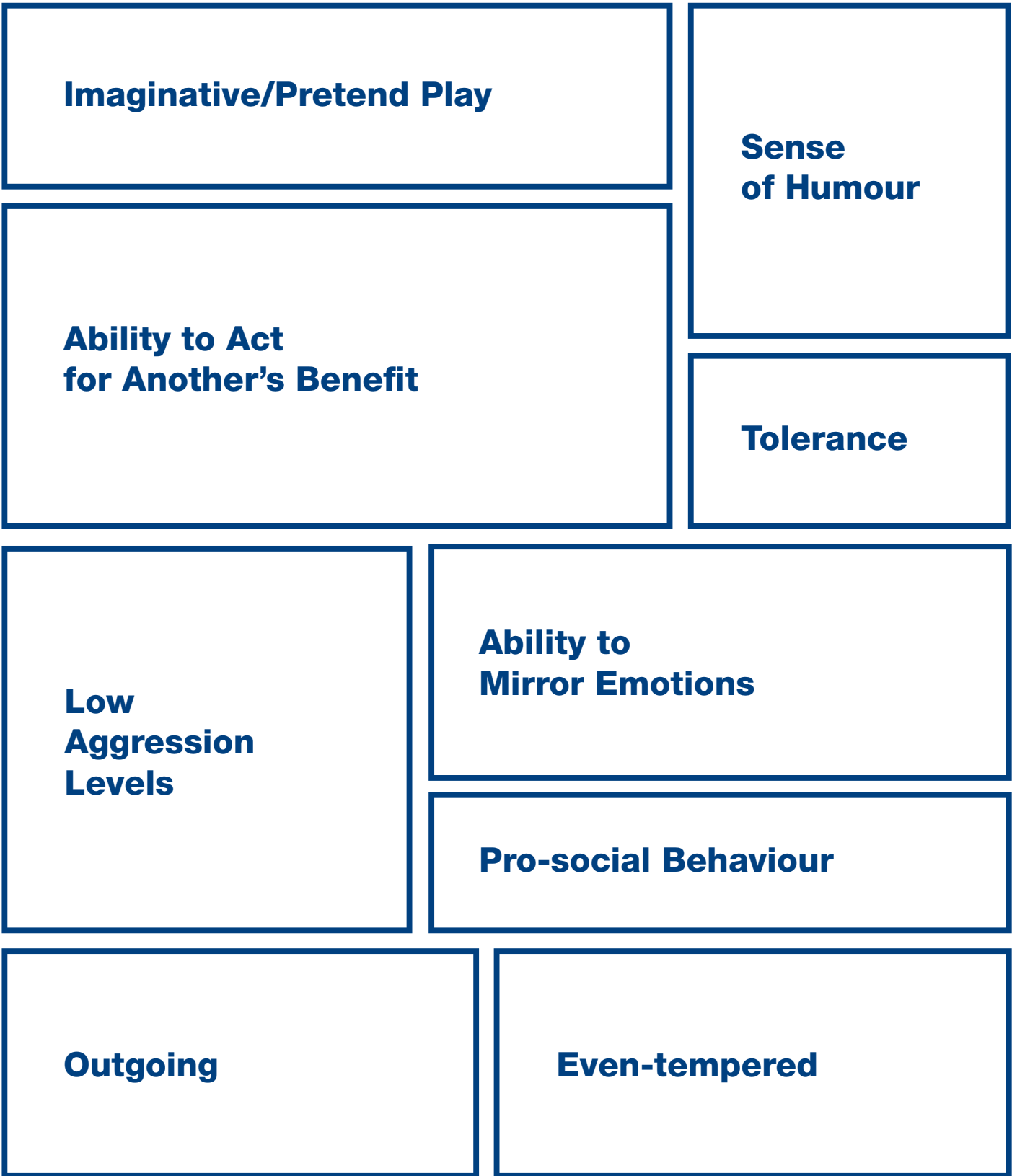**Pro-social Behaviour**

Outgoing

Even-tempered

Table 04 - *Empathy Constructs and Measurement Techniques*

Legend - ▮ Measures Available ▯ Measures Not Available

Unless otherwise stated, literature aligns to construct. *Evaldesign proposes alignment of test to construct
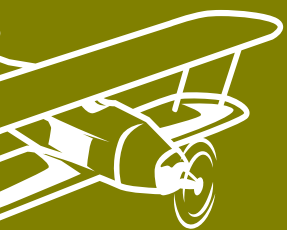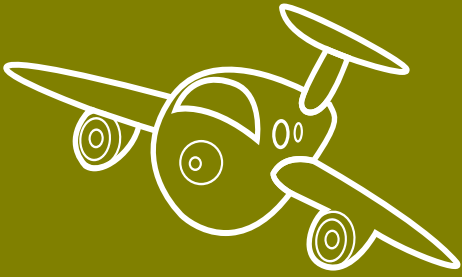
CHAPTER FOUR
EXECUTIVE FUNCTION

