Growth-Mindset-Oriented Teaching Practice to Weaken Gender Stereotypes

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Abstract: Weakening or eliminating the influence of prevailing gender-biased social norms on STEM and literacy achievement is essential to seeing gendered differences disappear from educational data. One way to help weaken detrimental effects of social stereotypes is to think of ways teachers can do their jobs without reinforcing unfair social norms and teach in ways that establish non-biased social norms. Focusing on the idea of "mindset," I explore how growth-mindset-oriented teaching practices work to provide inclusive and equitable education, shape the messages students receive in teacher feedback, and challenge gender stereotypes. Whatever teachers' personal views on mindset may be, it is imperative that teachers' professional practices project a growth-mindset.

Decades of data support the persistent presence of a gender gap in student performance in math and literacy: 1) Gender disparity in favor of boys is evident in STEM-related (Science, Technology, Engineering, Mathematics) subjects at all grade levels. From 2003 to 2012, male students scored about 5-20 points higher than female students in math, according to a survey of elementary and secondary schools carried out by the National Science Board (2016). Similarly, the TIMSS (Trends in International Mathematics and Science Study, 1995-2015) assessment of 4th graders' mathematics and science knowledge in six Nordic countries showed boys outperformed girls in five of the six countries studied (Borgonovi et al., 2018). Furthermore, in the 2022 NAEP (National Assessment of Educational Progress) Mathematics Assessment, 4th-grade boys scored six points higher than 4th-grade girls, representing the largest gap in gender since 1990. 2) Girls, in contrast, consistently outperformed boys in reading and literacy achievement across different countries. For example, PISA (Program for International Student Assessment) 2012 scores found girls' reading achievement was at least one academic grade level ahead of boys in all the 30 countries tested (OECD, 2015 — Organization for Economic Co-operation and Development). Moreover, 4th-grade girls in Norway and Finland scored significantly higher than their male counterparts, by 18 and 22 points, respectively, on the 2016 OECD PIRLS (Progress in International Reading Literacy Study) reading assessments (Borgonovi et al., 2018). In the PISA 2018 reading test, the proportion of boys and girls who achieved the minimum proficiency level was, on average, 4:5 across the world, and even more pronounced, at 3:5, in less developed areas like North Macedonia and Thailand.

Data on the gender gap in STEM and literacy seem to align with social norms about expected capabilities of boys as mathematicians and girls as wordsmiths; but making differentiated assumptions about children's abilities and performances based solely on gender is biased. Sex-based social norms unfairly stereotype girls as being more capable of reading and literacy and just as unfairly stereotype boys as performing better in STEM-related subjects. Such stereotypical judgment is hindering students' academic performance and, in turn, exacerbating the gender gap. Girls who hold the widespread but unfounded belief that boys are more suited to STEM careers than girls are less likely to choose STEM-related majors even if they perform equally well as boys in these subjects (Blažev et al., 2017). According to the 2018 PISA results from OECD countries, only 14% of the top-performing girls in STEM were willing to pursue careers in STEM fields as compared to 26% of boys with equally high scores on the PISA assessment (The Global Education Monitoring Report Team, 2020). Furthermore, research indicates that the stronger the math-related gender stereotypes girls hold, the lower their math

performance becomes (Muntoni et al., 2021). Conversely, boys are more likely to suffer damaging effects of reading anxiety which significantly and negatively affects reading achievement (Ramirez et al., 2019). Diminishing the influence of prevailing social norms on STEM and literacy achievement is essential to seeing gendered differences disappear from educational data. One way to help weaken social norms is to think of ways teachers can do their jobs without reinforcing old, unfair social norms and, more importantly, teach in ways that establish new, non-biased social norms. Focusing on the idea of "mindset," I explore how teaching practices could work better in providing inclusive and equitable education, shaping the messages students receive, and thereby challenging gender stereotypes.

Mindset Theory

Mindset functions as a cognitive filter that affects our attitudes in dealing with life circumstances and the formation of comprehensive self-perceptions. Dweck (2006) distinguishes two different theoretical approaches to the question about whether or not intelligence and/or ability can be cultivated in people: growth-mindset and fixed-mindset. Growth-mindset posits that intelligence and ability are malleable and, with hard work and strategic planning, can be improved by human effort (Zarrinabadi & Afsharmeh, 2024). Fixed-mindset, on the other hand, asserts the stability of human intelligence and regards human ability as beyond control by human effort (Yu et al., 2022). In real life, however, individuals' beliefs about the malleability of intelligence and ability range across the theoretical continuum between growth-mindset and fixed-mindset (Schroder et al., 2019). Willingham et al., (2021) found only 40–42.5% of people consistently held a growth-mindset; 40–42.5% remained consistently committed to fixed-mindset; and 15–20% constantly changed between the two.

