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**Title:** A review to characterize and map the growth mindset theory in health professions education

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**ABSTRACT**

**Introduction:** Growth mindset is a motivation theory proposed by Carol Dweck that posits our beliefs about intelligence and the ability to change mindsets can have impacts on how we approach challenges, respond to criticism challenges, and orient our goals. This study characterized articles on growth mindset theory in health professions education to: summarize the aspects of growth mindset being researched, describe the discussed benefits of growth mindset theory, and outline strategies discussed that may promote a growth mindset.

**Methods:** A systematic review of the literature yielded 4927 articles—articles were reviewed and excluded if they were outside of health professions education and did not discuss Dweck's growth mindset theory. The final review yielded 14 research articles and 13 commentaries, which were characterized and analyzed using content analysis.

**Results:** The included articles were published in 2016 and beyond; the articles represented a diverse context, participant type, and approach. Most research studies measured participant mindsets and evaluated the correlation with other variables (e.g. grit, well-being, anxiety). Articles often highlighted benefits and strategies to promote a growth mindset at the learner, educator, and organization level. The most common learner benefits were to help them be more receptive to feedback as well as increased resiliency and perseverance; educator benefits focused on supporting collaborative relationships and safe learning environments. The most prevalent strategies discussed were teaching learners about growth mindset theory, shifting faculty feedback to emphasize effort, and to prioritize feedback across the organization.

**Conclusion:** The growth mindset framework has been shown in other fields to help others manage educational challenges and enhance learning environments. Researchers are encouraged to explore how interventions such as teaching about and prioritizing a growth mindset can support learners, healthcare professionals, educators, and organizations.

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## BACKGROUND

Learning in the health professions requires students and clinicians to function effectively in complex and challenging environments—we often observe some individuals thrive while others stumble. To describe and understand this observed variability, many have hypothesized the factors that influence our motivation to achieve a goal or overcome a challenge.[1-3] For example, in the health professions this can have implications for how learners respond to a medication error, make a decision using limited information, or manage a procedural complication.[4,5] Understanding these influential factors is important because we can modify teaching environments to enhance learner motivation, beliefs, and behaviors that promote deeper learning.[3,6,7]

One group of theories that describe motivational influences focus on goal orientation, which include whether our focus is on performance or learning.[3,7,8] A performance-oriented individual is often highly focused on not performing more poorly than others (e.g., performance-avoidance) or trying to outperform others (e.g., performance-approach).[9-11] In contrast, learning-oriented individuals are focused on the value of learning and developing new knowledge or skills rather than the comparison to others.[1,2] The implicit theory of intelligence—more commonly known as growth mindset theory—posits that goal orientation is often influenced by an individuals' belief about the controllability of their intelligence or abilities (i.e., mindset).[7,12,13]

The abridged version of the growth mindset theory proposes that implicit mindsets vary along a spectrum of two extremes: fixed and growth. Individuals with a more fixed mindset (i.e., entity mindset) believe intelligence and ability are static and success comes from talent, whereas individuals with a more growth mindset (i.e., incremental mindset) believe these traits are malleable and success comes from effort.[7,12,13] Our mindsets appear to be situation specific, can change with age, and have implications for how we approach challenges and persist (Table 1).[14] Of note, our motivation involves a complex interaction of our goal orientation and mindset that manifests in different behaviors—the process described here offers a simplified approach that has been elaborated by others.[1-3] We argue the challenge confronting health professions education is how to prepare learners with the optimal mindset to better manage challenges in their education and development.

More than 30 years of mindset research has identified strategies to combat fixed mindsets and support a growth mindset. Examples of growth mindset interventions are mostly found in primary and secondary school settings.[15-18] Growth mindset interventions often focus on teaching educators and learners about the theory and that intelligence is malleable via purposeful effort; training through these interventions often incorporates research describing how a growth mindset promotes resilience and persistence, which are important for acquiring higher-order skills and knowledge.[19] To support a growth mindset, strategies can assist

individuals by improving self-talk, rewarding progress instead of achievement, and promoting more effective relationships between peers and educators.[7,12,13]

Despite widespread use of growth mindset theory in primary and secondary school settings, the application in health professions education is incompletely understood. Research in other fields suggests that growth mindset interventions could have positive effects; however, it is unclear if we have evidence to suggest this has been thoroughly evaluated. Previous reviews on motivation theories have called for additional research to understand how growth mindset theory can be applied and positively impact health professions education.[3] To address the status of this request, we conducted a systematic review of growth mindset research in health professions education—the aim was to characterize this body of research using content analysis. Specifically, our research question was to describe the aspects of growth mindset theory being researched in health professions education. In addition, to inform future research we wanted to highlight benefits being discussed in the literature and possible strategies that could promote a growth mindset in health professions education.

**METHODS**

A systematic review was conducted to identify growth mindset articles in health professions education. A medical librarian was consulted to assist with the search, which used the following terms: ("growth" AND "mindset") OR "growth mindset" OR "mindset theory" OR "implicit theory of intelligence" OR "implicit theories of intelligence" OR "Dweck". The review collected articles from 6 databases: MEDLINE, Embase, CINAHL, Scopus, ERIC, and PsycInfo (Figure 1). The search included non-healthcare related databases to ensure sufficient breadth; there were no restrictions in the publication type, year, or setting. The search was conducted on July 15, 2020 and returned 4927 citations with 2641 duplicates. After removing duplicates, a total of 2286 abstracts were screened independently by two members of the research team.