Defining Executive Function, Core Components of Executive Function, Measurement of Executive Function

Executive Function is a group of skills that equip individuals with adaptive, self-regulated, goal-directed and problem-solving behaviour, providing for a sense of readiness, agency, flexibility, and coherence.

04

Executive Function

The Center for the Developing Child at Harvard University describes Executive Function (EF) as an air traffic control system at a busy airport that manages the arrival and departures of dozens of planes at multiple runways. Elements of EF form a part of the 'flexibility and adaptability' component of the Life and Career skills as defined by the P21 framework, and are necessary to navigate complex life and work environments in the globally competitive information age (107). EF skills are essential for mental and physical health and cognitive, social, and psychological development (108) and enable individuals to lead independent and purposeful lives (109).

Defining EF

EF is an umbrella term that incorporates a collection of interrelated processes responsible for purposeful, goal-directed behaviour (110,111). These are skills that enable us to focus on, and work with information filter distractions, monitor errors, switch gears, make decisions and revise them based on new information (112). They allow for behavioural flexibility and adaptation to novel or changing situations (109).

Researchers have associated EF with metacognition, inhibition of habitual responses, delay of gratification, adjustment to changing rules, and decision making (113).[8] For the purpose of this handbook, EF is defined as a group of skills that equip individuals with adaptive, self-regulated, goal-directed and problem-solving behaviour, providing for a sense of readiness, agency, flexibility, and coherence.

EFs can be classified into two types:

1. **Cool EFs** are those that are manifested under relatively decontextualized, non-emotional, and analytical testing conditions (114).

2. **Hot EFs** are those that are elicited in contexts that engender emotion, motivation, and a tension between immediate gratification and long-term rewards (115).

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[8] Executive Dysfunctions (EDF) are deficits in one or more elements of EF. In children, cognitive deficits that may be associated with EDF include poor impulse control, difficulties monitoring or regulating performance, planning and organisational problems, poor reasoning ability, difficulties generating and/or implementing strategies, mental inflexibility, poor utilisation of feedback, and reduced working memory (110).

Core Components of EF

There is a general consensus that there are three core components of EF: (1) Inhibitory Control, (2) Working Memory and (3) Cognitive Flexibility (108,116). In most real-life situations, these core components are not entirely distinct, but work together to produce competent EF (112). There are several other components of EF that appear to be a part of, or emerge from the three core components (117,118). The three core components are explained below:

1. Inhibitory Control

Inhibitory Control (IC) is the skill used to master filter attention, behaviour, thoughts, emotions, resist distractions and think before one acts. Inhibitory control stops individuals from behaving impulsively. It makes it possible to focus, prioritize, control emotions and delay gratification (108,119).

2. Working Memory

Working Memory (WM) involves the holding of information and mentally working and manipulating it over short periods of time. It is critical for making judgments about what has happened over a period of time and to make decisions about the future. Reasoning would not be possible without WM, which is essential to see connections between unrelated things and discern elements from a whole. It is also essential to Creativity as it involves assembling and disassembling elements in different ways (108).

3. Cognitive or Mental Flexibility

Cognitive or Mental Flexibility is the capacity to see things from different perspectives, adjusting to changed demands, reprioritizing, revising and fixing mistakes and switching gears in the face of new information. It enables one to apply different rules in different settings (120). Cognitive Flexibility requires and builds upon both IC and WM to create new perspectives (108)

Measurement of EF

Based on a review of the existing literature, it is observed that there is a need for better-defined components of EF as well as the disambiguation of the linkages between them. Given that the field of EF is relatively new, most current EF assessments involve complex, demanding and multi-faceted tasks that tap both executive and non-executive processes and are sensitive to cognitive impairment (110). These tests are listed against the components of the EF constructs that they measure in the following table.