Teachers show similar trends in personal beliefs about mindset. For example, Zarrinabadi and Afsharmehr's (2024) research on 20 language teachers in Iran revealed more than half the teachers held mixed ideas about mindset and flipped between growth-mindset and fixed-mindset depending on circumstances. Certainly, it is impractical to expect every teacher personally to adopt belief in growth-mindset. However, teaching practices, regardless of teachers' personal beliefs about mindset, embody and express varying degrees and types of mindset beliefs, too. While much attention has been given to the personal mindsets of teachers, there is a scarcity of research on how teachers' pedagogical practices project a view on mindsets. It is, in fact, teaching practices that communicate to students degrees of fixed- or growth-mindset assumed in the philosophy of education that guides their schooling. Instructional methods are better guided by a growth-mindset than a fixed-mindset because growth in intelligence and ability in areas of study is a primary aim of the educational process. Understanding the role of mindset in teaching practices provides insight into how teachers can promote inclusion and equity, defy stereotypes, and create learning. Whatever teachers' personal views on mindset may be, it is imperative that teachers' professional practices project a growth-mindset.

Gendered stereotypes related to STEM and literacy endorse an educationally fixed-mindset. Weakening, eliminating, or supplanting gendered stereotypes with egalitarian social norms endorses a growth-mindset aimed at enhancing the abilities and improving the intelligence of all students. Comparing and analyzing patterns in pedagogy across diverse educational contexts identifies common teaching practices associated with different mindsets and provides data for evaluating influence of pedagogical mindset on students' self-concept, motivation, and subject engagement. Understanding the role of mindset in knowledge construction and classroom

interaction, teachers can act as a strong barrier against gender stereotypes. Rather than be perceived as individuals controlled by personal views on mindset theory, professional educators can use mindset theory to their advantage to generate new pedagogical insights for fighting gender stereotypes and developing learning environments in which students flourish.

Gender stereotypes impose "[n]egative ability labels" for "members of certain groups" (Dweck, 2006, p. 75). For example, our society traditionally assumes boys' math talent exceeds girls' while regarding girls' literacy skill as better than boys' (Vuletich et al., 2020). When it comes to children's learning habits and attitudes, fixed-mindset leads people to make *arbitrary* judgments based on the *assumption* that people's abilities are "natural born" and/or follow certain "preset" modes.[1] Fixed-mindsets disregard the role of effort in achievement by ruling out from the beginning the possibility of growth beyond some ill-imagined limits. Gender-stereotyped ideas or judgements most directly impact students who, themselves, have a fixed-mindset, leading to limited self-perception of their abilities and interests. Heyder et al. (2021) reported adolescent girls with fixed-mindsets are more likely to believe in the "math-male stereotype," resulting in lower self-concept in math and extra burden of study in school. Furthermore, teachers with fixed-mindsets are also significantly impacted by gender stereotypes. Leroy et al.'s (2007, p. 531) study of 336 elementary teachers revealed a lower rate of willingness to consider students' perspectives on academic study among teachers with fixed-mindsets. Consequently, it is easier for teachers with a fixed-mindset to form "negative beliefs about a student's potential" when confronted with gender stereotype ideas. Moreover, even teachers' subconscious beliefs about learning can be transferred to children through the way they teach and give feedback (Zarrinabadi & Afsharmehr, 2024). All these elements of fixed-mindsets ultimately hurt students' confidence and limit their potential for outstanding achievement in areas governed by gender stereotypes.

Growth mindsets enable teachers to avoid stereotypes and treat students equitably by focusing on individual talent and teaching according to student aptitude. Students with a growth-mindset are also less likely to be affected by other people's irresponsible judgments about their abilities based on uncritically accepted gender stereotypes (Malespina et al., 2022). Also, what a student believes about the learning process in a certain school subject massively influences their motivation, interest, and response to difficulties in learning that subject. A student with a growth-mindset is more likely to attribute failure to lack of hard work or an inefficient learning method, leading them to persist and improve regardless of demeaning stereotypes (Zarrinabadi & Afsharmehr, 2024; Kroeper, 2022). Students with a growth-mindset feel more comfortable with taking risks and are even more willing to deal with challenging tasks (Dweck, 2006). In fields where gender stereotypes prevail, a growth-mindset helps students remain confident and engaged, trusting their own abilities and focusing on proving the stereotypes wrong.