The team members classified the abstracts by context or intended audience (e.g., either within or outside health professions education) and by type (e.g., either commentary, original research, or other publication type). Commentaries and research articles were the only types used in the analysis because those were considered most applicable to the research questions. The lead researcher consolidated the screenings and resolved all discrepancies (85% agreement). Articles were excluded if they were not in a health professions education context; resulting in a total of 2227 articles being removed and 59 advanced to further screening.

The final screening used a theory talk coding strategy where articles are classified based on the extent their article used theory to inform the design, implementation, and analysis of the data.[20,21] Articles were coded by two research team members as either major, moderate, or minor theory talk; the lead researcher aggregated the data and resolved discrepancies (100% agreement). Major theory talk articles (n = 14) used growth mindset

as a significant feature of the study, such as informing the design, the data analysis, or to test the theory or instrument related to the theory. Moderate theory talk articles (n = 13) referenced or described Dweck's growth mindset theory, whereas minor theory talk articles (n = 32) had little or no reference to growth mindset or related components. Minor theory talk articles were excluded because they did not elaborate on the theory or its potential application. A total of 27 articles were in the final analysis and a summary of the review process is provided in Figure 1.

A qualitative review and mapping of the 27 articles was conducted to address the aims of the study; a content analysis allowed us to describe themes across texts, characterize the articles, and summarize the use of growth mindset theory in health professions education.[22,23] The research team used inductive coding methods to analyze the articles. The analysis started first with the commentaries; two research team members evaluated each publication and coded benefits and strategies that were compiled into a list for the lead researcher. In addition, the team members characterized each commentary by identifying the objective of the publication, the target audience (i.e., where the commentary was published), and who the authors proposed could be impacted by using growth mindset (e.g., learners, educators). A similar process was conducted for the research studies— the two team members identified the objective, discipline, study location, participants, sample size, growth mindset domains assessed, and study outcomes. The aggregated results from coding and characterization from the commentaries and research studies were reviewed by the lead researcher, who confirmed the analysis and identified patterns across the articles. These themes were mapped across commentaries and research articles to visualize the benefits and strategies described across articles. The findings were organized to address the research questions and were verified by the two research team members for accuracy.

**RESULTS**

Twenty-seven articles (i.e., 14 research articles and 13 commentaries) were included in the analysis and all articles were from 2016 onward. The results are organized according to the primary research question and the additional questions about proposed benefits and possible strategies. A map of the publications is provided in Figure 2.

**What aspects of growth mindset are being researched in health professions education?**

A descriptive summary of the research articles is provided in Table 2. Research articles had participants from medicine (n = 4; 29%), veterinary medicine (n = 4; 29%), nursing (n = 2; 14%), physical therapy (n = 1; 7%), pharmacy (n = 1; 7%) and multiple professions (n = 2; 14%). Research has been conducted in multiple countries including the United States (n = 6; 43%), United Kingdom (n = 3; 21%), Canada (n = 3; 21%), Sweden (n = 1; 7%), and Australia (n = 1; 7%). Most research study participants included students (n = 11; 79%) and the remaining studies included licensed practitioners (n = 2; 14%) and faculty (n =

1; 7%).

Eighty-six percent of the research studies (n = 12) measured participant mindset and evaluated its correlation with other variables, such as self-reported medical errors and scales measuring grit, resilience, anxiety, and performance. Most studies (n = 7, 50%) incorporated the Theories of Intelligence Inventory or Dweck's Mindset Instrument, which asks participants to rate their agreement with statements about their general intelligence and the ability to change it.[8,12] Studies varied in the number of questions they used from the instrument ranging from 2 to 20 items.[24-26,28,32,33,35]

Three studies described modified instruments for measuring mindset of domain-specific abilities, including clinical reasoning, professional reasoning, communication, talent, moral character, and empathy.[29,31,34] These studies focused on the impact of educational, cultural, and other background differences on mindset measures—there were significant differences in mindset based on the domain; however, mindset differences were not correlated with education or demographics.[31] Two studies used the Williams Inventory of Learning Strategies, which includes a measure of mindset as well as measures of learning strategies and behaviors—there were correlations between growth mindset and the use of evidence-based learning strategies.[36,37]

The study results showed variability in growth and fixed mindsets across participants with values ranging from 30-90% depending on the domain measured; however, one study did not report the growth mindset measures.[35] There were some correlations of fixed mindsets with measures of stress and anxiety while a growth mindset was correlated with psychological well-being.[25,29,33] Conversely, several studies showed no to minimal correlation with self-reported medical errors, grade point average, communication, and mental health aspects.[24,26,32,35] Only one research study evaluated the impact on mindset measures following a program implementation—this study included a one-hour educational intervention with 35 nursing students and demonstrated a statistically significant increase in the self-reported growth mindset measures.[36]

Two studies were also unique as they did not measure mindset. In one study, the researchers were developing and validating the results of an instrument to measure student perceptions of the teaching climate. This included questions about how well the educator supported learning goal orientations and growth mindset.[27] In the other study, the authors evaluated whether participant responses in a creativity exercise would differ if they were primed with a fixed or growth mindset prompt; for example, individuals with a growth prompt used verbs more frequently whereas those with a fixed prompt used the personal pronoun *I* more often.[30]