Inhibitory Control

Rating scale, BRIEF (133)

Rating scale, Childhood Executive Functioning Inventory (CHEXI) (141)

Physical action, CANTAB (Stop Signal Task) (132,135)

Listening, NEPSY-II (Auditory Attention & Response Set Inhibition) (134)

Verbal, Stroop Colour-Word Test (136–138) | NEPSY-II (Inhibition subtest) (134)

Tasks of Executive Control (139,140)

Flanker task (108) | Antisaccade tasks (108)

Delay-of-Gratification tasks (108) | Physical action, Tasks of Executive Control (Go/No-go tasks) (108)

Computerized, Stop-Signal tasks (108)

Rating scale, CEFI (131)

Cognitive Flexibility

Object Manipulation, Wisconsin Card Sorting Test (WCST) (108,121–123)

Verbal, Stroop Colour-Word Interference Test (123,124)

Computerized, Tower of Hanoi/London (125–127)

Delis-Kaplan Executive Function System (D-KEFS) | Verbal Fluency Test (108,128,129)

Drawing, D-KEFS Design Fluency Test (108,130)

Rating Scale, The Comprehensive Executive Function Inventory (CEFI) (131)

Object Manipulation, D-KEFS (Trail Making Subset) (128)

Cambridge Neuropsychological Test Automated Battery (CANTAB) (Intra-Extra Dimensional Switch Task) (132) | Rating scale, Behaviour Rating Inventory of Executive Function (BRIEF) (133)

Cognitive Assessment System 2 (CAS2) (Planned Connections) (123)

Fluency

Verbal, NEPSY-II (Word generation) (134) | Drawing, NEPSY-II (Design Fluency) (134)

Goal-Directed Attention

Object manipulation, Wisconsin Card Sorting Test (WCST) (121–123) | Object manipulation, D-KEFS (Trail Making) (123)

Conners' Continuous Performance tests (123)

NEPSY (Visual attention) (123)

Verbal, Stroop Colour-Word Interference Test (123,124)

CAS2 (Planned Connections) (123)

Planning

Rating scale, BRIEF (133)

Rating scale, CHEXI (141)

Object manipulation, CANTAB (Stockings) (132,135)

Computerized, Tower of Hanoi (137,138) Rating scale, CEFI (131)

Impulse Control

NEPSY (Visual attention) (123)

Verbal, Stroop Colour-Word Interference Test (123,124) CAS2 (Expressive Attention) (123)

Computerized, Tower of Hanoi (123)

Deployment of Attention

CAS2 (Expressive Attention subtest) (123)

Regulation

Rating scale, CHEXI (141)

Initiative

Rating scale, BRIEF (133)

Rating scale, CEFI (131)

Parallel Processing

CAS2 (Verbal-Spatial Relations) (123)

Organization

Drawing, Rey Complex Figure Tests (123)

Rating scale, BRIEF (133)

Rating scale, CEFI (131)

Visual Planning

D-KEFS (Trail Making) (123) | Drawing, Rey Complex Figure Tests (123) | CAS2 (Planned Connections) (123)

Maintenance of Order

Verbal, CAS2 (Sentence Repetition or Questions subtest) (123)

Working Memory

Object manipulation, Wisconsin Card Sorting Test (WCST) (121–123)

CAS2 (Expressive Attention) (123) | Tasks of Executive Control (140)

CAS2 (Verbal-Spatial Relations) (123) | Verbal, CAS2 (Sentence Repetition or Questions) (123) | Verbal, Backward-digit span (108) | Physical action, Corsi Block test (108)

Physical action, Self-Ordered Pointing task (108) | Rating scale, BRIEF (133)

Rating scale, CHEXI (141) | Rating scale, CEFI (131)

Divided Attention (180)

CAS2 (Planned Connections) (123)

Self-Regulation (108, 181-184)
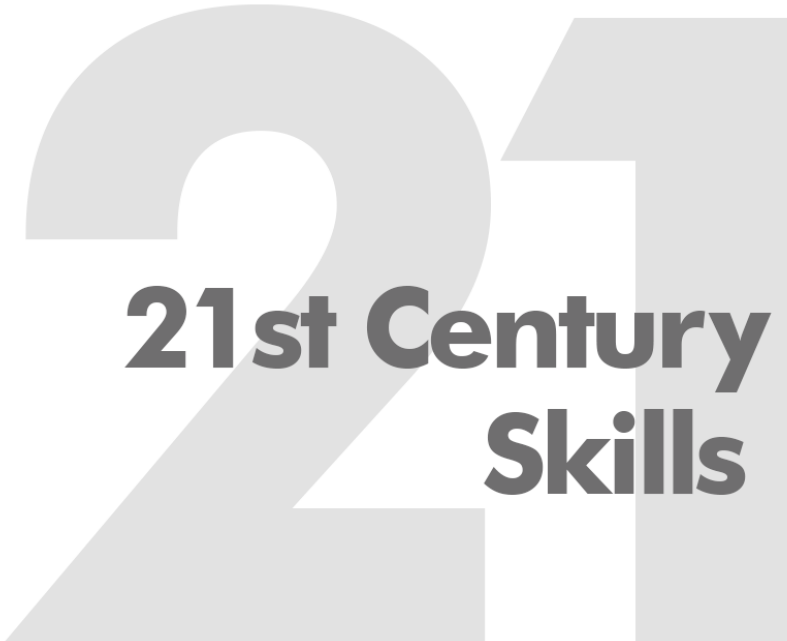
Rating scale, BRIEF (133)