Fixed-mindset-oriented Teaching Practices: What They Are, What They Do

Teaching practices that project a fixed-mindset orientation onto students' schooling experiences implement classroom activities, teaching pace, or feedback content based on preconceived notions of students' ability rather than professional assessment of students' real potential (Willingham et al., 2021). Zarrinabadi and Afsharmehr (2024) found teachers who

[1] In a case contrastive to American gender stereotypes, Song and her colleagues (2017) found that people in China tend to stereotypically believe high school girls treat academic work more seriously than their boy counterparts.

instructed using a fixed-mindset orientation provided more worksheet assignments and repetitions than encouragement or supportive guidance to students they perceived as having lower language ability. What's more, personal commitment to growth-mindset theory may not be strong enough to support a teacher's cultivation of a classroom culture that focuses away from biased judgments about students in order to foster belief in students' true potential. Even though some teachers express agreement with the power of effort in discovering potential, they may still exhibit fixed-mindset-oriented behaviors in their actual teaching practices, like praising students for their intelligence rather than effort, or losing confidence in children when they encounter difficulties. Barger and colleagues' (2022, p. 11) survey of 132 elementary school teachers about their math teaching experience revealed that, compared to others, teachers with fixed-mindset or "false growth mindset" were more likely to endorse the belief that "math is only accessible to few." This false belief easily connects to the generally accepted stereotype that unfairly underestimates "girls' natural ability in math." Additionally, school-level commitment to fixed-mindset beliefs about students makes it possible that both teachers who personally hold fixed-mindset theories and teachers who personally hold growth-mindset theories may be required to engage in fixed-mindset-oriented teaching practices. In general, teachers' negative reactions to students' academic struggles are the hallmark of fixed-mindset-oriented teaching practices. Any teaching practice that calls into question, either explicitly or implicitly, students' capabilities prior to educational assessment counts as fixed-mindset teaching practice (Kroeper et al., 2022).

Teachers profoundly influence their students' behaviors, even their students' futures through teaching practices (Henson, 2003). Fixed-mindset-oriented teaching practices hurt students' sense of belonging by making the learning environment less hospitable to some students. Fixed-mindset-oriented teaching practices, like focusing highly on grades, may result in minoritized students feeling less comfortable learning a subject due to insufficient support or timely guidance (Vermote et al., 2020). Consequently, students become more result-oriented and enjoy less pleasure in the learning process, with a lower sense of belonging in subjects where performance seems to align with negatively stereotyped assumptions about "that kind of student." Students experiencing teachers' instructions that reflect fixed-mindset beliefs were reported to have less classroom engagement and more behaviors focused on pursuing purely bureaucratic academic achievement (Kroeper et al., 2022). Gender stereotyped ideas about "boys' limited potential in literacy" starts to harm children when teachers respond to boys' struggle in literacy study with frustration or denial of possible improvement.

In cases where there is a significant gender disparity in academic performance in a subject, students who belong to the minoritized gender and show interest in that subject need additional encouragement to develop confidence. Transferred through fixed-mindset-oriented teaching practices, negative stereotypes about gender can limit students' potential growth and academic development by impacting their self-esteem and belief in their real talents in particular fields (Aina & Cameron, 2011). When children are surrounded by messages suggesting their gender makes them less capable in certain areas they tend to accept and frequently internalize these perceptions, which subsequently negatively influences "their performance on school tasks or tests" (Darling-Hammond et al., 2020, p. 123). In Block et. al's (2022) study of 336 elementary school students' reactions to either gender-stereotyped, gender-neutral, or gender-counter-stereotyped ideas about math ability, girls who were exposed to stereotyped ideas showed significantly lower expectations of their own math abilities. Similarly, Wieselmann et al. (2020) interviewed 30 elementary schoolgirls and found the girls perceived themselves as weaker in STEM-related subjects than boys despite little evidence supporting actual differences in abilities

between the boys and the girls. Even subtle cues reminding students of their gender, prior to testing in a subject where gender stereotypes assert their inferiority, can negatively impact their performance (Dweck, 2006).

