Creating a New Horizon in Pedagogy through the Growth Mindset

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TABLE OF CONTENTS

CHAPTER 1

OVERVIEW OF THE MINDSET

1.1 Belief system (Self-theory) 1.2 Views of mindset (Fixed and growth mindset) 1.3 Dimensions of mindset: Obstacle, Criticism, Effort, Failure, Success. 1.4 Mindset in Neuroscience: The mind is a muscle 1.5 Mindset in Psychology: Cultivate GRIT 1.6 Mindset in Education: How Minds Learn	The **first chapter** of this book, "Overview of the Mindset," introduces the overview of the mindset. The chapter starts with a crucial concept: the belief system in the mindset is bent. Next, it discusses Dweck's view of mindset (fixed and growth mindset) on the neuroscientific-based evidence showing the "malleability of the brain," which works like a muscle and becomes stronger while accepting challenges. Everyone has to nurture a mindset in their journey of success through the dimensions, i.e., obstacles, criticism, effort, and failure. Moreover, Dweck added that having a growth mindset is essential for success. The chapter explores the psychological perspective of mindset through GRIT, a personality trait of perseverance and passion for handling mental toughness and achieving long-term goals. The last piece of the discussion signifies that the mindset in education helps learners and educators understand how the mind learns and believes that persistent effort and practice lead to improvement.

It is well known that the learning and pedagogy fields include several psychological interventions due to the psychological context of the areas. Similarly, growth mindset pedagogy is also based on neuroscience and psychology, where mindset is central. A robust approach is needed to strengthen the power of the individual through mindfulness exercises. Our belief pattern constantly changes toward world entities due to the dynamics of the mind. To understand the vitality of the mind, we use the phrase "bumps in the road," which guides us to seek another path and venture into new vacancies.

Therefore, this chapter presents the foundations of growth mindset pedagogy, presenting the literature based on theoretical explanations. This chapter uniquely formalizes the chronology of a given subtopic to design and customize the context for a growth mindset and to open new horizons in education and pedagogy.

In this chapter, the authors first review historical views of intelligence before Carol Dweck's Mindset Theory because intelligence was thought to be the key to success. After that, they discuss the belief systems that maintain the view of the plasticity of intelligence rather than its fixed/static nature. After describing two views of intelligence and how they relate to belief systems, the authors begin a general conversation about belief systems and intelligence and their connection to the theory of the mind.

1.1 Belief System (Self-theory): As a Crucial Concept

Humans and beliefs are two inseparable things; as we all know, humans are social beings, and their ability to socialize is based on their belief system. Furthermore, beliefs arise from environmental experiences with relative understanding. The philosophical view on being social comes from the psychological background that "belief is a psychological acceptance or prepositional attitude." The term "belief system" can be interpreted as "a belief system representing a set of predispositions within an entity to cognize and interpret stimuli in a reliable model."

Everyone has certain core beliefs that are crucial to guiding basic behavior. These core beliefs shape the "belief system" that mutually influences individuals' perceptions. However, individuals vary in their tendency to structure their conceptual ideas. Differences in beliefs determine how individuals use their belief systems to make sense of the world around them.

Therefore, beliefs create a sense of reality.[1]

In particular, a belief system is a psychological mechanism that underlies changes in values, attitudes, and behaviors and links beliefs and behaviors.

A deep understanding of the entire process of belief requires attention to individual theories of self, which significantly impact human behavior and are considered a pillar of positive psychology. Likewise, different beliefs based on different experiences are called "meaning systems," and these meanings guide an individual's behavior[2][3][4]. Dweck presents a broad theoretical and empirical basis for a growth mindset, representing either a theory of the self or the strength of beliefs[5][6][7]. Dweck's research on mindsets shows how belief systems help to change learners' mindsets and attitudes. This further discusses historical interpretations of intelligence, belief systems, and their connection to mindsets.

Intelligence

It is generally assumed that intelligence reflects a person's overall character. Furthermore, reflections on "hundreds and thousands of studies" surrounding the concept of intelligence have changed the meaning of this statement over time. At various times, to condemn time and effort, psychologists, researchers, and educators have identified deeper understandings of the concept in terms of IQ tests, standardized tests of

[1] Connors and Halligan, "A Cognitive Account of Belief."
[2] Carol S Dweck, *Self-Theories* (Psychology Press, 2013), https://doi.org/10.4324/9781315783048.
[3] Sarah Mercer and Stephen Ryan, "A Mindset for EFL: Learners' Beliefs about the Role of Natural Talent," *ELT Journal* 64, no. 4 (October 1, 2010): 436–44, https://doi.org/10.1093/elt/ccp083.
[4] Mantz Yorke and Peter Knight, "Self-theories: Some Implications for Teaching and Learning in Higher Education," *Studies in Higher Education* 29, no. 1 (February 2004): 25–37, https://doi.org/10.1080/1234567032000164859.
[5] Teresa K. DeBacker et al., "Effects of a One-Shot Growth Mindset Intervention on Beliefs about Intelligence and Achievement Goals," *Educational Psychology* 38, no. 6 (July 3, 2018): 711–33, https://doi.org/10.1080/01443410.2018.1426833.
[6] Dweck, *Self-Theories*.
[7] Deborah Stipek and J. Heidi Gralinski, "Children's Beliefs about Intelligence and School Performance.," *Journal of Educational Psychology* 88, no. 3 (September 1996): 397–407, https://doi.org/10.1037/0022-0663.88.3.397.

aptitude, GPA (Grade Point Average), and SAT (Academic Ability propensity test).

In addition, they drew attention to dozens of "prime factors" of intelligence, such as reasoning, numerical ability, spatial ability, and metacognition.[8] For general interpretation, there is no clear definition of intelligence. Intelligence is "the ability to think, learn, and apply learned knowledge." The ambiguous nature of defining human intelligence reflects competing rigidities in historical contexts, including debates that republish the argument about whether intelligence is a 'fixed entity' or a 'malleable trait' (Modern Perspectives, Nature vs Nurture). Intelligence has thus become a widely used tool for coming up with various theories (old and modern) related to its nature. Some of the famous intelligence theorists are General Intelligence: Spearman (1961); Primary Mental Abilities: Louis Thurston; Multiple Intelligences: Howard Gardner (Gardner, 1992); Triad of Intelligence Robert Sternberg Grid (Sternberg, 1997); Intellectual Structure: Joy Paul Giltellect; Emotional intelligence: Daniel Goleman; Multifactor Theory: Thorndike, and many others[9][10]. The theories of intelligence published its innate traits, which cannot be changed. Hence, the concept of intelligence was assumed to be fixed and unchangeable, which can be identified with the primary factors of intelligence. This leads to the tangible nature of intelligence. Furthermore, the belief that each person has an ingrained and unchangeable amount of intelligence delivers an outlook of the explicit theory of intelligence. This was not the endpoint of intelligence.