Rating scale, The Comprehensive Executive Function Inventory (CEFI) (131)

Goal Selection

Metacognitive Knowledge of Tasks and Strategies

Anticipation

Explicit and Implicit Learning

Flexible Use of Strategies

Use of Feedback Mechanisms

Problem Solving

Monitoring

Reasoning

Table 05 - Executive Function Constructs and Measurement Techniques

Legend - ▉ Measures Available ☐ Measures Not Available

Unless otherwise stated, literature aligns to construct. *Evaldesign proposes alignment of test to construct

21st Century Skills

CHAPTER FIVE

EVALDESIGN'S WORK ON 21st CENTURY SKILLS

Methodology, Examples of Projects and Skills Measured

05

Evaldesign's Work on 21st Century Skills

Over the years, Evaldesign has evaluated a number of interventions using a range of approaches, from technology to storytelling, that are aimed at teaching 21st Century Skills in India. A consistent challenge has been to measure the impact of the skills being taught through these programs. This section presents Evaldesign's approach to developing assessments for these evaluations and examples of the interventions.

Methodology

Evaldesign has optimized the instrument design process through the years to enable high quality data collection. The development of instruments is undertaken in a three-step process:

1. Pre-pilot Phase

In the pre-pilot phase two parallel processes are undertaken. One, literature is reviewed to align research questions with instrument development; and two, field visits are undertaken to understand the context of the evaluation and open-ended discussions with all stakeholders are held. Insights generated from these two processes guide the development of the first set of pilot instruments – both qualitative and quantitative. The pre-pilots also ground the research and provide a platform for discussion with the implementation partners. Additionally, they provide the first ideas for organizing the research themes and aid refinement of the research design.

2. Pilot Phase

In the pilot phase, instruments developed through the pre-pilot phase and literature research are refined further. Qualitative feedback is obtained from all relevant stakeholders on the language, context and understanding of the instrument items or survey questions through individual feedback or focused group discussions. The instruments are then modified based on this feedback.

3. Statistical Validation

In the second phase of refinement, the instrument is tested across 300-1000 stakeholders (in case of quantitative studies) to obtain statistical information on capping effects, biases or skewness in responses. This phase also provides interesting insights based on contextual parameters such as gender or geography and is used to refine options for multiple choice type items.

Examples of Projects and Skills Measured

Design for Change

Intervention: Design for Change uses the Feel-Imagine-Do-Share framework of design thinking to instill a spirit of agency and community change through school children.

Skills measured: Leadership, Creativity, Problem Solving/Critical Thinking, Empathy.

Dream a Dream

Intervention: Dream a Dream uses a life skills approach to nurture empathy, expand creativity, develop listening and validation skills, and build facilitation skills for teachers so that they can positively influence young persons, particularly those who have experienced adverse conditions.

Skills measured: Empathy, Creativity, Facilitation Skills, Self-regulated Learning.