Growth-mindset-oriented Teaching Practices: What They Are, What They Do

Growth-mindset-oriented teaching practices are rooted in the belief that all students have the potential to learn and improve as long as educationally energetic, scientific support is provided and effort to learn is exerted. Providing individualized and timely help when students need it encourages a learning environment where challenges are seen as opportunities for growth, and teacher-student interactions foster positive attitudes towards learning. Growth-mindset-oriented teaching practices align with the growth mindset's emphasis on choosing the right strategy and learning from mistakes (Limeri et al., 2020). Showing an interest in every students' learning demonstrates appreciation for individual students' unique talents and individual progress, which is the very first step for teachers to take to form a comprehensive knowledge of each student. A quantitative analysis of 168 German teachers found a positive correlation between teachers' interests in individual students' needs and the quality of differentiated instruction (Pozas et al., 2022). Helping students with their learning puts teachers in the role of facilitators who nurture each student's potential using personalized guidance as part of the learning process. It's clear to students teachers value their learning when teachers give clear instructions on how to improve and where to develop. Students are likely to be receptive of teachers' growth-mindset-oriented teaching practices and know what to do next (Kroeper, 2022). Continuing teaching until the students understand also reinforces the belief that intelligence and abilities are not fixed since everyone has the potential for intellectual and personal growth.

Students can discern teachers' instructional mindsets from teacher reaction to student challenges and confusions (Kroeper, 2022). Over time, this perception shapes how students themselves deal with difficulties. Teachers' expectations, instructional behaviors, and daily interaction with students shape the children's confidence and mindset (Darling-Hammond et al., 2020). Teachers' confidence in students' ability is a strong influence on students' belief in themselves to achieve academically by developing mastery over school subjects (Mitchell & DellaMattera, 2011). A teacher does not have to personally believe in growth-mindset to cultivate a growth-mindset among students. Students who experience growth-mindset-oriented teaching are more likely to believe in the malleability of human intelligence, which will further affect their academic performance. (Henson, 2003; Jacovidis et al., 2020). When implementing growth-mindset-oriented teaching practices, teacher-student relationships become healthier, leading to a liberating and supportive class environment. As a result, a growth mindset can help students remain resilient and confident when faced with biased judgments about their learning ability. Without biased ideas obstructing them, students can form a comprehensive view of their potential, maintain strong motivation, and stay positive in the face of difficulties in learning.

When teachers base their evaluation of students' abilities mainly on actual performance in class, false distractors from the outside world, like gender stereotypes, are less likely to influence their judgment and treatment of students. In af Geijerstam et al.'s (2021) evaluation of students' writing skill, detailed analysis scales were developed for three main aspects of student writing: usage, flow, and voice. Uniformly applied to all students, irrespective of gender, these standards helped teachers form comprehensive understanding of each students' writing performance, which served as an important basis to develop corresponding teaching plans for each student. Growth-

mindset-oriented teaching practices focus on individual interests and strengths, developing tailored teaching strategies to support each student's learning regardless of gender. Truax (2018) followed 56 students on their reactions to different teacher feedback in writing class and found that teachers' feedback offering individualized suggestions on strengths and weaknesses has the power to shape students' belief about their writing abilities. Growth-mindset-oriented teaching practice minimized gender stereotype influences on boys' confidence in literacy learning by helping them visualize the possibility of becoming better writers through increased effort.

Pedagogical Implementation

"因材施教" (*Yīn cái shī jiào*), which means "teaching students in accordance with their aptitude" (Li, 2019), was a fundamental principle in the philosophy of education and theory of teaching developed by Confucius (551-479 B.C.E.), one of the most important philosophers and educators in Chinese history. The principle of aptitude reappeared some 500 years later and some 5,000 miles west of China in the educational theory of Roman philosopher, Quintilian (35-100 C.E.) (He, 2018). A veritable axiom of growth-mindset-oriented teaching practice, the ancient principle of aptitude retains validity for us 3,000 years after its first formulation. A strength of the principle is it's adaptability to time and place. People in different social and historical contexts have different understandings and interpretations of the connotation of "teaching students in accordance with their aptitude." As aptitudes diversify, the principle becomes richer in content — supporting each student's potential through effort, encouragement, and responsive instruction, rather than relying on fixed-mindset assumptions about their ability according to (pre)set limits on their learning. Instead, pedagogical suggestions for specific growth-mindset-oriented teaching practices implemented in real classrooms help teachers reduce the influence of stereotypes, including gender stereotypes, and uncover each student's unique shining points.

