
Growth in learning, academic attainment, and well-being

Having a growth mindset can positively affect learning, academic achievement, and subjective well-being. Although the activity of some brain regions has been related to mindset, interventions in schools to promote growth-mindset beliefs are controversial.

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Executive summary

- Growth mindset has been said to positively affect learning, academic achievement, and subjective well-being; it is related to the belief that intellectual abilities such as intelligence are malleable.
- Mindset refers to brain and mind functions like self-efficacy, motivation, coping skills, resilience, perseverance, grit, and well-being.
- Neuroimaging and event-related potentials studies have revealed that mindset is connected to particular brain regions involved in feedback value, reward, executive-functions management, motivation, perseverance, grit, and attention to mistakes.
- Interventions to change students' approach to learning by developing growth-mindset beliefs are controversial. Almost half the interventions that measured students' mindset before and after a specific intervention failed to generate a shift; moreover, some studies showed only small effects, and short-term interventions yielded only short-term results.
- To help students change their approach to learning by developing growth-mindset beliefs, permanently embedding a growth-mindset culture within the classroom throughout scholarship may be the most effective way of engendering long-term improvements.
- Interventions to foster a growth mindset in schools may need to address the teacher's mindset as well.
- In the light of ongoing controversies, more research is needed. Other areas related to engendering long-term improvements and well-being, including grit, goal-setting, resilience, coping skills, and motivation could be considered.

Introduction

The idea that intellectual abilities, including intelligence, are malleable has led many schools and educational systems to adopt growth-mindset interventions.^[1] Furthermore, self-belief—a person's positive attitude about their ability to complete tasks and achieve their goals—has also been found to have a powerful effect on academic success.^[2] Those who believe intellectual abilities are malleable are said to have *growth mindsets*. Those who believe the opposite are said to have *fixed mindsets*.

One influential line of research focuses on the correlations between academic achievement, motivation, and mindset.^[3–5] Holding a fixed mindset can impede or hinder goal pursuit and hamper test performance.^[6] If a student has a growth mindset and believes that intelligence can improve over time, they will want to master new information to grow their intelligence and be motivated to choose challenging tasks as opportunities to improve their intelligence. They are also more likely to persevere.

However, a recent meta-analysis revealed that nearly half of student-mindset interventions that measured mindset before and after specific interventions failed to generate a shift.^[1] Moreover, critics argue that the intervention effects may be too small and unreliable to be practically meaningful, pointing to nonsignificant results in some replication attempts,^[1, 7, 8] and leading to the suggestion that investments in the educational, economic, and time resources needed for growth-mindset interventions might be better allocated elsewhere.^[1]

In this brief, data on the effectiveness of growth-mindset interventions in increasing academic achievement, individual improvement, and self-belief will be presented and discussed, including neuroscientific data regarding the brain areas involved in mindset. This will lead to some recommendations being made, including one for more research to be focused on ongoing controversies.

Mindset influence on academic performance

Over 30 years ago, Carol Dweck and her colleagues became interested in students' attitudes toward failure.^[4, 9–12] They noticed that some students rebounded after major setbacks while others seemed overwhelmed by even the smallest setback. After studying the behavior of thousands of children in relation to the beliefs they had about learning, intellectual abilities,

and intelligence, the terms “fixed mindset” and “growth mindset” were coined.^[9] A growth mindset, also referred to in the literature as an “incremental mindset” or “incremental theory”, endorses the general belief that intellectual abilities, including intelligence, are amenable to improvement over time.^[13] Those who believe that ability can be enhanced are more likely to strive toward personal learning or improvement goals to advance their skills.