Belief System and Mindset (Implicit Theory of Intelligence)

Furthermore, several theories tried to push society and the academic field away from a fixed view of intelligence. Much of the research on beliefs and behaviors comes from the mind theory of intelligence, which establishes a link between belief systems and intelligence. "Belief systems are mental processes that influence an individual's perception, cognition, and action."

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[8] Meir Sternberg, "Universals of Narrative and Their Cognitivist Fortunes (I)," *Poetics Today* 24, no. 2 (June 1, 2003): 297–395, https://doi.org/10.1215/03335372-24-2-297.

[9] H R Pal, A Pal, and P Tourani, "Theories of Intelligence," *Everyman's Science* XXXIX, no. 3 (2004): 181–92.

[10] Robert J. Sternberg and James C. Kaufman, *The Evolution of Intelligence* (Hoboken: Taylor and Francis, 2013).

An entity's behavior is intricately embedded in decision-making[11][12]. It is specifically concerned with creating a solid self-concept in mental stability.

It is expanded through belief systems (intelligence is malleable) that arise in implicit theory. Implicit theory can be traced back to "lay theory," areas considered personal constructs or beliefs in everyday life[13][14][15]. In psychology, American psychologist Carol Dweck leads an entire section of the theory of how beliefs affect an individual's self-perception[16]. From this point of discussion, it is necessary to move toward Dweck's contribution to the belief system to understand the connection between intelligence and the belief system. Dweck refers to two specific groups of assertiveness or self-theories: (i) fixation (entities) and (ii) plasticity (incremental) theories[17][18].

The belief system (self-confidence) has unique implications for intelligence; "entity" theory - "the belief that one possesses a certain amount of intelligence and one really cannot change it much." In contrast, the "incremental" theory—argues that intelligence is malleable, can change, and constantly significantly changes how smart you are. In this way, belief systems shape individuals' goals, change the meaning of failure, and guide behavioral responses. According to Dweck, the learner's belief about the

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[11] Stipek and Gralinski, "Children's Beliefs about Intelligence and School Performance."

[12] Jennifer A. Mangels et al., "Why Do Beliefs about Intelligence Influence Learning Success? A Social Cognitive Neuroscience Model," *Social Cognitive and Affective Neuroscience* 1, no. 2 (September 1, 2006): 75–86, https://doi.org/10.1093/scan/nsl013.

[13] Chi-yue Chiu, Ying-yi Hong, and Carol S. Dweck, "Lay Dispositionism and Implicit Theories of Personality.," *Journal of Personality and Social Psychology* 73, no. 1 (1997): 19–30, https://doi.org/10.1037/0022-3514.73.1.19.

[14] Bettina Hohnen and Tara Murphy, "The Optimum Context for Learning; Drawing on Neuroscience to Inform Best Practice in the Classroom," *Educational and Child Psychology* 33, no. 1 (March 2016): 75–90, https://doi.org/10.53841/bpsecp.2016.33.1.75.

[15] Jason E. Plaks, Sheri R. Levy, and Carol S. Dweck, "Lay Theories of Personality: Cornerstones of Meaning in Social Cognition: Lay Theories and Social Cognition," *Social and Personality Psychology Compass* 3, no. 6 (December 2009): 1069–81, https://doi.org/10.1111/j.1751-9004.2009.00222.x.

[16] Mercer and Ryan, "A Mindset for EFL."

[17] Dweck, *Self-Theories*.

[18] Miguel A. Sahagun et al., "Developing a Growth-Mindset Pedagogy for Higher Education and Testing Its Efficacy," *Social Sciences & Humanities Open* 4, no. 1 (2021): 100168, https://doi.org/10.1016/j.ssaho.2021.100168.

nature of intelligence leads to the entity versus incremental belief, which affects the learners' performance[19].

Furthermore, Dweck states that individuals tied to the entity theory of intelligence or a fixed belief called "self-handicapped," and those who are connected with the incremental theory of intelligence are called more proactive toward learning. People's beliefs about their attributes, such as their personality and intelligence, can either be **fixed** (things they cannot change) **or malleable** (something they can change)[2021]. Consequently, Kahneman (2011) explored the seminal concept of thinking systems (System 1 and System 2) and gave two forms of thinking systems: System 1 - "fast" and System 2 - "slow"[22].

The rapid system is an involuntary system that effortlessly generates impressions and sensations to make quick decisions through involuntary control. It is the primary source of "clearly believed." Slow systems, like "effort systems," deliberate before making choices and use self-reasoning before making decisions. According to Kahneman, this dual-mind system, including states of mind (beliefs), is the cognitive component of thinking[23].

Therefore, various factors affect decision-making, including cognitive biases, information accessibility, experience, and personal relevance. It determines situational and dispositional factors influencing the decision pattern and helps to clarify the reason. The thinking system affects the mindset in decision-making and hits the right balance between autonomy and harmony to cultivate whole-system thinking around human challenges. It involves thinking in a broader sense to impact success and growth while it governs the capacity to respond to environmental changes. Thus, the thinking system has implications for growth mindset-based teaching in educational settings.

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[19] Ivar Bråten and Helge I. Strømsø, "Epistemological Beliefs and Implicit Theories of Intelligence as Predictors of Achievement Goals," *Contemporary Educational Psychology* 29, no. 4 (October 2004): 371–88, https://doi.org/10.1016/j.cedpsych.2003.10.001.

[20] Carol S Dweck and Ehrlinger, Joyce, "Implicit Theories and Conflict Resolution," *The Handbook of Conflict Resolution: Theory and Practice* 2 (2006): 317–30.

[21] Schunk, "Implicit Theories and Achievement Behavior."

[22] Udo Kannengiesser and John S. Gero, "Design Thinking, Fast and Slow: A Framework for Kahneman's Dual-System Theory in Design," *Design Science* 5 (2019): e10, https://doi.org/10.1017/dsj.2019.9.