Going to School
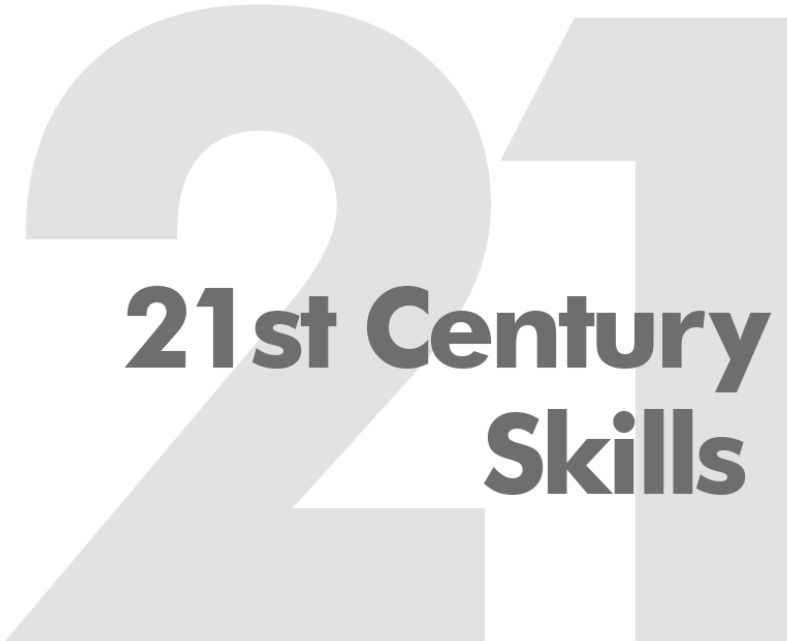
Intervention: Going to School teaches entrepreneurship skills in schools using storytelling, projects and games.

Skills measured: Creative Problem Solving, Creativity, Gender Attitudes, Business Skills.

Ashoka Changemaker Schools

Intervention: Ashoka supports innovative schools around the world that are empowering young people by equipping them with core skills such as empathy, teamwork, leadership and creative skills which will enable them to work successfully in rapidly changing environments.

Skills measured: Empathy, Teamwork, Leadership and Creative Skills.

21st Century Skills

Conclusions

The handbook on Measuring 21st Century Skills is an attempt to describe four core 21st Century Skills – Critical Thinking, Creativity, Empathy and Executive Function – and disaggregate them into mutually exclusive sub-skills or constructs using an in-depth literature review process.

When we examine the constructs and their alignment with existing testing methods, it is evident that a number of constructs do not have any available testing methods. Significant research is therefore required to develop assessments for these constructs. However, these assessments need not be limited to pen and paper tests or self reported measures but innovative means of measurement such as harvesting of digital data ('digital bread crumbs', according to Sandy Pentland from the MIT Media Labs) need to be developed. Importantly, the lack of measurement should not automatically translate to the elimination of these sub-skills from the teaching-learning processes.

There is a significant overlap in constructs across skills. For example, analogical thinking, abstract thinking and logical thinking are constructs within the Creativity skillset that could potentially be a part of the Critical Thinking skillset. As another example,

imaginative and pretend play, which are a part of Empathy could be required for Creativity. Or reasoning and problem solving, which are a part of Executive Function could be components of Critical Thinking. The cross-talk between the various sub-skills and their contribution to the synergistic development of other core skills needs to be a subject of rigorous research.

The ability to think, to be curious and creative may not necessarily be fostered through the education system as it stands today, but through learning processes that focus more on enquiry, play, exploration and experimentation. This also leads us to wonder whether we need to re-think the goals of education and the processes of teaching and learning as they stand today.

We hope that the handbook will prove to be a useful resource for policymakers, researchers and practitioners, and provide a framework to examine the gaps in literature and will help identify measurement techniques and teaching methods for those skills and sub-skills that are harder to define and measure, yet are critical for individuals in the 21st century.

Appendix

Table 06: Creativity Test Descriptions

Test	Specific Task	Age Group	Test/Task Description	Example of Item
Barron Welsh Art Scale or Figure Preference Test (44)		Age 6 and above	Individuals are presented with images of differing complexity and asked to select one.	
Elizabeth Starkweather (40)	Psychological Freedom Task	Preschool	A child is given the opportunity to play by himself with a series of simple toys. The variety of his play responses are analysed. The child is presented with toys which: (1) Are simple, i.e. play with them should be independent of intelligence and acquired ability. (2) Can be put to a number of uses and which could be played with singly or in combination. (3) The child has had little or no previous experience with.	
Elizabeth Starkweather (41)	Curiosity Task	Preschool	Each child becomes familiar with several designs by talking about them with the experimenter. The child is then asked to choose between two envelopes, one clearly marked with one of the Familiar designs and the other designated as containing a 'surprise' design.	
Flanagan Test (142)		Grade 9-11		"Intricate systems of circuits and wiring often need quick repair in emergencies. Part of the maintenance problem has been overcome by making it possible to spot where trouble occurs quickly and repair that section. Since the identification of such small wires by written