A fixed mindset, however, also referred in the literature as an “entity mindset” or “entity theory,” revolves around the belief that intelligence and other intellectual abilities are innate fixed traits.^[13] For those with a fixed mindset, the ultimate goal of learning is the demonstration of high intelligence through the attainment of a prescribed performance standard, such as achieving high marks on an exam, rather than individual improvement, such as discovering a new way to solve a problem. Individuals with fixed mindsets are unlikely to take on tasks that they believe will reveal the limits of their intelligence.^[9]

Mindset has been measured using different scales.^[4, 14] Some researchers believe that a fixed mindset can undermine academic performance and a person’s interest in working in a specific field, while a growth mindset can promote greater academic performance and more adaptive approaches to learning.^[13] Several lines of research show that endorsing or promoting a growth mindset is associated with improvements in academic performance.^[15, 16] These studies document numerous ways in which mindset influences behaviors that impact academic achievements, such as grit, perseverance, motivation, self-esteem, and self-belief.^[16–18]

One theory is that students with a fixed mindset tend to avoid situations in which they might struggle or fail because these experiences undermine their sense of their own intelligence. In contrast, students who have a growth mindset tend to see difficult tasks as a way of increasing and improving their abilities,^[15] and they are more likely to seek out challenging learning experiences that enable them to do so.^[16, 18] Consequently, students who have a growth mindset may tend to earn better grades than students who hold a fixed mindset, especially in the face of difficulty, although this seems to depend on the type of assessment.^[15–17] Students with fixed mindsets can do well on traditional “show what you know” tests, rather than “show what can you do” tests. Several field experiments have revealed that a growth mindset correlates with achievement, suggesting that targeted interventions can help students start to develop a growth mindset.^[e.g., 15, 19–23]

Growth mindset in education

Despite the publication of dozens of works setting out different pedagogical and methodological approaches to stimulating a growth mindset in children from infancy to young adults—each of which has its own particularities according to the age of the students and the educational system in the country where they have been assayed or implemented—there is a set of observations that are common to all of them.^[24, 25] It is not the purpose of this brief to discuss them in detail, but a summary of the main features of growth-mindset pedagogy in basic education is presented below.

In one of the most apposite approaches, students are taught about brain development and function with a special emphasis on brain plasticity and learning.^[4, 11, 13] In other words, if an individual understands how the brain works and how learning can increase intellectual ability, they can begin to gain a sense of control over their own learning (Fig. 1).^[15]

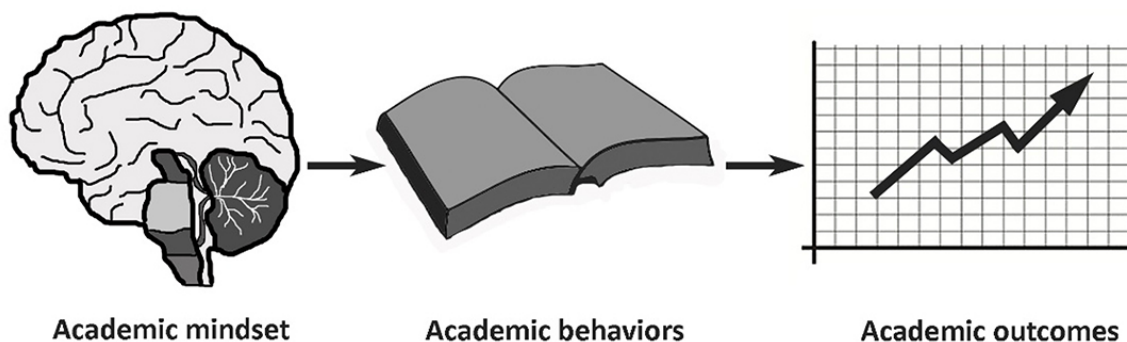


Figure 1. Mindset influence on academic performance.

Other pedagogical and methodological approaches used in different settings include the following:^[24]

1. Supporting students' individual learning processes by avoiding quick, stereotypical judgments of them, conducting frequent one-on-one interactions with them, learning about and helping them overcome their individual barriers, and differentiating as the basis of pedagogical practice.
2. Promoting mastery orientation by fostering learning goals, emphasizing formative assessment, and avoiding comparisons to other students.
3. Favoring persistence by not giving up on students and leaving no room for helplessness behavior patterns, not protecting students from challenges, and giving honest critical feedback in the "not yet" form.
4. Fostering students' process-focused thinking by praising courage, strategies, and effort; teaching the positive role of failures, mistakes, and challenges in learning; fostering students' incremental beliefs and situational attributions, and teaching learning strategies, emphasizing learning-to-learn goals.

