

Abstract

This research aims to use a systematic literature review to investigate the effect of students' mindsets while learning in the middle school mathematics classroom. Mindset embodies the framework of an individual's perspective and varies from growth to fixed. A growth mindset fundamentally correlates with positive, purposeful, and progressive learning. It is a powerful tool in a middle school mathematics classroom, which is stereotypically rampant with its converse, a fixed mindset. This stereotype stems from two main erroneous thoughts: There is only a one-dimensional approach to mathematics, and humans have innate, unchangeable amounts of capabilities.

Background and Research Questions

- Current research : A growth mindset fosters measurable success regarding resilience, engagement, academic achievement, and mental health.
- Growth mindset: Abilities and intelligence are not inherent but malleable traits.
- Mindset theory stems from two branches: attribution theory and achievement goal theory (See Figure 1)
- Sociocultural theory conveys the significance of learning through social interactions with acknowledgments of cultural influences.

Two Main Research Questions

1. How do we measure a student's mindset in the middle school mathematics classroom?
2. How can mathematics teachers foster a growth mindset in their students?

Methods

- PRISMA process through the EBSCO Quick Search (Figure 2)
- **Key terms:** mathematics or math or 'math education' or 'mathematics education' AND 'growth mindset' or 'implicit theories of intelligence' or 'incremental belief' or 'entity belief'
- **Limiters:** Peer Reviewed, 2018-2023, English, 'Subject: mathematics'
- **Expander:** 'Apply equivalent subjects'

Results

Significant Themes

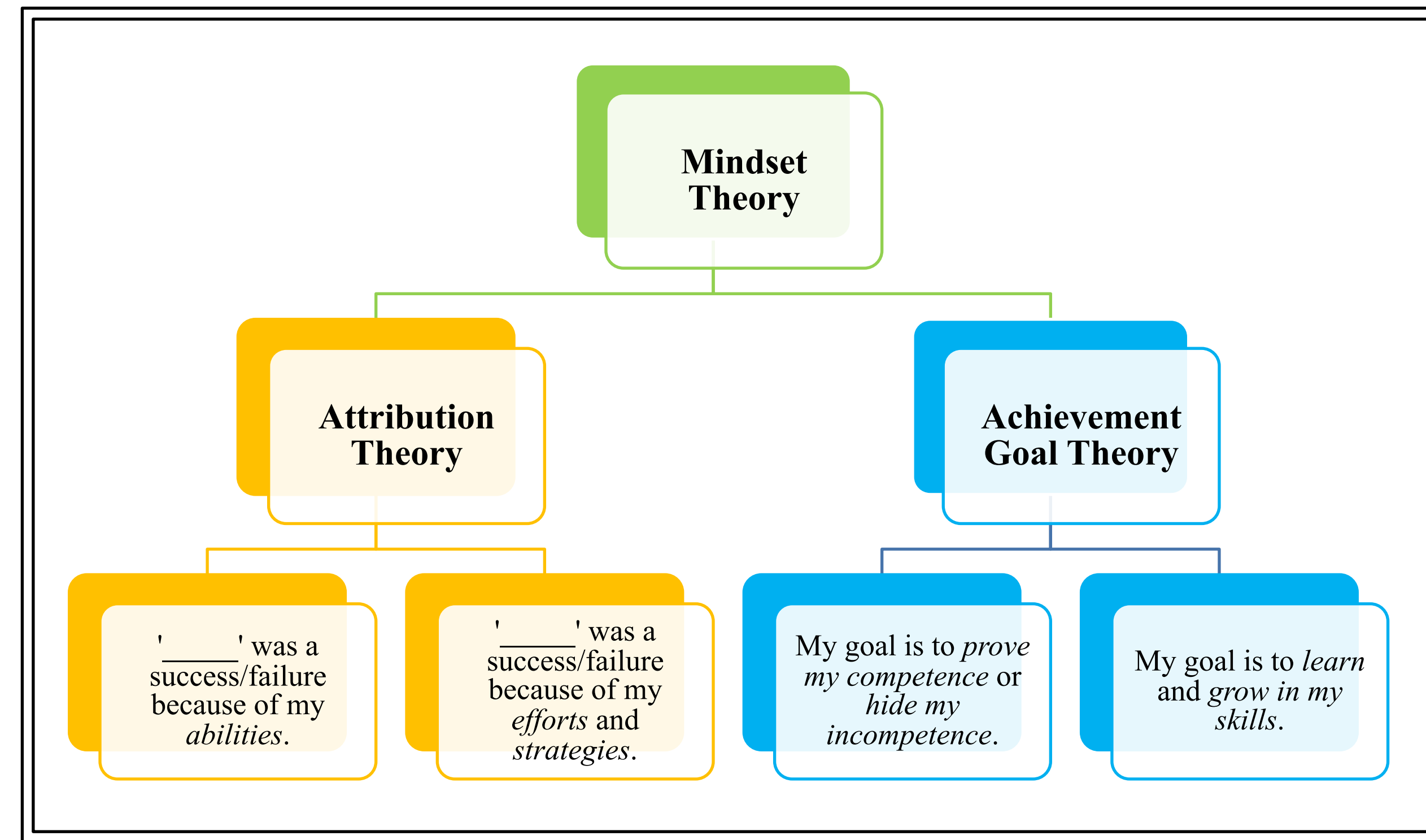
Learning with an understanding of neuroplasticity: (see Figure 3)