				labels is impossible, they are identified by using: 1.　　S_ _ _ _ s 2.　　D _ _ _ _ s 3.　　C_ _ _ _ s 4.　　L_ _ _ s 5.　　M_ _ _ _s (142)"
Guilford's Alternative Uses Test (35)			Participants are asked to think of alternate uses for a variety of common objects, such as a shoe. (43)	To think of alternative uses of a shoe (43)
Guilford's Plot Titles Test(43)			Participants are asked to generate clever titles to two stories.	
Mednick's Remote Association (7)			Provides three words that are each separately connected to a fourth word which the participant is asked to guess.	Sleeping, Bean, Trash Answer: Bag
Onomatopoeia and Images (39)		Adults	Test for adults that uses word stimuli, including semantic and sound elements to evoke imaginative responses. Consists of 10 items selected from a pool of onomatopoeic words and is administered by a recorded text.	
Playfulness Scale Lieberman 1977 (42)		Preschool and adolescents	Teacher rating of students in preschool and adolescents. (143)	
Sounds and Images (38)			Respondents are asked to generate ideas based on unusual words and sounds.	
Torrance Tests of Creative Thinking-Figural (34)		All ages and levels (144)	The TTCT-Figural has two parallel forms, A and B, and consists of three activities: picture construction, picture completion, and repeated figures of lines or circles.	Compose a drawing from parallel lines

Torrance Tests of Creative Thinking-Figural (34)	Ambiguous Figures	All ages and levels (144)	Respondents are asked to form a picture by combining a given set of shapes.	
Torrance Tests of Creative Thinking-Verbal (34)		Grade 1 and above (144)	Includes: (a) Asking Questions and Making Guesses, where participants write out questions and make guesses about possible causes and consequences of situations based on a drawing of a scene; (b) Improvement of a Product, where the examinees list ways to change a toy elephant so that they will have more fun playing with it; (c) Unusual Uses, where the examinees list interesting and unusual uses of a cardboard box; and (d) Supposing, where the examinees are asked to list all the consequences should an improbable situation come true.	To list interesting and unusual uses of a cardboard box (145)
Torrance Tests of Creative Thinking-Verbal (34)	Ambiguous Figures	Grade 1 and above (144)	A drawing of an ambiguous figure in an ambiguous action situation is presented to individuals, and they are asked to generate questions that they would like to ask to clarify what is going on in the picture.	
Wallach and Kogan Tests of Creativity (36)	Ambiguous Figures		Participants are asked to suggest what a given set of lines could represent	
Wallach and Kogan Tests of Creativity (36)	Similarities		Participants are asked to suggest how two common objects are alike	
The following references were used to develop the Creativity construct: (146–151)				

Table 07: Critical Thinking Test Descriptions

Test	Specific Task	Age Group/ Level	Test/Task Description	Example of Item
California Critical Thinking Skills Test (78)		Various ages and professional backgrounds	Multiple choice items using everyday scenarios. Any needed specialized information is provided in the question itself (152).	
College and Work Readiness Assessment (CWRA) (74)	Performance Task	High school	Students answer several open-ended questions about a hypothetical but realistic situation. They are provided with a Document Library that includes a range of information sources, such as letters, memos, photographs, charts, or newspaper articles.	The CWRA Student Guide provides an example. Available here: http://cae.org/images/uploads/pdf/CWRA_Student_Guide_Institution.pdf
College and Work Readiness Assessment (CWRA) (74)	Selected-Response	High school	Respondents are presented with a set of questions as well as supporting documents to refer to. The selected-response questions are divided into the three following sections: (a) Scientific and Quantitative Reasoning (b) Critical Reading and Evaluation (c) Critique an Argument.	The CWRA Student Guide provides an example. Available here: http://cae.org/images/uploads/pdf/CWRA_Student_Guide_Institution.pdf
Cornell Critical Thinking Test (77)		Grade 7 and above	Students take one of two Multiple Choice tests; Level X (primarily for grades 7-12), and Level Z (for gifted high school students, adults, undergraduates, and graduate students).	

Ennis-Weir Essay Test (79)		Most appropriate for high school and college students, but has also been successfully tested with 6th graders.	An essay containing a complex argument is presented to the respondent, who is then required to provide a complex argument in response to the first.	Respondents are provided with a letter to the editor arguing why overnight parking should be banned on all the city's streets. They are then required to write a letter to the editor, responding to each paragraph in the first one, stating whether they think the paragraph's reasoning is good or bad. They must also write a concluding paragraph summarizing their argument. They must provide reasoning for all their judgements.
Halpern Critical Thinking Assessment (HCTA) (80)			Consists of 20 everyday scenarios. For each everyday scenario, respondents are first asked an opened ended (i.e., constructed response) question, which is followed by a forced choice question (e.g., multiple choice, ranking, or rating of alternatives).	
The following references were used to develop the Critical Thinking construct: (71,153–164)				