It is also noteworthy that a growth mindset is not limited to academic learning. For example, parents' mindsets about intellectual abilities and intelligence also contribute to their interactions with their children.^[26] For example, it has been shown that gesture intervention with a growth-mindset component among parents of 10-month-olds increases the parents' use of the pointing gesture, which is paralleled in the infant's use of pointing, although no effects on toddlers' vocabulary growth have been detected. Research has also demonstrated that the application of a growth mindset to social skills can help individuals overcome adversity in social interactions with their peers^[27, 28] and that teaching individuals that social attributes can be developed can reduce levels of aggression and improve behavior in pupils.^[28]

Mindset influence on self-efficacy

To fully understand mindset, it has to be put in a broader context of brain and mind functions, namely self-efficacy, motivation, coping skills, resilience, and well-being. It has been said that mindset shares similarities with personal self-efficacy—a personal judgment of how well one executes the courses of action required to deal with various situations. Self-efficacy involves determination and perseverance to overcome obstacles that interfere with achieving goals, and includes elements of motivation, work performance, and behavioral control.^[29] It has been proposed that when students believe that they can get smarter and stronger through effort, they will put in the extra time and effort that leads to higher achievements. Performance expectations and values are likely to be shaped by individual differences in mindset, whether that means intelligence and other intellectual abilities are seen as fixed, immovable traits or a malleable process that can be improved through hard work, practice, and experience.^[9]

Although mindset and self-efficacy are related in some ways, a key difference between them is that self-efficacy reflects a person's belief in their own agency and ability to produce a preferred outcome in their life.^[30] Mindset, conversely, reflects a person's perspective on intellectual ability in general and on whether broad or domain-specific intelligence emerges from a skill set that is malleable (growth mindset) or static (fixed mindset). In other words, self-efficacy involves a reflection of the self while mindset involves a belief about intelligence and other intellectual abilities that reflects the capabilities of the self and others. Research suggests that mindset may influence the development of self-efficacy for individual students.^[14, 31]

Mindset, motivation, coping skills, resilience, grit, and well-being

Mindset has been said to be related to motivation and well-being. According to expectancy-value theory, students' achievement and achievement-related choices are determined by two factors: the anticipation of success and subjective task values—how confident an individual is in their ability to succeed in a task in a particular field (expectancy) and how important, useful, or enjoyable the individual perceives the task to be (subjective task value).^[32–34] Motivational and expectancy beliefs tend to be strongly linked to academic performance, and both are highly predictive of academic achievement.^[32, 35]

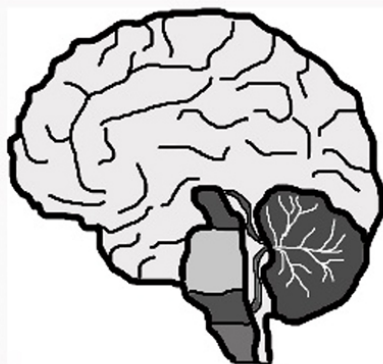
Studies show that mindset affects how students cope with challenging material, which also affects academic achievement and learning.^[36] Because students with a fixed mindset are more likely to believe that success and failure are closely tied to ability,^[9] they may, when faced with difficulties, reduce their perception of their own ability and, consequently, their

expectations of future success.^[31, 37] Thus, these students are also more likely to avoid challenging problems and to engage in maladaptive coping strategies such as withdrawal and disengagement.^[37–39] On the other hand, students who have a growth mindset tend to believe that success and failure are linked to effort and practice, which thus become the keys to academic success.