[23] Kannengiesser and Gero, "Design Thinking, Fast and Slow."

Thus, core beliefs have distinct implications for shaping the personality and give an exclusive idea of how the personality functions through self-attribution. An individual who learned the malleable trait theory can rebound with positive changes[24][25][26]. In this line, Albert Bandura's view is posited as "social cognitive theory" and discusses the impact of the social environment on the individual. Her research has clarified the supporting aspects of psychosocial mechanisms such as self-perception, motivation, and behavior. She cognized that the things that have the most significant impact on self-perception play a crucial role in "social persuasions and verbal judgments" that go back to cultivating the person's belief in their talents, abilities, and capabilities. She significantly contributed to understanding self-efficacy and the perceptions of self-influence to build the mindset that shapes individuals' attitudes[27].

Much of the evidence from the research work described above provides insight into how beliefs (based on incremental or entity theories), perceptions, thoughts, and actions influence mindsets and are reflected in personality and behavior. Therefore, the evidence assembled through Bandura's social cognitive theory, self-theory (1989), strongly supported belief systems in decision-making ability, fixed or incremental. The theoretical position of beliefs derived from different theories and approaches to explore Dweck's study, which supports the idea of a growth mindset, will be discussed under the following head based on Dweck's views on mindset in this chapter.

1.2 Views of Mindset (Fixed and Growth Mindset)

The central theme of this chapter, "Mindset Perspectives (Fixed and Growth Mindsets)," explores different views on mindset and is discussed as follows.

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[24] Albert Bandura, "Self-Efficacy: Toward a Unifying Theory of Behavioral Change.," *Psychological Review* 84, no. 2 (1977): 191–215, https://doi.org/10.1037/0033-295X.84.2.191.

[25] Yorke and Knight, "Self-theories."

[26] Schunk, "Implicit Theories and Achievement Behavior."

[27] Albert, "Social Cognitive Theory of Self-Regulation," *Organizational Behavior and Human Decision Processes* 50, no. 2 (December 1991): 248–87, https://doi.org/10.1016/0749-5978(91)90022-L.

Theoretical Construct of Mindset (Mind, Mindset, and Growth Mindset)

In the same way, the human mind is like a parachute; when it opens (the mind), it flexibly adapts to the changes around it and builds beliefs within itself to remain optimistic and deal with the changes confidently—in particular, knowing that the powerful mind is the form of self-confidence that can perform miracles and soar to unknown limits yet stay firmly on the ground and remain connected to core beliefs. Additionally, let us consider how the mind holds information. It can be understood that it is interconnected like a giant, multi-dimensional spider web. It connects any point in the network to any other end to an endpoint to clear paths and take future targeted routes[28]. When the mind starts thinking about the channel of being persuaded, the path seems obvious and known to spin new information and connect new links on the web.

In the mindset context, mental models (beliefs, assumptions, concept transformation) guide our perception of new information. A mindset forms a lens through which we perceive the world. Recent research explains how these mental blocks are activated in the brain through synaptic formation/neural connection[29].

Growth means to grow, change, develop, revise, and progress. All living things, namely plants, animals, and people grow. In the same way, our brains can thrive. When we combine these words, two terms come out, i.e., growth and mindset, which mean something energizing. Our mindset helps us see problems positively or negatively. These ways depend on the intelligence and ability to perceive things, whether we think things are difficult and give up or get clues to solve the problem.

Stanford University psychologist Carol Dweck divides mindset into fixed and growth mindset[3031]. Mindset research combined with implicit theories

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[28] Andreas Demetriou, Michael Shayer, and Anastasia Efklides, eds., *Neo-Piagetian Theories of Cognitive Development: Implications and Applications for Education* (London [England]: Routledge, 2017).

[29] Demetriou, Shayer, and Efklides, *Neo-Piagetian Theories of Cognitive Development*, 2017.

[30] Carol S. Dweck and David S. Yeager, "Mindsets: A View from Two Eras," *Perspectives on Psychological Science* 14, no. 3 (May 2019): 481–96, https://doi.org/10.1177/1745691618804166.

[31] Kyla Haimovitz and Carol S. Dweck, "The Origins of Children's Growth and Fixed Mindsets: New Research and a New Proposal," *Child Development* 88, no. 6

of intelligence has focused on two perspectives: fixed or malleable/incremental[32]. People with a fixed mindset feel like things are "I cannot do it yet," and they get stuck in general patterns that make them unachievable and debilitating. On the other hand, a person who thinks, "I can do better with practice and hard work" and does not give up easily feels happy and robust[3334].

The mindset in action describes the fixed and growth mindsets. Remember the story of the Tortoise and the Hare. Instead of believing it ran too slowly, Tortoise accepted the race challenge and stepped up, maintaining the standard, thinking he had a chance to win. Hare was so sure of his innate ability to win that he took the weight off his feet and fell asleep during the game. After the rabbit stood up, he ran as fast as he could, but he was too late: the tortoise won. A real sense of story in the context of mentality; Rabbit has a fixed mentality about innate ability for speed. The tortoise has a growth mindset; he thinks of working hard and running; otherwise, he would never have agreed to race the hare, and he is not afraid of failure (because of the slowness). This story is an excellent example of how a growth mindset can lead to amazing results.

Carol Dweck focused on the mindset that shapes an individual's view of the world. A mindset is a powerful approach to reframing the way of thinking that profoundly affects the top way of life. Dweck was curious to know why some people have thriving lives whereas others flounder. With the determination of a curious mind, she contributed to several studies and examined the congruence between the views of Mindsets. She found that people hold two beliefs that lead to the views of mindset: (i) Fixed mindset and (ii) Growth mindset (Dweck coined both terms)[35]. Let us see what these mindsets are in further discussion.

In 2006, Carol Dweck published her well-known book "Mindset: The New Psychology of Success". She differentiated the views of individuals' mindsets.

(November 2017): 1849–59, https://doi.org/10.1111/cdev.12955.
[32] Haimovitz and Dweck, "The Origins of Children's Growth and Fixed Mindsets."
[33] Dweck and Yeager, "Mindsets."
[34] Haimovitz and Dweck, "The Origins of Children's Growth and Fixed Mindsets."
[35] Dweck and Yeager, "Mindsets."