Table 08: Empathy Test Descriptions

Test	Specific Task	Age Group/ Level	Test/Task Description	Example of Item
Feshbach and Roe Affective Situations Test for Empathy (FASTE) (104)		Age 6–7	Children are asked to describe their own feelings and emotions about pictures or stories either verbally or choosing from a response set of different facial expressions depicting different emotions.	A picture or story of a birthday party (depicts happiness)
Basic Empathy Scale(105)		Adolescents	Self-reported statements	"I can usually work out when people are cheerful"
IRI Davis Scale (86)		Adults	Self-reported statements. The scale from A to E denotes "Does not describe me well" to "Describes me very well".	"Other people's misfortunes do not usually disturb me a great deal."
Empathy Quotient (106)		Adults	Self-reported statements measured on a four-point scale.	"Seeing people cry doesn't really upset me. Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree"
Bryant's Index of Empathy for children and adolescent (99)		Children and adolescents	Self-reported statements	"I really like to watch people open presents, even when I don't get a present myself"
The following references were used to develop the Empathy construct: (82,85,86,96,97,165–170)				

Table 09: Executive Function Test Descriptions

Test	Specific Task	Age Group/ Level	Test/Task Description
Backward-digit span (108)			Participants are required to repeat a list of numbers in the reverse order to what they have heard (108)
Cambridge Neuropsychological Test Automated Battery (CANTAB) (132,171)	Intra-Extra Dimensional Switch Task	Available for adults and children in Clinical mode.	The participant is required to select one of two simple colour-filled shapes. Feedback teaches the participant which stimulus is correct. After six correct responses, the stimuli and/or rules are changed.
Cambridge Neuropsychological Test Automated Battery (CANTAB) (132,135)	Stop Signal Task		In the first part, participants are instructed to press a left- or right-hand button in response to an arrow pointing in that direction. In the second set of trials, arrows continue to appear but the response is to be withheld if an auditory signal precedes the arrow presentation (132).
Cambridge Neuropsychological Test Automated Battery (CANTAB) (132,135)	Stockings of Cambridge	Available for adults and children in Clinical mode.	The participant attempts to move coloured balls to match a displayed pattern in the least possible number of moves. The time taken to complete the pattern, number of moves taken, and trials performed in minimum number of moves are measured (132).
Childhood Executive Functioning Inventory (CHEXI) (141)		Age 4–15	Rating scale for parents and teachers
Cognitive Assessment System 2 (CAS2) (123)	Expressive Attention	Age 5–7	Students between age 5 and 7 are presented with three items consisting of seven rows of six pictures of common animals that are depicted as either big (1 in. by 1 in.) or small (1/2 in. by 1/2 in.) for each item. In each of three items, the student is required to identify whether the animal depicted is big or small in real life ignoring the relative size of the picture on the page. (131)
Cognitive Assessment System 2 (CAS2) (123)	Sentence Repetition and/or Questions subtest	Age 4–7 (Sentence Repetition) Age 8–18 (Sentence Questions)	The Sentence Repetition subtest requires the student to repeat syntactically correct sentences containing little meaning such as "The blue is yellowing." The Sentence Questions subtest (only administered to 8–18 year olds) requires the student to answer questions about similar sentences. For example, the student reads the sentence "The blue is yellowing" and then is asked the following question: "Who is yellowing?" (123)