Students with growth mindsets are more likely to persist through difficult material, to use adaptive coping strategies, and to have higher expectations of success in solving problems in the future (see Fig. 2).^[9, 37, 38] In other words, students with a growth mindset are more resilient in the face of challenges and less susceptible to reduced confidence and reduced expectations of future success in the wake of failure.^[13]

FIXED MINDSET

Intelligence and abilities are fixed qualities that cannot be changed significantly



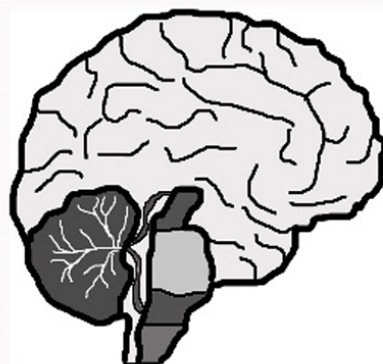
Leads to a desire to look smart and therefore a tendency to:

- Avoid challenges
- Give up easily
- See effort as fruitless or worse
- Ignore useful negative feedback
- Feel threatened by the success of others

As a result they may achieve less than their full potential

GROWTH MINDSET

Intelligence and abilities can be developed with effort, strategies and support



Leads to a desire to learn and therefore a tendency to:

- Embrace challenges
- Persist in the face of setbacks
- See effort as the path to mastery
- Learn from criticism
- Find lessons and inspiration in the success of others

As a result they may reach higher levels of achievement

Figure 2. Summary of the main characteristics attributed to fixed and growth mindsets. Based on C. S. Dweck, Mindset.⁴

Students with a growth mindset are more likely to set learning goals while those with a fixed mindset are more likely to endorse performance goals.^[15, 37] Learning goals emphasize the importance of increasing one's ability or skill set, while performance goals emphasize the importance of demonstrating high ability and avoiding the external perception of low ability.^[40] When faced with a challenging task, individuals with a fixed mindset may worry about appearing incompetent, to the point that it impedes not only their success in the task but also any intrinsic interest or enjoyment they might derive from it.^[9, 41] Endorsing personal learning goals rather than performance goals has been associated not only with greater academic interest^[42] but also with enjoyment^[43, 44] and well-being.^[45, 46] In this regard, studies show that well-being mediates the relationship between a growth mindset and performance.^[46]

The term "well-being" encompasses both physical and mental health and refers to the interconnected nature of social, relational, mental, physical, and material health as well as the experience of engagement in life and in learning. In the context of education, well-being has been identified as both an outcome and as a process that facilitates children's and adolescents' progress toward learning as well as development and academic outcomes.^[47]

A variety of other areas that also need to be carefully considered when promoting a growth mindset in schools include praise,^[18] mistakes,^[48, 49] grit,^[50] feedback,^[51] and goal-setting.^[52] For example, it has been shown in adolescents that grit (defined as perseverance and passion directed toward longer-term goals and the sustained commitment to completing an endeavor despite episodes of failure, setbacks, and adversity)^[50, 53] predicts rank-order increases in growth mindset and concomitantly, growth mindset predicts rank-order increases in grit.^[54] Indeed, it has been suggested that, at least during adolescence, grit and a growth mindset are mutually reinforcing.^[54] The outcomes of interventions aimed at affecting mindset may improve further when other necessary aspects of the system are in place.^[5]

Mindset and stereotyping

Several bodies of empirical research show that academic achievement is influenced by many factors, including structural factors such as socioeconomic background^[e.g., 56] and social stereotyping. It is well known that economic disadvantage can lower students' academic achievement through multiple mechanisms, including reduced access to educational resources and health care, higher levels of stress, and poorer nutrition.^[57-59] Interestingly, it has been shown that students' mindset may temper or exacerbate the effects of economic disadvantage on a systemic level and that students from lower-income families are less likely to hold a growth mindset than their wealthier peers,^[23] pointing to the importance of pedagogical work to endorse and promote a growth mindset.^[e.g., 15, 19, 20-23] This does not mean that if a student just believes in themselves and in their own learning ability enough they can overcome the effects of poverty but rather that growth mindset is a factor that can decrease the negative influences of poverty. Nevertheless, students with similar economic backgrounds clearly also vary in their academic outcomes.