**What potential benefits of growth mindset theory are being discussed?**

All commentaries and research articles advocated that the growth mindset approach had at least one benefit from published research in other disciplines. A comprehensive list of described benefits is mapped in Figure 2A. The findings are categorized based on the individual who receives the benefit. There were 26 benefits described for learners (10 benefits described), educators (12 benefits described), or organizations (4 benefits described). Benefits for learners were most often discussed across commentaries and research articles—24 (89%) of the articles included at least one learner benefit, whereas only 11 (41%) articles referenced at least one educator benefit. Commentaries included more references to educator benefits, whereas only two research studies referenced educator benefits.[28,34] Six of the commentaries (46%) included organizational-level benefits and only one research article described organization benefits.[27,41-44,46]

Authors consistently argued that growth mindset approach offers emotional and psychological support for learners and that it is insufficiently promoted in health professions education. Babchenko and colleagues summarized that, "cultivation of the psychological aspects of being a good [healthcare provider]—such as self-confidence, ability to handle stress, and resilience—has received much less attention in the educational context" (p. 812).[42] The most commonly described learner benefits were that a growth mindset can reinforce a desire to increase resiliency and perseverance, seek and be receptive to feedback, offer an openness to failure as a learning opportunity, provide a more goal-oriented motivation focused on process, and improve psychological well-being, self-esteem, and confidence.

Another emphasis was educator benefits—growth mindset approaches were described as a structure to support faculty development.[41,49] For example, Shapiro and Dembitzer noted faculty members—much like learners—are not impervious to imposter syndrome or feeling inadequate when being evaluated by others.[47] A growth mindset approach for educators was encouraged to build collaborative and trusting relationships and create a safe learning environment as well as improving faculty self-esteem, confidence, self-awareness, and openness to viewing failure as a learning opportunity. Organizational-level benefits highlighted by six commentaries suggested a growth mindset culture can support safe learning environments, normalize failure, foster feedback-seeking behaviors, and is more conducive to longitudinal relationships.[41-44,46]

**What are the strategies for promoting growth mindset in health professions education?**

All commentaries and research articles offered at least one strategy that could be used to promote growth mindset from published research in other disciplines. A comprehensive list of strategies or interventions that can promote a growth mindset is mapped in Figure 2B; the results are categorized according to the level the strategy should be implemented—the learner, educator, or organizational level. A total of 27 strategies were described across the articles; there were a greater number of educator-level strategies (14 strategies) than

learner-level (9 strategies) and organization-level (4 strategies). Learner-level strategies, however, were referenced in more articles (n = 22, 81%) than educator-level (n = 20, 74%) and organization-level (n = 10, 27%) strategies. Research articles focused predominantly on learner and educator strategies and only one identified organization-level strategies.[27]

The most frequently described learner-level strategies were interventions that assess and track how learner mindsets may shift over time, teach students about growth and fixed mindsets, and help learners create learning goals focused on progress instead of performance goals or letter grades. Some articles referenced specific interventions such as learners writing a letter to their future-self, establishing learning communities to share their experiences, and instructing learners to "talk back" to their failure mindset as if it were a person.

Articles included educator-level interventions that improved delivery of praise and constructive feedback to learners; specifically, the recommendations are that feedback focuses on effort and observable behaviors instead of personality traits or talents. Other strategies included educators modeling growth mindset behaviors, learning about growth mindset, prompting learner reflection, and creating psychologically safe learning environments through open discussions. Organization-level strategies described prioritizing feedback at all levels of the organization, establishing a safe and just learning culture, providing systemic training on growth mindset, and helping organization members identify their biases and stereotypes they may propagate.

**DISCUSSION**

This review characterized growth mindset research in health professions education using a content analysis of relevant articles. The goal was to address a call by Cook and Artino to better understand how growth mindset, among other motivation theories, are being described and applied in health professions education.[3] The review identified 27 articles that referenced Dweck's growth mindset theory, which highlighted benefits and strategies to promote growth mindsets in health profession education. These benefits and strategies were best categorized based on their impact at the learner, educator, and organizational level. Proposed benefits of the growth mindset orientation included helping learners be more receptive to feedback, supporting collaborative relationships between learners and educators, as well as positive impacts on resiliency, perseverance, and psychological well-being that foster safer learning environments across organizations. Most articles advocated for growth mindset approaches to facilitate feedback delivery and receipt and normalize failure at the learner, educator, and organizational level.

An important observation was the scarcity of research that extended beyond measuring mindsets and the assumption that growth mindset theory can have benefits for health professions education. Most of the research conducted in health professions education evaluated learner, practitioner, and faculty mindsets and often correlated these values with other variables. Every publication identified at least one strategy to promote

a growth mindset that could be implemented to support learners, educators, or organizations; however, only one study evaluated the impact of a growth mindset intervention in a small group of nursing students.[36] This should give pause as to whether we can confidently argue that growth mindset theory can benefit health professions without additional research; the current support and documented references rely on research conducted in other disciplines, which may have contextual factors that influence the impact. In addition, future research needs to investigate more nuanced approaches to motivation that account for the complex interaction of goal orientation, mindset, and behaviors to better understand these phenomena.