Cognitive Assessment System 2 (CAS2) (123)	Verbal-Spatial Relations subtest	Age 5–18	
Cognitive Assessment System 2 (CAS2) (123)	Planned Connections subtest		Participants are required to connect a series of stimuli (numbers and then alternating numbers and letters) in an order as quickly as possible (123)
Comprehensive Executive Function Inventory (CEFI) (131)		Age 5–18	The CEFI is completed by parents (or similar caregivers) or teachers (or similar professionals) who rate behaviours of children ages 5–18 years. There is also a self-report version for 12–18 year olds. (131)
Conners' Continuous Performance tests (123)		Age 8 and above	
Corsi Block test (108)			A subject watches the tester touch a series of blocks, then the subject is to touch the blocks in the same order (108).
Delay-of- Gratification tasks (108)			
Delis-Kaplan Executive Function System (D-KEFS) (108,130)	Design Fluency Test	Age 8–89	The participant is presented with a record form containing rows of boxes, with each containing an array of dots and instructed to draw a different design in each box using only four lines to connect the dots (172).
Delis-Kaplan Executive Function System (D-KEFS) (128)	Trail Making Subset	Age 8–89	Participants rearrange coloured balls (or different sized discs) from an initial starting point on three laterally placed 'posts' or 'stockings' to a specified end point in the minimum number of moves.
Delis-Kaplan Executive Function System (D-KEFS) (108,128,129)	Verbal Fluency Test	Age 8–89	Participants are required to list words fluently. It consists of three letter fluency trials (for e.g.: the participant lists as many words as possible beginning with the letter 'B'), two category fluency trials (for e.g.: the participant lists as many animals as possible) and one category switching trial (such as the participant switches back and forth between naming as many vegetables and musical instruments as possible) (172)
Delis-Kaplan Executive Function System (D-KEFS) (108,130)	Sorting Test	Age 8–89	Respondents are asked to sort a set of six items that look like puzzle pieces into two piles in as many ways as possible (e.g. colour, shape, background design, category) (172)
Flanker task (108)			
NEPSY (123)	Visual attention		
NEPSY-II (134)	Inhibition subtest	Age 5–16	The child looks at a series of black and white shapes or arrows and names either the shape or direction or an alternate response, depending on the colour of the shape or arrow (134).

NEPSY-II (134)	Word Generation	Age 3–16	The child is given a semantic or initial letter category and asked to produce as many words as possible in 60 seconds (134)
NEPSY-II (134)	Design Fluency	Age 5–12	The child draws designs in the response booklet by connecting two or more dots within arrays containing five dots each (134).
NEPSY-II (134)	Auditory Attention & Response Set Inhibition	Age 5–16	The child listens to a series of words and touches the appropriate circle when he or she hears a target word. Auditory Attention assesses selective auditory attention and the ability to sustain it (vigilance). Response Set assesses the ability to shift and maintain a new and complex set involving both inhibition of previously learned responses and correctly responding to matching or contrasting stimuli.
Rey Complex Figure Tests (123)		Age 6–89	The participant is presented with a complex, detailed, geometric figure to copy and reproduce from memory.
Self-Ordered Pointing task (108)		Age 5–11, young adults	Participants see from 3 to 12 items (which might be line drawings, abstract designs, or boxes containing rewards) and are asked to touch one item at a time, in any order, without repeating a choice, making sure to touch all (108).
Stop-Signal tasks (108)			Participants press a button on the left when they see a left-pointing arrow and a button on the right when they see a right-pointing arrow and stop when they hear a sound.
Stroop Colour-Word Interference Test (123,124)		Age 15–90	Names of colours are written in ink of a different colour. Participants are required to report the colour of the ink, rather than the word (108).
Tasks of Executive Control (TEC) (108)	Go/No-go tasks		"Go" stimuli require a rapid motor response such as pressing a button on the keyboard to establish a prepotent or automatic response. In contrast, responding must be withheld, or inhibited, when the "no-go" stimulus appears. In the TEC, the no-go cue is a box surrounding any pictured object—examinees are instructed to not respond when the box is present. In contrast, any stimulus not surrounded by a box is a go stimulus (140).
Tasks of Executive Control (TEC) (139,140)		Age 5–18	
Tower of Hanoi/London (125–127)		Age 7 and above (Tower of London)	Computerized test involving the movement of small blocks of different colours on 3 different pegs.
Wisconsin Card Sorting Test (WCST) (108,121–123)		Age 7–89	The participant is presented with stimulus cards, each of which can be sorted by colour, number and symbol. The individual needs to find the correct sorting criterion based on on-going and changing feedback (108).
The following references were used to develop the Executive Function construct: (110,114–118,123,131,133,134,141,173,174)			

Abbreviations

BRIEF	Behaviour Rating Inventory of Executive Function
CANTAB	Cambridge Neurological Test Automated Battery
CAS 2	Cognitive Assessment System 2
CEFI	Comprehensive Executive Function Inventory
CHEXI	Childhood Executive Functioning Inventory
CWRA	College and Work Readiness Assessment
DeSeCo	Definition and Selection of Competencies
D-KEFS	Delis-Kaplan Executive Function System
EDF	Executive Dysfunctions
EF	Executive Function
FASTE	Feshbach and Roe Affective Situations Test for Empathy
HCTA	Halpern Critical Thinking Assessment
IC	Inhibitory Control
IRI	Interpersonal Reactivity Index
NEPSY	A Developmental Neuropsychological Assessment
OECD	Organisation for Economic Cooperation and Development
WCST	Wisconsin Card Sorting Test
WM	Working Memory

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