Further regarding social stereotyping, research shows that endorsing or promoting a growth mindset is particularly associated with increases in academic performance^[15,16] by youth historically affected by stereotyping of their underperformance in specific fields.^[19, 20] One example is the connection between mindset and aspirations for a career in STEM (science, technology, engineering, and mathematics).^[42] Middle-school students with growth mindsets are more likely to take more advanced math courses in the future.^[16] Furthermore, women who perceived a greater endorsement of a growth mindset in their college calculus classes expressed a greater interest in taking additional math courses in the future.^[59] Thus, mindset may influence the pursuit of intensive studies in disciplines that have traditionally discouraged women.^[60] Furthermore, gender discrepancies across STEM may be partially attributed to how males and females are affected by growth and fixed mindsets in relation to math ability.^[42]

It has been suggested that girls often have a growth mindset for language and arts but a more fixed mindset for math; although the concept may seem categorical, beliefs most likely fall along a continuum with (uncommon) all-growth and all-fixed mindsets at either end. This, again, points to the importance of pedagogical work to endorse and promote a growth mindset. However, it is worth noting that mindset alone does not explain gender discrepancies in career choices; other psychological processes, such as motivational beliefs and social influences are also critically involved.

Neural basis for the mindset hypothesis

Mindset may be traced back to the activity of certain brain regions, most of which are involved in feedback value, reward,

executive-function management, motivation, grit, and attention to mistakes. Although most studies on the neural basis of mindset focus on young adults, they also point to the biological background of this psychological construct.

Mindset influences the value of feedback through striatal activation

Positive or negative feedback influences neural responses in different ways depending on mindset. For individuals with a growth mindset, mistakes are seen as opportunities to learn and improve. Conversely, for individuals with a fixed mindset, mistakes indicate a lack of ability.^[61] The hypothesis is that the brain regions involved in reward and punishment responses to feedback are engaged accordingly. The striatum (a component of the basal ganglia), which is the region of the brain implicated in learning, has also been linked to reward and punishment contingencies.^[62, 63]

Feedback-based learning relies particularly on the caudate nucleus, one of the structures that make up the striatum, which facilitates learning through neural signals reflecting the subjective value of response outcomes.^[64–67] Striatal value signals are sensitive to individual differences in intrinsic motivation^[68] and achievement goals^[69] as well as to contextual influences such as the availability of other outcomes^[70, 71] and to feedback timing.^[72]

Neuroimaging studies show the existence of neural differences between fixed-mindset people and growth-mindset people. Growth-mindset individuals show a more dynamic striatal response to negative mixed feedback.^[5] They have greater coactivation, at rest, between reinforcement-learning-related regions—such as the striatum—and executive-function-related regions—such as the dorsal anterior cingulate cortex and the dorsolateral prefrontal cortex.^[73] The dorsal anterior cingulate cortex is involved in some higher-level functions, such as attention allocation, reward anticipation, decision-making impulse control (including performance monitoring and error detection), and emotion.^[74] The dorsolateral prefrontal cortex is, in turn, involved in core executive functions such as working memory, cognitive flexibility, planning, inhibition, and abstract reasoning.^[75]

A possible mechanistic explanation is that increased attentional demand distracts fixed-mindset people from worrying about their performance.^[6] And yet this is what a fixed mindset entails: worrying about demonstrating competence and not going beyond one's limits. This may buffer their performance relative to growth-mindset people, whose mastery-oriented strategy engages regions such as those involved in executive functions—i.e., the dorsal anterior cingulate cortex and the dorsolateral prefrontal cortex—to correct their striatal reinforcement signals. In other words, according to these experiments, when competence was threatened, individuals who viewed intelligence as fixed showed stronger punishment responses to negative feedback. Receiving a competence threat may thus exacerbate the threat of failure inherent in receiving negative feedback, causing poorer learning following negative feedback in the evaluative, blocked feedback context and a punishment response to negative feedback.^[5]