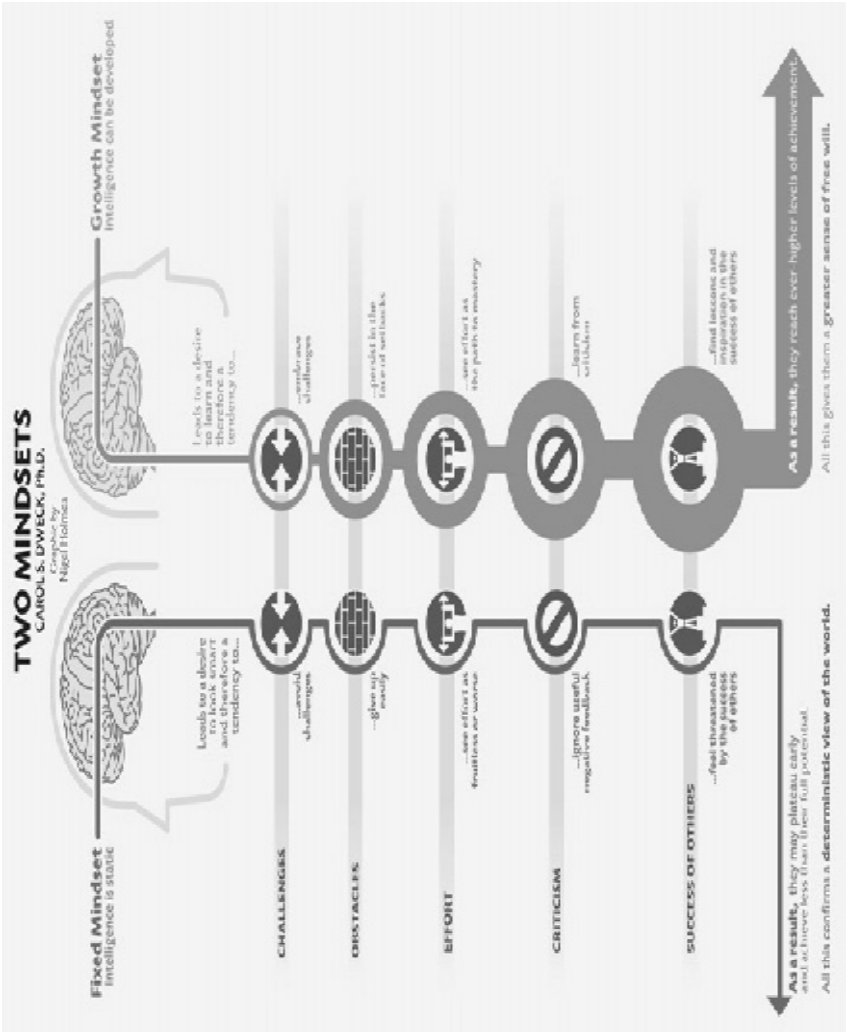

Fig. 1-1: Two mindsets (fixed and growth mindset)

A fixed mindset (ontology of intelligence) believes that a person's abilities are limited and that talent and intelligence cannot be changed. A growth mindset (an incremental theory of intelligence) looks at expansion and believes intelligence is malleable and can grow through hard work and

dedication."[36]

People with a fixed mindset establish a primary goal of earning a certificate based on their ability rather than actual learning. When they encounter obstacles, they see them as a burden on their innate abilities and become self-protective and helpless. On the other hand, people with a growth mindset respond to adversity by stepping up to efforts and changing routines. According to Carol Dweck, both mindsets (fixed and growth mindsets) revolve around a being throughout one's life. However, overly simplistic mindsets suggest that the human mindset forms a simple dichotomy of fixed and growth mindsets. It can be defined as "a person may hold different mindsets from different perspectives."[37] People with a growth mindset believe that effort and failure can be a source of progress or drain their failure

Conceptual Construct

Firstly, the authors' prime responsibility is to take readers through definitional aspects to understand the conceptual construct of mindset. Dweck defined a **fixed mindset** as "a person's beliefs and thoughts that intelligence is a fixed concept *or* **growth mindset,** a person's beliefs and thoughts that intelligence is a quality that can grow and change through hard work and effort." The theory of intelligence, which addresses the individual who holds beliefs about their intelligence, abilities, traits, talent, and capabilities, is commonly coined as a "person's mindset or implicit theory." The theory concerns how one's mindset trustingly assesses capabilities, talent, and intelligence (such as inborn vs. effort). Therefore, the implicit theory of intelligence is streamlined in the form of belief systems and mindsets by the work of many authors, including Dweck. Further, more definitions need to be dug into the concept. "Believing that your qualities are carved in stone—the fixed mindset—creates an urgency to prove yourself repeatedly[38]." A growth mindset is based on the belief that your essential qualities, talent, and intelligence can be cultivated through your efforts. However, people may differ in every way, which can grow through application and experience.

After discussing the definitional construct, the conceptual construct of a

[36] Stipek and Gralinski, "Children's Beliefs about Intelligence and School Performance."
[37] Mercer and Ryan, "A Mindset for EFL."
[38] Dweck and Yeager, "Mindsets."

mindset focused on characteristics and dimensions of the concept are as follows;

Characteristics of a Fixed Mindset;

- Believing that your qualities are engraved by birth and that you cannot change them.
- Risk and effort are two possessions that reveal individuals' shortfalls.
- Individuals believe that the whole thing is good and will happen automatically.
- The fixed mindset person is limiting the way of doing.

Characteristics of the Growth Mindset;

- The hallmark of a growth mindset is the passion for stretching manually and sticking to do well.
- Growth-minded individuals believe in human potential and develop it as an engine of growth.
- Individuals with growth mindsets believe talent comes through effort.
- With the growth mindset, effort is an essential ingredient to mastery.

1.3 Dimensions of Mindset

Carol Dweck identified five key dimensions (shown in Table 1) in which the actions of individuals differ in the frame of mind: challenges, obstacles, effort, criticism, and success of others. Responses to any of the five situations manifest themselves naturally; one's willingness to look smart and avoid failure is a fixed mindset, while one's response to improve is a growth mindset. The first dimension is called "**Challenge**," which means how an individual accepts challenges. A fixed mindset individual takes a challenge as pain and tries to avoid it, while another one finds it an opportunity to re-cap their general knowledge in advanced knowledge. The next dimension is the "**Obstacles**," which means the individual encounters an obstacle. At that moment, instead of giving up, it is essential to identify something valuable in the road blocker elements. The third dimension, "**Effort**," states that anyone can be the best performer by putting in effort, as consistent efforts create success. Furthermore, "**Criticism**" is the fourth dimension of the mindset, considering criticism as a tool for learning and taking it positively despite fearing it. The last and most specific dimension is "**Success of others,**" which focuses on the positive outlook on others'

success, which becomes the source of inspiration.