Moreover, research has focused predominantly on learner mindset and not external factors that can support or diminish their mindset (e.g., educator- and organizational-level strategies). No research study has evaluated organizational-level aspects in relation to mindsets and only one research study measured faculty mindset, which has been shown in other settings to influence learner outcomes if an educator perceives learner ability as fixed.[51,52] Therefore, we concur with Cook and Artino that the study of growth mindset theory in the health professions continues to be underrepresented.[3] We encourage others to explore the advantages prescribed by commentaries and evaluate the impact of interventional studies in health professions education that evaluate how implementing these strategies can impact participants longitudinally.

Recent studies in the growth mindset research also suggest other opportunities to explore in the health professions beyond those listed in this review. For example, a meta-analysis from Burnette and colleagues provides evidence that growth mindsets are negatively related to psychological distress and positively related to effective coping strategies.[53] This suggests growth mindset interventions could be beneficial for supporting learners and their psychological needs in learning and as practitioners. In addition, another study demonstrated mindsets can be contagious—being surrounded by others with a growth mindset can influence the mindset of others.[54] Additional research to explore how contagion effects could be propagated throughout organizations or among interprofessional teams could have impacts on creating effective work cultures. Ng offers another review of the overlap between growth mindset theory and neuroscience research, which provides opportunities to explore how neurological changes may manifest following interventions.[55]

One challenge of conducting growth mindset research observed during this review is related to mindset assessment. The growth mindset theory and instruments used often focus on perceptions of general intelligence, whereas it has been demonstrated our mindset can vary based on the domain.[34,56] For example, an individual can be more growth-oriented in clinical reasoning and more fixed-oriented in communication ability. To explore these domain-specific abilities, researchers may need to develop their own instruments, which can require additional vetting of the reliability and validity of the results. In addition, identifying the appropriate cut-scores on an instrument that may indicate a growth, fixed, or mixed mindset can have implications for

research. Mindset represents a continuum instead of a dichotomy; therefore, having scales that can be sensitive to those differences is important.[12,13]

Another challenge with growth mindset research is overlooking the broad scope of the theory's applicability—often growth mindset is touted as an approach that exclusively relates to praise and feedback. This has occurred so much that Dweck has noted the emergence of a "false mindset" in which praise is misdirected or does not relate to the task being evaluated.[57] For example, individuals giving praise for work that was subpar under the assumption that any feedback oriented towards growth can have a positive impact; the goal is that feedback is authentic to have a benefit. In addition, multiple articles focused predominantly on the benefits of growth mindset from a feedback perspective—the growth mindset approach offers strategies beyond addressing feedback to promote well-being, resilience, and perseverance. Individuals are encouraged to explore growth mindset impacts broadly and how strategies support intrinsic motivation, changes in self-perception, and learning from failure; these benefits could help manage clinician burnout, enhance educator-learner interactions, and stimulate psychologically safer work environments.[58-60]

This study had several limitations. First, the review only included only commentaries and research studies in the final analysis—other articles such as posters, conference proceedings, and editorials, may have provided additional insights if they included results from growth mindset interventions. The review also focused on characterizing the articles and did not evaluate the quality of the research or the specific discourse within the articles. Since the goal was not to critique the direction or quality of the research, it was not considered pertinent to provide that depth especially considering the limited number of articles; a meta-analysis in future reviews may require a deeper analysis of quality.

The review identified numerous opportunities for a research agenda to evaluate growth mindset theory in health professions education. Early research should continue to evaluate mindsets of learners, practitioners, and educators—research that expands to evaluate organization-level interactions and connections would be a substantial addition to growth mindset research. Specifically, health professions not currently represented in the research domain should consider initiating work to evaluate mindsets—dentistry, social work, and the allied health professions. Next steps in research should focus on design and implementing interventions aimed to shift mindsets from fixed to growth for learners, educators, and others within healthcare organizations. In addition, research can explore how growth mindset perspectives influence interprofessional teams and enhance interprofessional education opportunities. Evaluating the impact of these interventions could focus on changes to academic and workplace performance, goal orientations, and our approaches to educational can offer additional insights in designing effective learning environments. As Osman and colleagues described it, "let's agree that we don't quite maximize [growth mindset's] great benefit…yet." (p. 695)[50]

## CONCLUSION

This review identified an expanding interest in the growth mindset theory for health professions education. We hope this review stimulates additional research that extends our understanding of the benefits of growth mindset for learners, educators, and organizations. Researchers are encouraged to explore how interventions can be designed to promote growth mindset and encourage more productive responses to educational challenges that support resiliency, well-being, and perseverance among health professionals and educators.

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**Table 1.** Comparison of fixed and growth mindset features[8,12]

| Features | FIXED MINDSET | GROWTH MINDSET |
|---|---|---|
| Beliefs About Intelligence | Intelligence is static | Intelligence can be developed |
| Focus | To look smart | To learn |
| Approach to Challenges | Avoided | Embraced |
| Response to Obstacles | Give up early | Persist |
| Perception of Effort | Negative view—indicates lack of talent | Positive view—necessary for success |
| Response to Criticism | Feedback is often ignored | Feedback is often used to aid learning |
| Others' Successes | Viewed as a threat—invokes insecurity | Viewed as a source of inspiration |
| Goal Orientation | Tend to focus on performance | Tend to focus on mastery |