Attention to mistakes, motivation, and grit in relation to mindset

It is possible to use resting-state functional magnetic resonance imaging (fMRI) to examine how grit and a growth mindset are associated with cortico-striatal networks important for learning.^[73] This technique is used in brain mapping to evaluate regional interactions that occur in a resting or task-negative state, i.e. when an explicit task is not being performed. Grit was proved to be associated with ventral striatal networks, including connectivity to regions such as the medial prefrontal and rostral anterior cingulate cortices implicated in perseverance, delay, and receipt of reward; and a growth mindset with both ventral and dorsal striatal connectivity with regions thought to be important for error monitoring, such as the dorsal anterior cingulate cortex.^[73] Similarly, intrinsic motivation, which is thought to be associated with the sensitivity of feedback processing, also involves activation of the striatum,^[68] which functionally links motivation and mindset.^[76]

Event-related potentials, which are measured brain responses resulting directly from a specific sensory, cognitive, or motor event, show that a growth mindset is associated with enhancement of the error-positivity component, which, in turn, reflects awareness of mistakes and the allocation of attention to them.^[61] Individuals who are more inclined to have a growth mindset show superior accuracy after mistakes compared to individuals endorsing a more fixed mindset, suggesting that neural mechanisms indexing awareness of and attention to mistakes are intimately involved in a growth-mindset individual's ability to rebound from mistakes.^[6] Experiments performed on school-aged children (from 5 to 8 years old) during which event-related potentials were recorded, have shown that a growth mindset is related to greater attention to mistakes and higher post-error accuracy.^[77–80] Furthermore, exploratory moderation analyses reveal that a growth mindset increased post-error accuracy in children who did not attend to their errors.^[79, 80]

Controversies around the growth-mindset hypothesis and interventions

Despite some academics' enthusiasm for the concept of growth mindset, its beneficial impact on academic achievement has been challenged.^[81] On the one hand, as with any other psychological trait, mindset is influenced by an individual's genetic constitution (the so-called genome), which depends on the specific alleles for a variety of genes.^[82] Although no specific quantification of mindset heritability is given in the literature, heritability for other traits linked to learning processes and related to mindset is quantified. Heritability is a statistic typically interpreted as capturing how much of the variation of a trait is due to genetic differences^[83, 84] and it is expressed on a scale ranging from 0 to 1 (or as a percentage). Some traits related to learning processes and mindset, for which heritability has been calculated, including intelligence (from 0.2 to 0.8, depending on age and test type), resilience (0.52 for males and 0.38 for females), coping (from 0.11 to 0.14), grit (0.37), motivation (from 0.2 to 0.49), and exam results (0.57 in mathematics and 0.66 in humanities), among other factors.^[82] This evidence of a genetic predisposition has led to some criticisms of the growth-mindset hypothesis, warning that it could be greatly overplayed and even harmful to children,^[85] as it may create unaffordable expectancies. In other words, it has been argued that the assumption that changing students' attitude to learning can make a big difference is misplaced. It should be emphasized that the heritability of cognitive traits also considers the importance of environmental factors in shaping cognitive functions through their effect on the brain, as experiences contribute to shaping neural networks (the connectome) by means of neural plasticity during childhood^[86] and adolescence.^[87] As explained above, heritability captures how much of the variation of a trait is due to genetic differences, on a scale from 0 to 1. The difference then, between any given heritability value and 1, is accounted for by environmental factors.

On the other hand, critics of mindset interventions have argued that the effects are too small and unreliable to be practically meaningful.^[1, 7, 8] Some lines of evidence show that trust in the instructor is much more relevant than students' views of their own intelligence (mindset) in measuring student commitment to, and engagement in, active learning.^[88] Similarly, as mentioned above, some results are hard to replicate in different contexts, or they yield contradictory results.^[1, 15, 21, 89, 90] A recent meta-analysis^[91] revealed that 46 percent of student mindset interventions that measured mindset before and after a specific intervention failed to generate a shift.