Table 1-1 A comparative description of fixed and growth mindsets

Fixed Mindset		**Growth mindset**
(Skill/talent/abilities/ intelligence are fixed traits at birth and cannot grow)	**Meaning**	(Skill/talent/abilities/ intelligence can be grown)
Dimensions		
Avoid challenges /Give up easily.	**Challenges**	Embrace challenges (Welcome the challenge and struggles)
Avoid obstacles	**Obstacles**	Persists despite setbacks
Believe that efforts are beyond their capabilities **(**Effort = Worthless)	**Effort**	Understand that hard work, effort, and failure are the paths of mastery learning (Effort = Mastery)
Ignore the feedback (View critical feedback as an attack and ignore it)	**Criticism**	Learn from criticism and take it as a challenge to enjoy it (Belief that negative feedback is helpful to achieve a goal)
Threatened by other's success (Feel jealous and frustrated by own lack of success)	**Success of others**	Find inspiration in other successful persons

Dimensions of Mindset: Challenges, Obstacles, Criticism, Effort, Success

"People can hold one of two beliefs: an entity theory that portrays one's ability and personal attributes to be an unchangeable and incremental theory that portrays one's ability to be relatively built upon and improved."[39] **A detailed description of the dimensions of Dweck's Mindset theory is given here.** Dweck's journey began with the influential theory of mindset, which tended to handle failure in two ways: best to avoid the challenging

[39] Carol S. Dweck, "The Journey to Children's Mindsets-and Beyond," *Child Development Perspectives* 11, no. 2 (June 2017): 139–44, https://doi.org/10.1111/cdep.12225.

situation or be willing to grapple with the challenging situation[40][41]. Much in the same way, pursuing challenges and failure in leading the line from effort to progress offers a gift to students that fosters growth mindsets. Thus, it considers this basic coverage of mindset theory[42][43]. Dweck documented the five key dimensions or situations in which an individual's mindset significantly affects their outcome[44][45].

i) Challenges

The challenge is the ideal composition of learning. Moreover, challenges demand intellectual engagement involving interest and desire in various complex situations. Suppose people take the challenge as a desire to work hard against the hunger for learning, leading to more success. How you respond to challenges determines a personal growth mindset and character affirmation. People who believe in incrementalism develop a mindset that accepts challenges. Neuroscience has proven that the tendency to work harder is responsible for increased synapses between neurons and the brain becoming smarter.

Few people improve their lives with whatever they have, and some improve with whatever they do not; when they do, they accept challenges and prove others wrong[46].

Let us look at some real-life illustrations: Dean Du Plessis was blind as he suffered from a tumor in both eyes since birth and was not predicted to live. He started his career as a sports commentator for cricket games in Zimbabwe after following cricket from 20 to 35 years old. Plessis

[40] Carol Dweck, "Carol Dweck Revisits the 'Growth Mindset,'" *Education Week* 35, no. 5 (2015): 20–24.
[41] Dweck and Yeager, "Mindsets."
[42] Yorke and Knight, "Self-theories."
[43] Peter M. Gollwitzer, "Mindset Theory of Action Phases," in *Handbook of Theories of Social Psychology: Volume 1*, by Paul Van Lange, Arie Kruglanski, and E. Higgins (1 Oliver's Yard, 55 City Road, London EC1Y 1SP United Kingdom: SAGE Publications Ltd, 2012), 526–46, https://doi.org/10.4135/9781446249215.n26.
[44] Lisa S. Blackwell, Kali H. Trzesniewski, and Carol Sorich Dweck, "Implicit Theories of Intelligence Predict Achievement Across an Adolescent Transition: A Longitudinal Study and an Intervention," *Child Development* 78, no. 1 (January 2007): 246–63, https://doi.org/10.1111/j.1467-8624.2007.00995.x.
[45] Maurice Yolles and Gerhard Fink, "An Introduction to Mindset Theory," *SSRN Electronic Journal*, 2013, https://doi.org/10.2139/ssrn.2348622.
[46] Mangels et al., "Why Do Beliefs about Intelligence Influence Learning Success?"

tracks the players' actions by listening to stump microphones around the cricket ground. How did he make it possible? By simply accepting the challenge of what he did not have. He also writes a sports column for the newspaper and broadcasts a daily sports report over the radio.
Sintayehu Tishale lost the permanent use of his arms after getting polio in infancy. He learned to use his feet for daily work as he grew up. His parents could not think of his bright future and thought he might only earn a livelihood by begging. However, he was inspired to get an education and learn reading and writing. He started his career as a carpenter, making furniture using tools, hammering, cutting wood, and finishing with his feet. He again proves to the world that anything can be possible through self-belief, and it does not matter what you do not have and others have. The determination to accept challenges and to believe in changing the scenario matters.

ii) Obstacle

"Obstacles are the things, objects, situations that block/prevent one's progress in pursuit of goal or achievement." The second dimension of Dweck's theory is 'Obstacle,' which is often intended to not give up on obstruction, and it enriches the mental exercise to tackle the problem and shows GRIT and resilience[47]. Generally, individuals meld with obstacles and pin down their responses, while studies show that when individuals face obstacles and are determined to overcome them, they grow more brain cells. Similarly, an individual dealing with failure learns new ways[48]. ***Let us take a few stories related to overcoming obstacles;***

Joe Riffe lost his left leg after falling 110 feet while hiking. His leg was amputated. He amputated his leg and got a prosthetic one to return to work. Riffe started a blog sharing stories from amputation to losing his paycheck, including fighting the insurance company for a new leg and getting his job back. His story narrates that a simple person can overcome any obstacle if he decides to win the show.