**Table 2.** Description of research articles included (N = 14) in the final review examining growth mindset theory in health professions education

| Year | Objective | Disciplines Included | Study Location | Participants & Sample Size | Domain(s) Assessed | Outcomes / Results |
|---|---|---|---|---|---|---|
| 2016 | Evaluate the relationship between mindset and self-reported medical errors[24] | Medicine | United States | Pediatric residents, fellows, and attendings (n = 176) | General intelligence mindset (4 items) | 49% with FM, 51% with GM; no differences by physician type; mindset did not correlate with error self-reports |
| 2017 | Evaluate the relationship between mindset and psychological well-being[25] | Veterinary Medicine | United Kingdom | First-year veterinary students (n = 148) | General intelligence mindset (8 items) | 41% with FM, 43% with GM, 16% intermediate; those with FM had lower psychological well-being reports in all dimensions except "environmental mastery" |
| 2017 | Evaluate the relationship between mindset, grade point average, and self-assessed levels of stress[26] | Veterinary Medicine | United States | Second-year veterinary students (n = 57) | General intelligence mindset (20 items) | 70% had a strong GM or a growth mindset with some fixed ideas; mindset was not correlated with first-year grade point average or perceived stress level |
| 2017 | Develop an instrument to assess educational climate[27] | Medicine | United States | First- through fourth-year medical students (n = 1,441) | Did not measure individual mindset | Final Educational Climate Inventory (ECI) tool can assess student perceptions of the learning climate |
| 2018 | Evaluate the relationship between mindset and | Medicine, Nursing, | Canada | Nurses, nurse practitioners, | General intelligence | Participants report high levels of GM; the more recently |

| | | | | | |
|---|---|---|---|---|---|
| | performance on a neonatal resuscitation game[28] | Respiratory Therapy | | respiratory therapists, & fellows (n = 50) | mindset (2 items) | participants completed the game, the more tries they needed when they had a more FM perspective |
| 2018 | Evaluate the relationship between mindset and anxiety[29] | Veterinary Medicine | United Kingdom | Fourth-year veterinary students (n = 130) | Overall, ability, and personality mindset (20 items) | 63% were growth or strongly growth mindset; a FM was significantly correlated with increased anxiety |
| 2019 | Evaluate the influence of priming for FM or GM on utterances about person-center care and creativity[30] | Medicine, Nursing, Psychology | Sweden | Medical, nursing, and psychology students (n = 73) | Did not measure individual mindset | Participant utterances differed semantically when primed for a FM or GM |
| 2019 | Evaluate mindset across different curriculum areas and identify background characteristics that influence mindset[31] | Veterinary Medicine | United Kingdom | Third-, fourth-, and fifth-year veterinary students (n = 198) | Clinical reasoning, professional reasoning, communication, and reflection mindset (25 items) | GM varied based on domain: 84% reflection, 83% clinical reasoning, 59% communication, 34% professional reasoning; no difference in mindset based on cultural or educational background |
| 2019 | Evaluate the relationship of GM, grit, resilience measures and demographic characteristics[32] | Physical Therapy | Australia | Final-year physical therapy students (n = 134) | General intelligence (16 items) | 7% have a FM about intelligence & 10% have a FM about talent; mindset had low correlation with grit and resilience scores and not correlated with mental health |

| | | | | | | condition or hours studying and working |
|---|---|---|---|---|---|---|
| 2019 | Evaluate the relationships among motivational constructs, stress, exhaustion, and lifelong learning[33] | Medicine | Canada | Medical students across 4 years (n = 267) | General intelligence mindset (4 items) | FM was associated with maladaptive cognitions (e.g., avoidance goals) and psychological distress; GM was associated with beneficial cognitions (e.g., mastery approach goals) and more likely to engage in lifelong learning |
| 2019 | Evaluate clinical supervisors' mindsets[34] | Medicine | Canada | Clinical supervisors from three specialties (n = 40) | Intelligence, clinical reasoning, moral character, and empathy mindset (24 items) | 88% have a GM about clinical reasoning; 45% have a FM about empathy; 53% have a FM about intelligence; 53% have a FM about moral character |
| 2020 | Develop a tool to assess self-views of a growth mindset and team communication skills[35] | Pharmacy | United States | First-year pharmacy students (n = 174) | General intelligence mindset (14 items) | Did not report growth mindset scores—research was focused on instrument validity related to team communication skills |
| 2020 | Evaluate impact of growth mindset training on mindset and learning strategies[36] | Nursing | United States | First-year nursing students (n = 35) | Williams Inventory of Learning Strategies | Statistically significant increase (p = 0.03) in self-reported growth mindset following a one-hour educational intervention |

| | | | | | (33 items) | |
|---|---|---|---|---|---|---|
| 2020 | Evaluate relationship of mindset to learning strategies[37] | Nursing | United States | Nursing students across 200 schools (n = 151) | Williams Inventory of Learning Strategies (33 items) | 89% have a GM and 10.6% with a FM; GM correlated with more effective learning strategy use (e.g., quizzing, seeking feedback) |
| SUM | 11 measured mindset & correlated with other variables<br>1 measured educational climate<br>1 measured impact of prompting on utterances<br>1 measured impact of an intervention | 4 Veterinary<br>4 Medicine<br>2 Nursing<br>2 Inter-professional<br>1 Physical Therapy<br>1 Pharmacy | 6 United States<br>3 United Kingdom<br>3 Canada<br>1 Sweden<br>1 Australia | 11 Students<br>2 Practitioners<br>1 Faculty | 7 Theories of Intelligence or Dweck Mindset<br>3 domain-specific instruments<br>2 Williams Inventory of Learning Strategies<br>2 no individual measure | Variability of GM and FM distribution based on context and domain<br>Some correlations of FM with stress and anxiety<br>Some correlations of GM with well-being<br>No correlation with medication errors or grade point average<br>Benefit of a growth mindset intervention in small sample |