In subjects like math and literacy where boys and girls exhibit differentiated aptitudes, a well-designed assessment tool that evaluates diverse types of knowledge and skill; accurately reflects children's present performance; and monitors their progress can assist teachers in forming a comprehensive understanding of students' true talents. When teachers get to know students in contexts with the least interference from societally biased assumptions they can develop individualized plans that cater to unique strengths and needs. A clear rubric that adequately applies to the whole class serves as an important reference for both students and teachers to evaluate performance and set study goals (Darling-Hammond et al., 2020). Recognizing that students should not be defined solely by one exam, and reflecting on student progress through a series of assessments helps teachers focus on the individual child's learning achievements. Wafubwa and Csíkos (2021) found that incorporating metacognitive tasks into formative assessments contributes to mathematics teachers' evaluation skill. What's more, Leenknecht et al. (2021) suggested that effective discussions after each periodic assessment provide valuable insights into students' performance at different stages, thereby enhancing teachers' understanding of students' learning progress. As assessment becomes an intimate, interpersonal exploration of individual academic strengths and learning needs stereotypes drop away to reveal an unbiased presentation of students' abilities and present performance.

Growth-mindset-oriented feedback for assignments includes detailed comments on specific problems that provide practical suggestions to inspire students on how to improve (Hattie & Gan, 2011). In their meta-analysis of students learning in response to teachers' feedback, Klueger and DeNisi (1996) noticed feedback about the task itself and exact learning goals works most

efficiently in promoting children's development. Darling-Hammond et al. (2020) recommend that growth-mindset-oriented feedback should focus on students' exact effort and progress, and provide opportunities to revise their original work. In an experiment on in-text commentary feedback, students reported positively on comments that pointed out errors as those comments helped them not only detect errors but also understand where they made mistakes. Feedback of this nature helps students concentrate on their current progress and actual performance, while respecting their attitudes towards certain subjects, preferences of interest, and learning styles (Patra et al., 2022). Guiding inquiries, a typical feature of class discussions, contribute to the development of a growth-mindset among students when implemented on a consistent and frequent basis (Yu et al., 2022). During class discussions, teachers view students' thinking processes, track changes in their ideas, and provide timely feedback by asking questions that encourage students to think deeply into the topic. In an experiment on the effects of teachers' guiding questions, Moussa-Inaty (2015) found that students formed higher levels of reflections after being provided with guiding questions. In her action research about effective in-class feedback to inspire further discussion and encourage students' critical thinking, Latham (2013) combined multiple forms of guiding questions, like clarifying questions, sequencing questions, and expanding questions. Guiding students to question rather than uncritically accept ideas and judgements puts fixed-mindset thinking at risk of being recognized as unhelpful, both in school and outside of it, as students develop their own growth-mindset-oriented learning practices.

Recommendations for the Field

An important innovation in my argument is a shift in our understanding of "mindset" away from having to accept whatever mindset teachers may hold and towards encouraging growth-mindset in teaching practice. While we cannot mandate teachers' personal mindsets, we can require teachers as a regular part of their job to implement strategies that ensure teaching practices are growth-mindset-oriented. Seeing "mindset" as a feature of teaching practice moves the idea of "mindset" from a purely psychological interpretation ("frame of mind") to an ontological understanding ("frame of mind in which certain practices require us to be"). By modifying teaching style (Hattie & Gan, 2011), interaction language (Yu et al., 2022), and student monitoring methods (Darling-Hammond et al., 2020), teachers have positive influence on students' interest in school subjects and their beliefs about their abilities and learning habits.

Growth-mindset-oriented pedagogy plays a significant role in cutting the link between things like gender-stereotyped ideas from the outside world and children's development inside the classroom. Teaching strategies guided by mechanisms of growth-mindset-oriented practice minimize the impact of gender-stereotyped judgments on teachers' perceptions of students' true abilities and foster positive thinking about success and failure among students. Leveraging the mindset mechanism in everyday teaching contributes to a more inclusive and supportive classroom that promotes equitable opportunities for all students. In this way, students will develop a more accurate and confident understanding of their own interests and abilities, without being constrained by gender-stereotyped judgments about their potential.

Embracing growth-mindset-oriented pedagogy does not imply teachers should hold the slogan of "I can achieve whatever I want/think I can." Nor does it require teachers to deny or ignore any inherent difference between boys and girls. Rather, the secret of growth-mindset lies in the understanding that "I am not defined by anyone or anything." Growth-mindset provides teachers with a lens to view students as who they truly are; not who they are supposed to be.

Every student deserves to be perceived as a unique individual, neither confined by social expectations nor constrained by predefined roles. Growth-mindset-oriented teaching helps children learn to accept themselves and embrace challenges on their own terms, despite any prejudicial judgment or presumption by anyone else about their potential. We plant a seed, give timely guidance with respect to their natural growth and interests, and then watch in awe as students blossom in the world. Because growth-mindset-oriented pedagogy collaterally inculcates a growth-mindset among students, students proudly learn that school is the place you go to grow.

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