Likewise, Dergin Tokmak got polio at the age of one year. As a result, he

[47] Daeun Park et al., "The Development of Grit and Growth Mindset during Adolescence," *Journal of Experimental Child Psychology* 198 (October 2020): 104889, https://doi.org/10.1016/j.jecp.2020.104889.
[48] Tara Devi S Ashok, "Development of a New Mindset for ELearning Pedagogy: For the Teacher and the Learner," *Current Issues in Emerging ELearning* 1, no. 1 (2014), https://scholarworks.umb.edu/ciee/vol1/iss1/4.

lost control of his left leg and a small quantity of control of his right leg. He started walking on his arms. After watching the movie "Breakin," he thought of learning to breakdance. He danced using a forearm cane on the street called "Stix" and had a reputation and a team. He has won awards all over the world. Finally, in 2004, Tokmak started in a small role in "The "Lamphing Angel" and became popular with the audience. This story tells how one person changed the fate of hapless to success through their state of mind."

iii) Criticism

"Criticism refers to critical judgment from others."[49]

Dweck proposes a third dimension, 'criticism,' as a learning tool. Criticism opens up various options for progress. Feedback and criticism are valuable parts of the learning experience teachers, peers, and others provide[5051].

Thus, learners' responses to criticism are crucial in resisting constructive and personal negative feedback. Others see it as a tool to master in pursuit of goals[52]. The learner demonstrates his willingness to rely on criticism from others, seeing it as a resource for learning rather than a sign of his poor performance.

iv) Effort

"Effort is the power of a person or machine to accomplish a task."[53] The fourth dimension of Dweck's theory of mind is 'effort.'

In the context of effort and its neuro roots, neuroscience looks at the role of efforts in building insulation, a type of myelin that builds neuronal circuits. Effort changes the perception of action. Effort triggers the brain to create new synaptic connections[54]. If the person perceives effort as positive, it is a

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[49] Annie Brock and Heather Hundley, *In Other Words: A Teacher's Guide to Empowering Students through Effective Praise and Feedback* (La Vergne: Ulysses Press, 2018).
[50] Dweck, *Self-Theories*.
[51] C. Anne Gutshall, "TEACHERS' MINDSETS FOR STUDENTS WITH AND WITHOUT DISABILITIES," *Psychology in the Schools* 50, no. 10 (December 2013): 1073–83, https://doi.org/10.1002/pits.21725.
[52] Ashok, "Development of a New Mindset for ELearning Pedagogy: For the Teacher and the Learner."
[53] Brock and Hundley, *In Other Words*.
[54] Usha Goswami, "Principles of Learning, Implications for Teaching: A Cognitive

constructive force. Deliberate effort/practice surpasses optimal learning through repeated improvement. People who view effort as the path to mastery break the failure chain by maximizing the number of efforts. Let us go with one small story to understand the importance of effort.

"One day, a small gap appeared in the cocoon, through which the butterfly had to appear. A boy who accidentally passed by stopped and watched how the butterfly was trying to get out of the cocoon. It took much time; the butterfly was trying very hard, and the gap was as small as before. It seemed that the power would leave the butterfly soon. The boy decided to help the butterfly. He took a penknife and cut the cocoon. The butterfly immediately got out, but its body was weak, and its wings barely moved. The boy continued to watch the butterfly, thinking that now its wings would spread and it would fly. However, that did not happen. The butterfly had to drag its weak body and wings that were not spread for the rest of its life. It was unable to fly because the boy did not realize that an effort to enter through the narrow gap of the cocoon was necessary for the butterfly so that the life-giving fluid would move from the body to the butterfly's wings and that the butterfly could fly. Life forced the butterfly to leave its shell hard so that it would become stronger and would be able to grow and develop". (Source: Short Inspirational Stories About Overcoming Challenges and Obstacles*)*

v) Success of others

"Success or achievement attained by others."[55]

This is the final dimension of Dweck's theory of mind. Individuals learn from the success of others and gain lessons and inspiration from the interpretation of success. Others' success, a shared experience of others' perseverance, is seen by individuals as an opportunity to learn how to sustain themselves during difficult times and to help overcome insecurities or vulnerabilities. Of course, people with a growth mindset view the success

Neuroscience Perspective," *Journal of Philosophy of Education* 42, no. 3–4 (August 2008): 381–99, https://doi.org/10.1111/j.1467-9752.2008.00639.x.

[55] Brock and Hundley, *In Other Words*.

of others as an inspiration for progress.[56][57][58][59]

At this point, the authors would like to mention some names of successful people such as Bill Gates, Elon Musk, Steve Jobs, Chris Pratt, Sylvester Stallone, Henry Ford, Beyoncé, etc. The surprising truth is that before being successful, all struggled. They were unsure of success and thought about failure. At some point in the struggle, they had self-doubt to transform their dreams into reality and feared failure. They also thought they would spend the rest of their lives in office jobs because they expressed stupidity. At some point, "they resolved to take on the challenge and overcome obstacles, analyzing why they are a failure, and how they can learn from their mistakes and realize what they need to change in their approach to perfect execution the next time." Afterwards, they win and become successful. Any celebrity or icon you look at struggled with their goals. There is undoubtedly a need to go through the success stories of others; it helps to change the mindset of the individuals.

Although Dweck did not mention failure as a dimension, she discusses "The Power of Failure" in her theory of Mindset. Failure is a concept that runs parallel with all dimensions of mindset theory. For both mindsets, fixed and growth, dealing with failure is also vital. It plays a significant role in shifting from fear to progress. Authentic learning is an exuberant process of failure, reflected in an individual's journey to success. This process can be seen heroically in the success of some famous people worldwide. The value of failure or error drives a mindset; thus, it creates the big picture of success through repeated efforts. "Making mistakes is one of the best ways to learn."[60]

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[56] Ashok, "Development of a New Mindset for ELearning Pedagogy: For the Teacher and the Learner."
[57] Brock and Hundley, *In Other Words*.
[58] Melissa A. Chase, "Should Coaches Believe in Innate Ability? The Importance of Leadership Mindset," *Quest* 62, no. 3 (August 2010): 296–307, https://doi.org/10.1080/00336297.2010.10483650.
[59] Laurie Murphy and Lynda Thomas, "Dangers of a Fixed Mindset: Implications of Self-Theories Research for Computer Science Education" (ITiCSE '08: Proceeding of 13th annual conference on Innovation and technology in computer science education, Madrid Spain: ACM, 2008), 271–75, https://doi.org/10.1145/1384271.1384344.
[60] Dweck and Yeager, "Mindsets."