GM = growth mindset; FM = fixed mindset
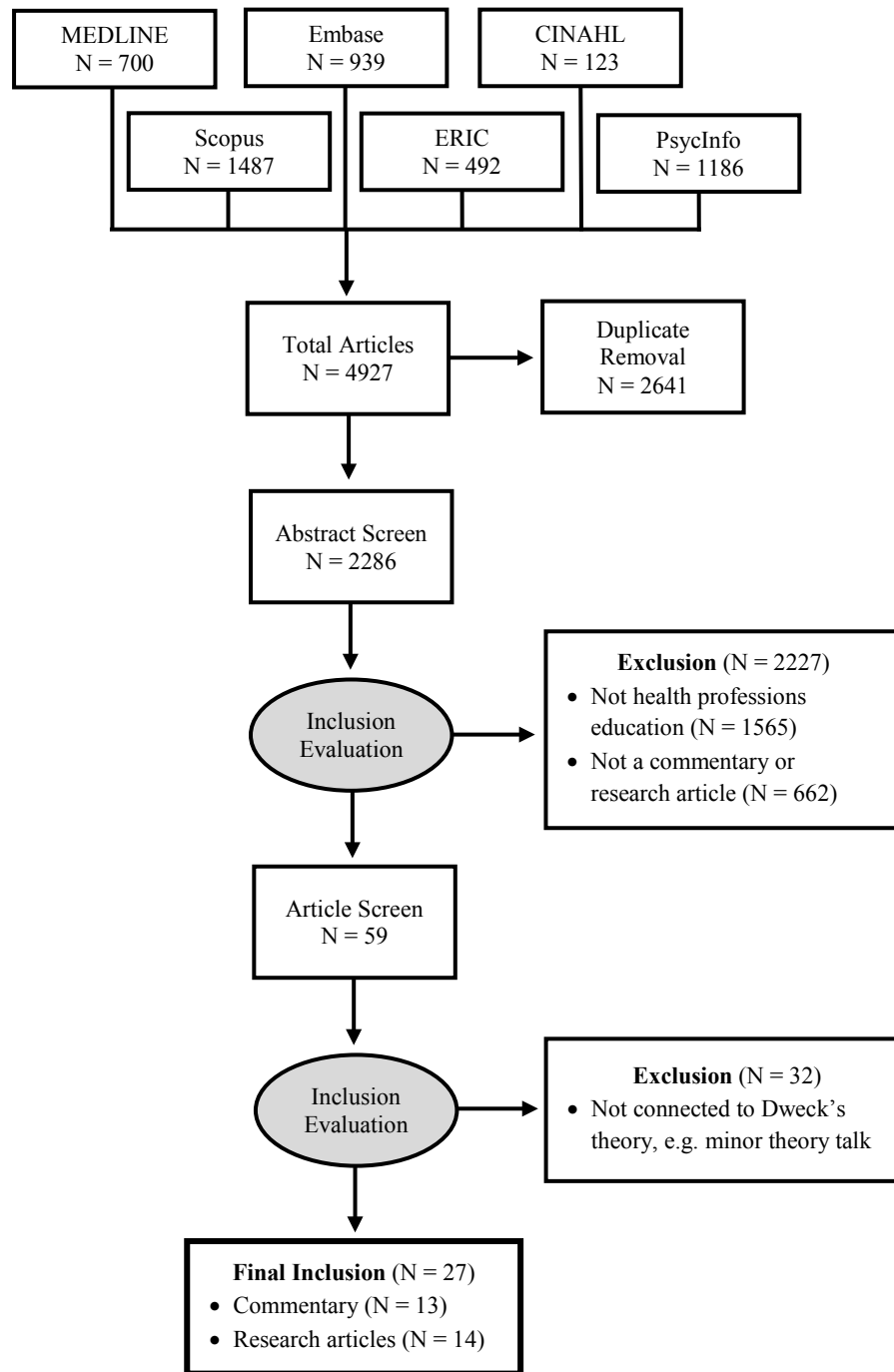
**Figure 1**. Article review flow diagram for growth mindset literature in health professions education