The success of mindset interventions hinges greatly on persuading participants to shift their mindset.^[91] This implies that some mindset interventions may fail to produce measurable improvements because they are not effective in convincing students to adopt growth-mindset beliefs. Mindset interventions could potentially be made more persuasive if their messaging is informed by data about how students form and change their beliefs about intelligence throughout their life.^[91]

Moreover, it has been said that these interventions may not have a lasting impact. At a 3-month follow-up of one study, participating students were found to have returned to their original mindset, suggesting that the effects of the intervention were temporary.^[92] One brief mindset intervention, lasting less than an hour, with no prior teacher training, only improved lower-achieving adolescents' grades by 0.10 points over 10.^[93]

Last but not least, mindset may also affect a variety of other noncognitive factors such as the types of goals students set,^[94, 95] how (and to what) they attribute their successes and struggles,^[14, 96] and how they cope with the challenges they encounter.^[97] Students' mindsets are themselves malleable and appear to change over time.^[91] For example, a cross-sectional study^[98] found that students in middle school held stronger fixed mindsets about math and literacy than both younger students in elementary school and older students in high school and college. Another longitudinal study of students from fourth grade to sixth grade^[99] revealed that as they aged students increasingly viewed intelligence as a stable trait. Conversely, another longitudinal study of fifth- and sixth-grade students showed that growth beliefs about intelligence tended to get stronger over the course of one year.^[100] In addition, five factors influencing undergraduates' mindset have been identified: academic experiences, observing peers, deducing logically, taking societal cues, and formal learning.^[91] More research into ongoing controversies is clearly needed to investigate the type and extent of pedagogical interventions with maximum effectiveness.

Addressing the controversies: Short-term and long-term effects of mindset interventions

As stated above, interventions to promote growth-mindset thinking in students can take many different forms. For example, by understanding how the brain works and how learning can increase intellectual ability, students can begin to gain a sense of control over their own learning.^[15] Exposing learners to stories about achievements gained as a result of effort rather than an innate ability have had some success in changing participants' self-conception, but the change may not be long-term.^[14] The results are a long way from eliminating achievement gaps and revolutionizing educational systems, and researchers and educators should not expect any single intervention to do so, especially not one lasting less than an hour.

Mindset proponents argue that these short-term interventions will improve outcomes only when other aspects of the system necessary for improvement are in place, such as social and economic well-being.^[55] Since short-term interventions have been shown to have only a short-term impact, a culture is clearly needed that promotes a growth mindset in schools throughout all scholarship, from early childhood to young adulthood.^[101, 102] Embedding permanent growth-mindset culture in the classroom may be the best or the only effective way of engendering long-term improvements.^[103]

Research on interventions to develop growth mindset thinking suggests that they are most successful when delivered by teachers who hold an incremental mindset themselves, because the teachers' mindset influences both pedagogical decisions and feedback to students.^[94, 104, 105] In other words, teachers' views about the ability and consequently the learning potential of their pupils are key to the successful implementation of strategies and techniques to improve learning (Fig. 3). Teachers who hold a fixed mindset use teaching practices that promote fixed-mindset thinking, where students are learning in an environment in which those identified as low ability have little motivation to learn and lower expectations of academic achievement.^[106] Thus, interventions to foster a growth mindset in schools may need to be carefully implemented to address the teachers' mindset as well.^{[10][7-9]}