Furthermore, striving for the perfectionistic inclination is a human tendency: "Nobody particularly likes mistakes or being wrong" because they are seized by the perfection-paralysis cycle. "It is the immobilizing fear of making the wrong choice, fear of failure, which wrecks the human psyche and prevents them from moving forward because they feel scared about the results. Therefore, it traps humans and stresses them out of their full potential."[61] Thus, the failure viewpoint perceives mistakes as paths to avoid. Indeed, one must turn around and face them, not be away from them. Turning to failure by breaking the perfection-paralysis cycle is problematic because it often brings failure. On the other hand, being willing to face all failure rather than "hide or run" improves the relationship with failure and the ability to learn (occupying a growth mindset).[62][63]

With live illustration, let us understand that James Dyson invented cyclonic vacuum technology, which caused 5,126 failures. Thomas Edison, ten thousand times, created the failed prototype of an electric bulb before succeeding. Sylvester Stallone was rejected 1,500 times when he tried to sell his script. Steven Spielberg, the Oscar Award winner, faced rejection from the University of Southern California; after that, he accepted to become a creator. The author of the famous book "Harry Potter: The Story of Witches and Wizard" won several awards for her bestselling fantasy book series. A few know that she has faced many failures, was troubled by acute depression, and tried to commit suicide, and to overcome this, she started writing. Many publishers rejected her first book even though her name is registered in the "golden letters" in the literary world today. Many people faced failure multiple times before achieving success and becoming icons worldwide. Every person can do the same, only thinking that failure is typical and everybody has to face it. Without failure, it is imaginary to think of success. Facing failure is a kind of polishing to remove our mental rust.

[61] Kaci Bishop, "Framing Failure in the Legal Classroom: Techniques for Encouraging Growth and Resilience," *Arkansas Law Review* 70, no. 4 (2018): 970, https://scholarworks.uark.edu/alr/vol70/iss4/4.
[62] Bishop, "Framing Failure in the Legal Classroom: Techniques for Encouraging Growth and Resilience."
[63] Yolles and Fink, "An Introduction to Mindset Theory."

1.4 Neuroscience: The Mind is a muscle

This chapter clearly shows the "neuroscientific perspective of mindset." This section introduces neuroscience's key components and the importance of developing a growth mindset. Human thinking emerges with the operation of the brain. There is no doubt that the complexity of the brain makes it complicated to understand the human mind. However, the more dynamic aspects of the human mind have attracted researchers to understand its mechanisms through the lens of "neuroscience."[64] Before we move on to how "mindset and neuroscience" relate, let us briefly discuss neuroscience.

Neuroscience

The science of learning and success has been turned upside down by an easy-going basic understanding of "neuroscience." Neuroscience means "neurological science". Remarkably, neurons send signals to neighboring neurons through their tiny connections. Each neuron has thousands of small connections that are responsible for brain mechanisms. New research shows that the brain is like a muscle. This view brings up the understanding that when a person learns something new, it exercises and becomes denser through the multiplication of long-range connections formed in the brain machinery. Through this echo exercise, these tiny connections become stronger.[65][66][67]

With more practice, the brain becomes healthier and produces the neuronal lining called "myelin" (a tubular structure) that connects neurons to neurons. Neuroplasticity illustrates how neural pathways are always changeable due to our experiences. The brain is just a giant pond of

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[64] Demetriou, Shayer, and Efklides, *Neo-Piagetian Theories of Cognitive Development*, 2017.

[65] Scott A. Huettel, "Ten Challenges for Decision Neuroscience," *Frontiers in Neuroscience* 4 (2010), https://doi.org/10.3389/fnins.2010.00171.

[66] Betsy Ng, "The Neuroscience of Growth Mindset and Intrinsic Motivation," *Brain Sciences* 8, no. 2 (January 26, 2018): 20, https://doi.org/10.3390/brainsci8020020.

[67] Eleanor O'Rourke et al., "Brain Points: A Growth Mindset Incentive Structure Boosts Persistence in an Educational Game" (CHI '14: CHI Conference on Human Factors in Computing Systems, Toronto Ontario Canada: ACM, 2014), 3339–48, https://doi.org/10.1145/2556288.2557157.

hundreds of billions of nerve cells (neurons), similar to the number of stars in our galaxy.[68][69][70]

Neuroplasticity/Brain Plasticity (Cells that Fire Together, Wire Together)

Neuroplasticity suggests neurons fire with their partners, then join forces and wire together. The supporting idea is based on the mental exercise that flourishes and remodels the brain by distributing large neuronal networks.[71][72][73][74] Different brain exercises, such as foundational training, can increase the number of neuronal firing rates and the coherence of firing patterns. Myelin (insulating sheath/layer) is a signaling site that allows electrical impulses to transmit accurate information through environmental input/activation in existing networks.[75][76] Therefore, the brain always creates a tiny new connection between neurons and kills off unused ones. A variety of actions to deal with obstacles, use force, try again and again, demonstrate perseverance, and demonstrate a solid determination to face failure used by the acronym "Feeds" the brain by forming the tiny connections that underlie its daily practice of new moves. Thus, the inherent qualities of the mind can be developed by feeding the brain. Therefore, "to give is to receive." promotes "Neuroplasticity," which allows experience to build neural

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[68] Michael S. C. Thomas, Denis Mareschal, and Iroise Dumontheil, eds., *Educational Neuroscience: Development across the Life Span* (New York, NY: Routledge, 2020).
[69] O'Rourke et al., "Brain Points."
[70] Ng, "The Neuroscience of Growth Mindset and Intrinsic Motivation."
[71] Jo Boaler, *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages, and Innovative Teaching* (San Francisco, CA: Jossey-Bass & Pfeiffer Imprints, 2015).
[72] Thomas, Mareschal, and Dumontheil, *Educational Neuroscience*.
[73] Huettel, "Ten Challenges for Decision Neuroscience."
[74] O'Rourke et al., "Brain Points."
[75] Ng, "The Neuroscience of Growth Mindset and Intrinsic Motivation."
[76] Rajeev Raizada, "Effects of Socioeconomic Status on Brain Development, and How Cognitive Neuroscience May Contribute to Leveling the Playing Field," *Frontiers in Human Neuroscience*, 2010, https://doi.org/10.3389/neuro.09.003.2010.

scaffolds. The term "plasticity" refers to the brain's ability to shape things through experience ."[777879]