## 2A.

| BENEFITS (n = 26) | TOTAL, n (%) | | | RESEARCH ARTICLES (n = 14) | | | | | | | | | | | | | | COMMENTARIES (n = 13) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALL (n = 27) | RSH (n = 14) | COM (n = 13) | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| **Learner (n = 10)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Resiliency & perseverance | 19 (70) | 11 (79) | 8 (62) | | • | • | • | | • | | • | • | • | • | • | • | • | • | • | • | • | • | | | • | | | • | | • |
| Seek & be receptive to feedback | 18 (67) | 8 (57) | 10 (77) | • | • | • | | | | | • | • | • | • | • | | | | • | • | • | • | • | • | • | • | | • | | • |
| Openness to failure as a learning opportunity | 17 (63) | 10 (71) | 7 (54) | • | • | • | | | • | | • | | • | • | • | • | • | • | | • | • | | | • | | • | | • | | • |
| Goal-oriented motivation (process > product) | 17 (63) | 8 (57) | 9 (69) | | • | • | • | | • | | | | • | • | | | • | • | • | • | • | • | • | • | | | • | | • |
| Psychological well-being | 15 (56) | 8 (57) | 7 (54) | | • | • | • | | • | | • | • | • | | • | | | • | • | | • | • | | | • | | • | • | • |
| Self-esteem & confidence | 15 (56) | 5 (36) | 10 (77) | | • | • | • | | • | | | | | | • | | | • | • | • | • | • | • | • | • | • | | • | | • |
| Academic performance & success | 11 (41) | 7 (50) | 4 (31) | | | • | | | • | | • | | • | • | • | | • | • | • | • | • | | | | | | | • | | |
| Teamwork & collaboration | 11 (41) | 4 (29) | 7 (54) | | | | | • | | | | | | | • | • | • | | | | • | • | • | • | • | • | | | | • |
| Self-awareness & openness of limitations | 10 (37) | 3 (21) | 7 (54) | • | | | | | | | | | | | • | | • | • | • | • | | | | • | • | • | | | | • |
| Autonomy & independence | 2 (7) | 0 (0) | 2 (15) | | | | | | | | | | | | | | | | | | | | | • | • | | | | | |
| Enhance creativity | 1 (4) | 1 (7) | 0 (0) | | | | | | | • | | | | | | | | | | | | | | | | | | | | |
| *AT LEAST ONE* | 24 (89) | 13 (93) | 11 (85) | • | • | • | • | | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | | • | | • |
| **Educator (n = 12)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Collaborative & trusting relationships | 7 (26) | 1 (7) | 6 (46) | | | | | | | | | | | • | | | | | | | • | | | • | • | | • | | • | • |
| Safe learning environment | 7 (26) | 1 (7) | 6 (46) | | | | | | | | | | | • | | | | | • | | | | | • | | • | | • | • | • |
| Attention to learner abilities & autonomy | 5 (19) | 1 (7) | 4 (31) | | | | | | | | | | | • | | | | | | | | | | • | | | | • | • | • |
| Openness to failure as a learning opportunity | 5 (19) | 1 (7) | 4 (31) | | | | | • | | | | | | | | | | | | | • | | | | | | • | | • | • |
| Self-awareness & openness of limitations | 5 (19) | 0 (0) | 5 (38) | | | | | | | | | | | | | | | | • | | • | | | • | | | | • | • |
| Resiliency & perseverance | 4 (15) | 1 (7) | 3 (23) | | | | | • | | | | | | | | | | | | | • | | | | | | | • | • |
| Self-esteem & confidence | 4 (15) | 0 (0) | 4 (31) | | | | | | | | | | | | | | | | | | • | | | | • | • | | • | |
| Seek & be receptive to feedback | 4 (15) | 0 (0) | 4 (31) | | | | | | | | | | | | | | | | | | • | | | | | | • | | • | • |
| Workplace performance & success | 3 (11) | 1 (7) | 2 (15) | | | | | • | | | | | | | | | | | | | • | | | | | | | • | |
| Psychological well-being | 3 (11) | 0 (0) | 3 (23) | | | | | | | | | | | | | | | | | | • | | | | • | | | | • |
| Goal-oriented motivation (process > product) | 2 (7) | 0 (0) | 2 (15) | | | | | | | | | | | | | | | | | | • | | | | | | | • | |
| Enhance coaching for growth | 2 (7) | 0 (0) | 2 (15) | | | | | | | | | | | | | | | | | | | | | • | • | | | | |
| *AT LEAST ONE* | 11 (41) | 2 (14) | 9 (69) | | | | | • | | | | | | • | | | | | • | | • | | • | • | | • | • | • | • | • |
| **Organization (n = 4)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Support safe learning environments | 6 (22) | 1 (7) | 5 (38) | | | | | • | | | | | | | | | | | | | • | • | • | | | • | | | • |
| Encourage a culture of learning & normalize failure | 5 (19) | 1 (7) | 4 (31) | | | | | • | | | | | | | | | | | | | • | | | • | • | | | | • |
| Foster feedback-seeking behaviors | 3 (11) | 0 (0) | 3 (23) | | | | | | | | | | | | | | | | | | | | | • | • | | | | • |
| Conducive to longitudinal relationships | 2 (7) | 0 (0) | 2 (15) | | | | | | | | | | | | | | | | | | | | | • | | | | | • |
| *AT LEAST ONE* | 7 (26) | 1 (7) | 6 (46) | | | | | • | | | | | | | | | | | | | • | • | • | • | | • | | | • |