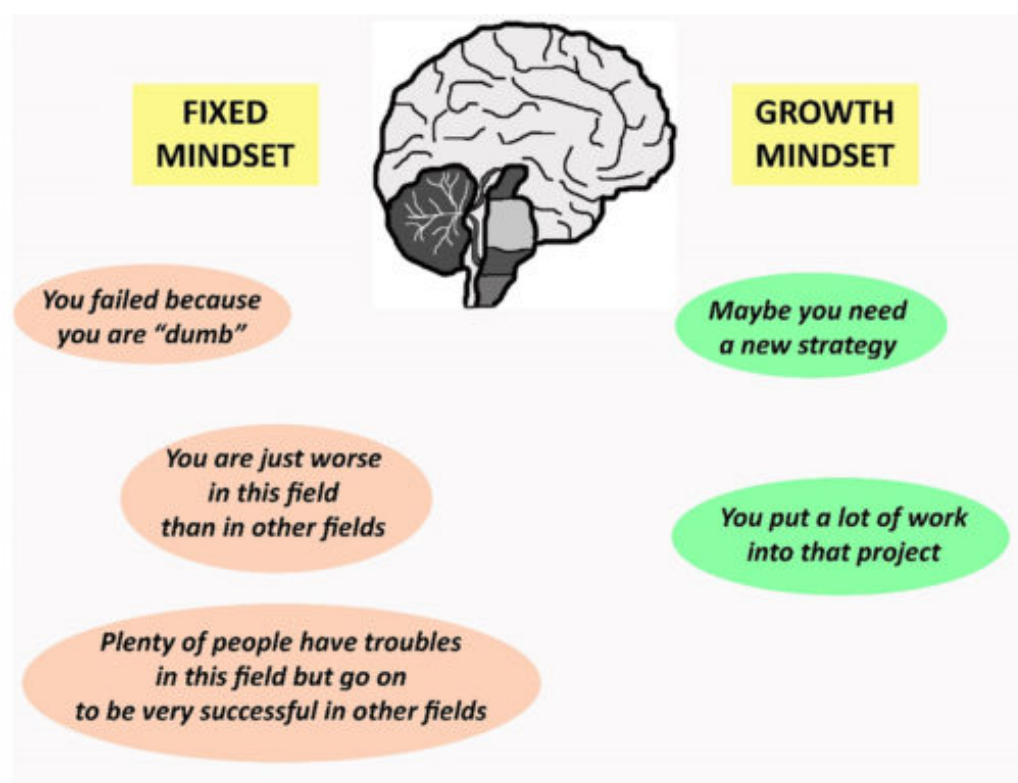


Figure 3. Teachers' views of the learning potential of their pupils may affect students' mindset.

The way in which schools communicate with children about their learning may be one of the reasons why fixed-mindset thinking can often prevail.^[78] For example, differential ability groupings, where some groups are given harder work than others, suggest that the teacher believes some pupils are less able than others.^[48] Further, because there is a lack of mobility of students between the differentiated groups,^[110, 111] ability groupings are particularly supportive of the notion that individuals have a fixed ability, with most school pupils remaining in the same ability group for the duration of their school career.^[112] However, it is worth noting that this is a tricky balance. There is strong evidence in support of flexible ability grouping, but appropriate ability grouping is also powerful for development and learning.^[113]

In summary, while the way that educators communicate with learners can reinforce either a fixed or a growth mindset concerning intelligence and other intellectual abilities, it may be possible to encourage students to approach learning with a growth mindset and subsequently benefit from improved attainment in the classroom.^[4, 15, 114, 115] However, more convincing evidence may be needed in the light of ongoing controversies, and a variety of areas need to be carefully considered when promoting growth mindsets in schools, including grit, goal-setting, resilience, coping skills, and motivation.

Conclusion

Given the current state of the research, teaching mindset interventions may be helpful to positively affect students' learning, academic achievement, and subjective well-being, although such interventions are controversial. Some studies show only small effects, and short-term interventions yielded only short-term results. Thus, in order to engender long-term improvements, there is a need to embed students in a permanent growth-mindset culture within the classroom throughout their school career. In this regard, more research is needed, especially to consider the other areas related to engendering long-term improvements and well-being, including grit, goal-setting, resilience, coping skills, and motivation.

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