Research-Evidences on Mindset and Neuroscience

It is well known that the science of mind and neuroscience has been widely recognized to have roots from a "neuropsychological" standpoint. The concept of the mind encompasses several cognitive processes, including perceptions, beliefs and feelings, qualities of thought, sensations, emotional attention, awareness, imagination, and self-reflection. The attributes mentioned above of the mind are found in several different parts of the brain and are responsible for cultivating these mental qualities. However, the mind does not reside alone in any corner of the brain. However, the mind ultimately involves all activities of the brain. An analogy can define the mind: "The mind is the CEO deciding what instructions must be sent to the brain to function in the body." This interpretation suggests that "the brain is a Muscle that can be exercised and strengthened. Numerous research

[77] Gregory M. Donoghue and Jared C. Horvath, "Translating Neuroscience, Psychology and Education: An Abstracted Conceptual Framework for the Learning Sciences," ed. Gregory Yates, *Cogent Education* 3, no. 1 (December 31, 2016): 1267422, https://doi.org/10.1080/2331186X.2016.1267422.
[78] Murphy and Thomas, "Dangers of a Fixed Mindset."
[79] Judy Willis and Malana Willis, *Research-Based Strategies to Ignite Student Learning: Insights from Neuroscience and the Classroom*, Revised and expanded edition (Alexandria, Virginia: ASCD, 2020).

demonstrates strong evidence linking neuroscience to a growth mindset[8081828384858687888990].

A research study led by **Eleanor Maguire** on the "**London Cab drivers"** about **brain plasticity** has shown to address the growth mindset intervention or the intelligence and that it can be grown. A set of findings led by scientists investigating black cab drivers in London is that cab drivers memorize an incredible number of 25,000 streets and 20,000 landmarks within London. The **Magnetic resonance imaging (IRI)** technique was used to take a test about "The Knowledge." An electric fire current in the brain creates the synapsis and forms the structural pathway by connecting different areas. The result was that larger hippocampi were found due to increased grey matter in the posterior hippocampus. Hippocampi had grown over the memory profile expansion of the cabbie drivers. This study shows

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[80] Eloise Carvalho and Yvonne Skipper, "A Two-component Growth Mindset Intervention for Young People with SEND," *Journal of Research in Special Educational Needs* 20, no. 3 (July 2020): 195–205, https://doi.org/10.1111/1471-3802.12472.

[81] Carol S. Dweck, "Mindsets and Human Nature: Promoting Change in the Middle East, the Schoolyard, the Racial Divide, and Willpower.," *American Psychologist* 67, no. 8 (2012): 614–22, https://doi.org/10.1037/a0029783.

[82] Diana M. Fraser, "An Exploration of the Application and Implementation of Growth Mindset Principles within a Primary School," *British Journal of Educational Psychology* 88, no. 4 (December 2018): 645–58, https://doi.org/10.1111/bjep.12208.

[83] Goswami, "Principles of Learning, Implications for Teaching."

[84] Huettel, "Ten Challenges for Decision Neuroscience."

[85] Thomas, Mareschal, and Dumontheil, *Educational Neuroscience*.

[86] O'Rourke et al., "Brain Points."

[87] Jérémie Blanchette Sarrasin et al., "Effects of Teaching the Concept of Neuroplasticity to Induce a Growth Mindset on Motivation, Achievement, and Brain Activity: A Meta-Analysis," *Trends in Neuroscience and Education* 12 (September 2018): 22–31, https://doi.org/10.1016/j.tine.2018.07.003.

[88] Maximiliano A Toledo et al., "Interactive Student-Centered Neuroscience Workshops for Sixth Graders Enhance Science Knowledge and Education Attitudes," *Journal of Undergraduate Neuroscience Education* 18, no. 2 (n.d.).

[89] Katherine Woollett, Hugo J. Spiers, and Eleanor A. Maguire, "Talent in the Taxi: A Model System for Exploring Expertise," *Philosophical Transactions of the Royal Society B: Biological Sciences* 364, no. 1522 (May 27, 2009): 1407–16, https://doi.org/10.1098/rstb.2008.0288.

[90] David S. Yeager et al., "Using Design Thinking to Improve Psychological Interventions: The Case of the Growth Mindset during the Transition to High School.," *Journal of Educational Psychology* 108, no. 3 (April 2016): 374–91, https://doi.org/10.1037/edu0000098.

a degree of brain plasticity or flexibility and the extent of the brain's possibilities to develop and change.[91] This study can be tempting to support the growth of mind dates related to brain exercise. **Other empirical studies have shown** that a growth mindset significantly affects individual performance.

Another cost-effective study by Blackwell, Trzesniewski, and Dweck implemented the growth mindset intervention on 7th-grade students. The essential message of the study on the growth mindset was that "efforts" engage the brain to be adept at creating new connections throughout life. In another sense, the brain is malleable and can be expanded.[92] Based on the study conducted by Ng, it has been shown that there exists a neural interplay between the constructs of growth mindset and intrinsic motivation. According to Ng, cognitive processes have a noticeable impact on the implicit aspects of an individual psyche since this signifies the adaptability of intelligence[93]. Fitzakerley, Michlin, Paton, and Dubinsky suggested that neuroscience knowledge addresses the positive attitudes toward the science field, which uniquely increases additional knowledge about the brain and learning. Neuroscience expands the agreement with statements related to the growth mindset and science of learning[94]. Donohoe, Topping, and Hannah conducted an intervention through an online interactive Brainology Programme (an interactive learning tool) intending to encourage a growth mindset among students. The study indicated a shift in mindset, and the "Brainology Programme" provided short-term changes in mindset[95]. Several studies have been undertaken to promote the growth mindset within the neuroscience setting, and an overview of some of the studies is

[91] Woollett, Spiers, and Maguire, "Talent in the Taxi."
[92] Blackwell, Trzesniewski, and Dweck, "Implicit Theories of Intelligence Predict Achievement Across an Adolescent Transition."
[93] Ng, "The Neuroscience of Growth Mindset and Intrinsic Motivation."
[94] Janet L. Fitzakerley et al., "Neuroscientists' Classroom Visits Positively Impact Student Attitudes," ed. Daniel Ansari, *PLoS ONE* 8, no. 12 (December 16, 2013): e84035, https://doi.org/10.1371/journal.pone.0084035.
[95] Claire Donohoe, Keith Topping, and Elizabeth Hannah, "The Impact of an Online Intervention (Brainology) on the Mindset and Resiliency of Secondary School Pupils: A Preliminary Mixed Methods Study," *Educational Psychology* 32, no. 5 (August 1, 2012): 641–55, https://doi.org/10.1080/01443410.2012.675646.