COM = commentaries, RSH = research studies

**2B.**

| STRATEGIES (n = 27) | | TOTAL, n (%) | | | RESEARCH ARTICLES (n = 14) | | | | | | | | | | | | | | COMMENTARIES (n = 13) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ALL (n=27) | RSH (n=14) | COM (n=13) | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| Learner (n=9) | Assess learner mindset & track changes | 13 (48) | 11 (79) | 2 (15) | • | • | • | | • | • | | • | • | • | | • | • | • | | • | • | | | | | | | | | | |
| | Learn about growth and fixed mindsets | 12 (44) | 6 (43) | 6 (46) | • | | • | | • | | | • | | • | | | • | | • | • | • | • | | | | | | | • | • | |
| | Create learning goals instead of performance goals | 7 (26) | 2 (14) | 5 (38) | | • | | | | | | | • | | | | | | | | | | | | • | • | | • | | • | • | |
| | Reflect on failure | 5 (19) | 2 (14) | 3 (23) | | | | | | | • | | | | | • | | | • | | | • | | | | | | | | | | • |
| | Create learning communities with peers | 4 (15) | 2 (14) | 2 (15) | | | | | | | | | | | • | • | | | | | | • | | | | | | | • | | |
| | Prompt yourself to think with growth-orientation | 2 (7) | 2 (14) | 0 (0) | | | | | | | • | | | | | • | | | | | | | | | | | | | | | |
| | "Talk back" to the failure mindset | 2 (7) | 2 (14) | 0 (0) | | | | • | | | | | | | | • | | | | | | | | | | | | | | | |
| | Write a letter about future performance | 2 (7) | 0 (0) | 2 (15) | | | | | | | | | | | | | | | • | | | | | | | | | | | • | |
| | Take responsibility for gaps in knowledge and ability | 1 (4) | 0 (0) | 1 (8) | | | | | | | | | | | | | | | | | | | | | • | | | | | | |
| | *AT LEAST ONE* | 22 (81) | 12 (86) | 10 (77) | • | • | • | | • | • | • | • | • | • | | • | • | • | • | • | • | • | | | • | • | | • | | • | • | • |
| Educator (n=14) | Praise & constructive criticism on effort not traits | 16 (59) | 6 (43) | 10 (77) | | • | • | • | | | | • | | • | | • | | | • | • | • | • | • | • | • | | • | | • | • | |
| | Learn about growth and fixed mindsets | 9 (33) | 3 (21) | 6 (46) | | | • | | | | | | • | | • | | | | • | • | • | | | | • | | | | • | • | |
| | Model growth mindset behaviors | 9 (33) | 1 (7) | 8 (62) | | | • | | | | | | | | | | | | • | • | • | | | | • | | • | | • | • | • |
| | Encourage learner reflection & self-assessment | 7 (26) | 3 (21) | 4 (31) | • | • | | | | | | | | • | | | | | | • | | • | • | • | | | • | | | | |
| | Create a safe learning environment / climate | 7 (26) | 2 (14) | 5 (38) | | | | | • | | | | | • | | | | | | | | | | • | | • | | • | • | • | |
| | Design assessments that identify & reward growth | 5 (19) | 3 (21) | 2 (15) | • | • | • | | | | | | | | | • | | | | | | | | | • | | | | | | |
| | Provide opportunities for learner growth & autonomy | 5 (19) | 2 (14) | 3 (23) | | | • | | | | | | • | | | | | | | | | | | | • | • | | | • | | |
| | Assess educator mindset & track changes | 4 (15) | 2 (14) | 2 (15) | | | • | | | | | | | | • | | | | | • | | | | | | | | | • | | |
| | Reflect on personal behaviors & mindset | 4 (15) | 0 (0) | 4 (31) | | | | | | | | | | | | | | | | | • | | | | | | • | • | | | • |
| | Create collaborative & trusting relationships | 3 (11) | 2 (14) | 1 (8) | | | | | | | | • | • | | | | | | | | | | | | | | | | | | • |
| | Encourage feedback-seeking behavior | 3 (11) | 0 (0) | 3 (23) | | | | | | | | | | | | | | | | | | | | | • | • | | • | | | |
| | Share personal stories for failure | 3 (11) | 0 (0) | 3 (23) | | | | | | | | | | | | | | | • | • | • | | | | | | | | | | |
| | Integrate "yet" into feedback | 2 (7) | 0 (0) | 2 (15) | | | | | | | | | | | | | | | | | | • | | | | | | | | • | |
| | Create learning communities with peers | 1 (4) | 0 (0) | 1 (8) | | | | | | | | | | | | | | | | | | • | | | | | | | | | |
| | *AT LEAST ONE* | 20 (74) | 8 (57) | 12 (92) | | • | • | • | | | | • | • | • | • | • | • | | • | • | • | • | • | • | • | | • | • | • | • | • |
| Organization (n=4) | Prioritize & normalize feedback / learning at all levels | 8 (30) | 0 (0) | 8 (62) | | | | | | | | | | | | | | | • | | • | | • | • | • | | • | | • | • | • |
| | Establish a safe and just learning culture | 7 (26) | 1 (7) | 6 (46) | | | | | • | | | | | | | | | | • | | • | | | | • | • | | • | | | • |
| | Provide training on growth mindset | 2 (7) | 0 (0) | 2 (15) | | | | | | | | | | | | | | | | | | | | | • | | | • | | | |
| | Identify bias and stereotypes | 1 (4) | 0 (0) | 1 (8) | | | | | | | | | | | | | | | | | | | | | | | • | | | | |
| | *AT LEAST ONE* | 10 (37) | 1 (7) | 8 (66) | | | | • | | | | | | | | | | | • | | • | | | • | • | • | • | • | | • | • |

COM = commentaries, RSH = research studies

**Figure 2**. Mapping of growth mindset articles in health professions education. A. Benefits described in commentaries and research articles organized by potential impact on learners, educators, and organizations. B. Strategies described in commentaries and research articles organized by use for learner, educators, and organizations. Dark squares indicate the strategy used in the research study. Numbers at the top of each column are the reference numbers and are listed in chronological order of publication date.