- Neuroplasticity: The brain can strengthen and form new connections.
- Propels growth mindset objectives with physical evidence of learning and eliminates the validity of a fixed mindset
- Helps students realize the potential to expand their mathematical abilities^{4, 6, 7, 9}
- **A growth mindset helps eradicate harmful stereotypes:**
- Fixed mindset: belief that females in STEM are less intelligent and less capable than their male counterparts.
 - undermines female potential and creates a gender gap in STEM fields
- Growth mindset: reroutes ingrained gender stereotypes into new realizations that females are *not inevitably* less intelligent or less capable than males^{2, 3, 4, 7, 9}
 - empowerment and unbounded potential for women in STEM

A performance goal vs. a mastery goal:

- Achievement goal theory: performance goals and mastery goals (see Figure 1).
- Performance goal: A student focuses on how the outcome of their experiences or challenges reflects their competence.
- Mastery goal: A student focuses on growth and learning amidst challenges and experiences.
- Mastery-based learning goals correlate with a growth mindset and produce deeper learning and increased academic achievement^{1, 3, 6, 9, 10}

Figure 1. Derivation of Mindset Theory Diagram¹¹



Created by author and adapted from Yeager & Dweck, 2020

Figure 2. The PRISMA Process Using EBSCO Quick Search⁵

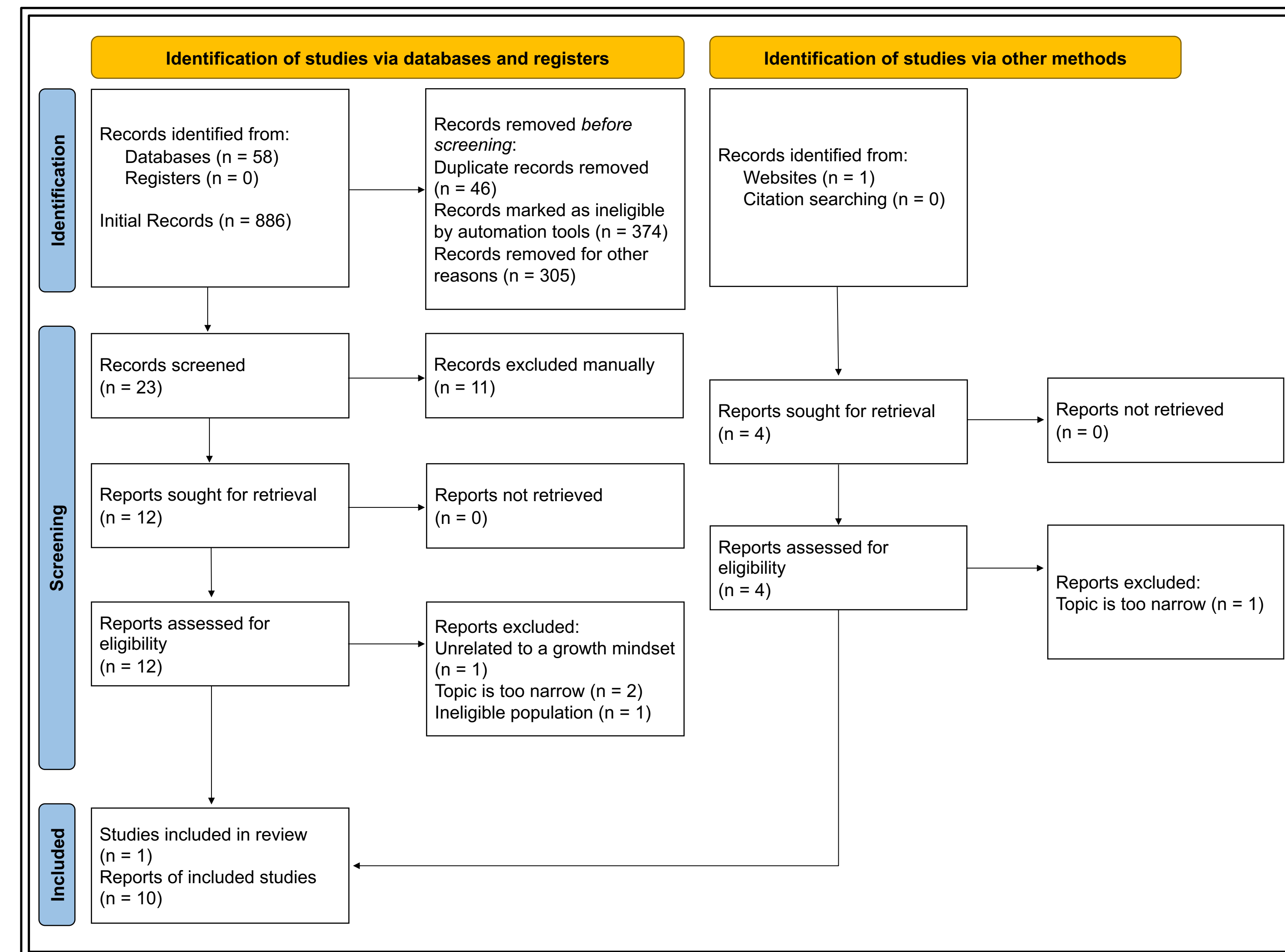
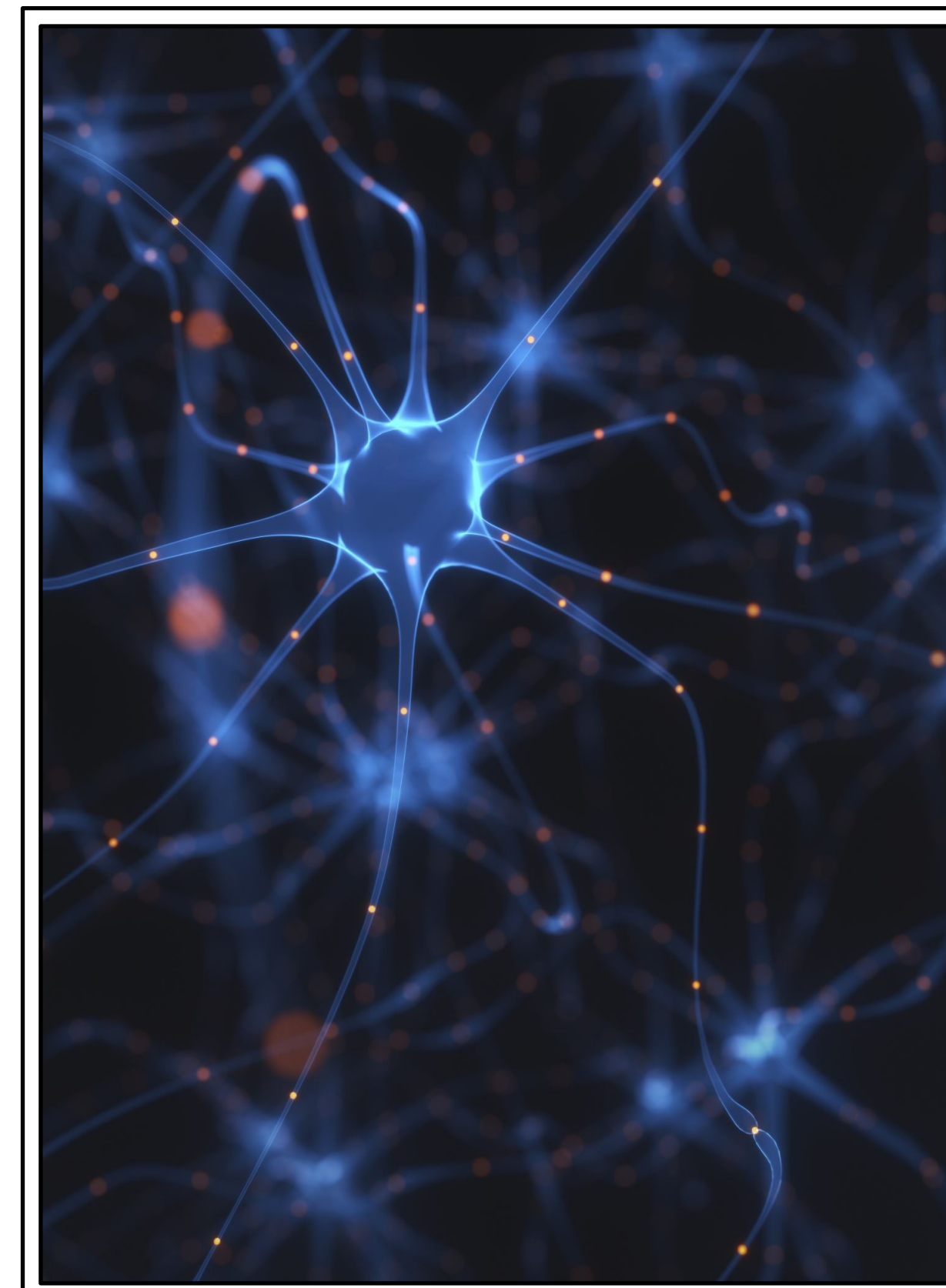
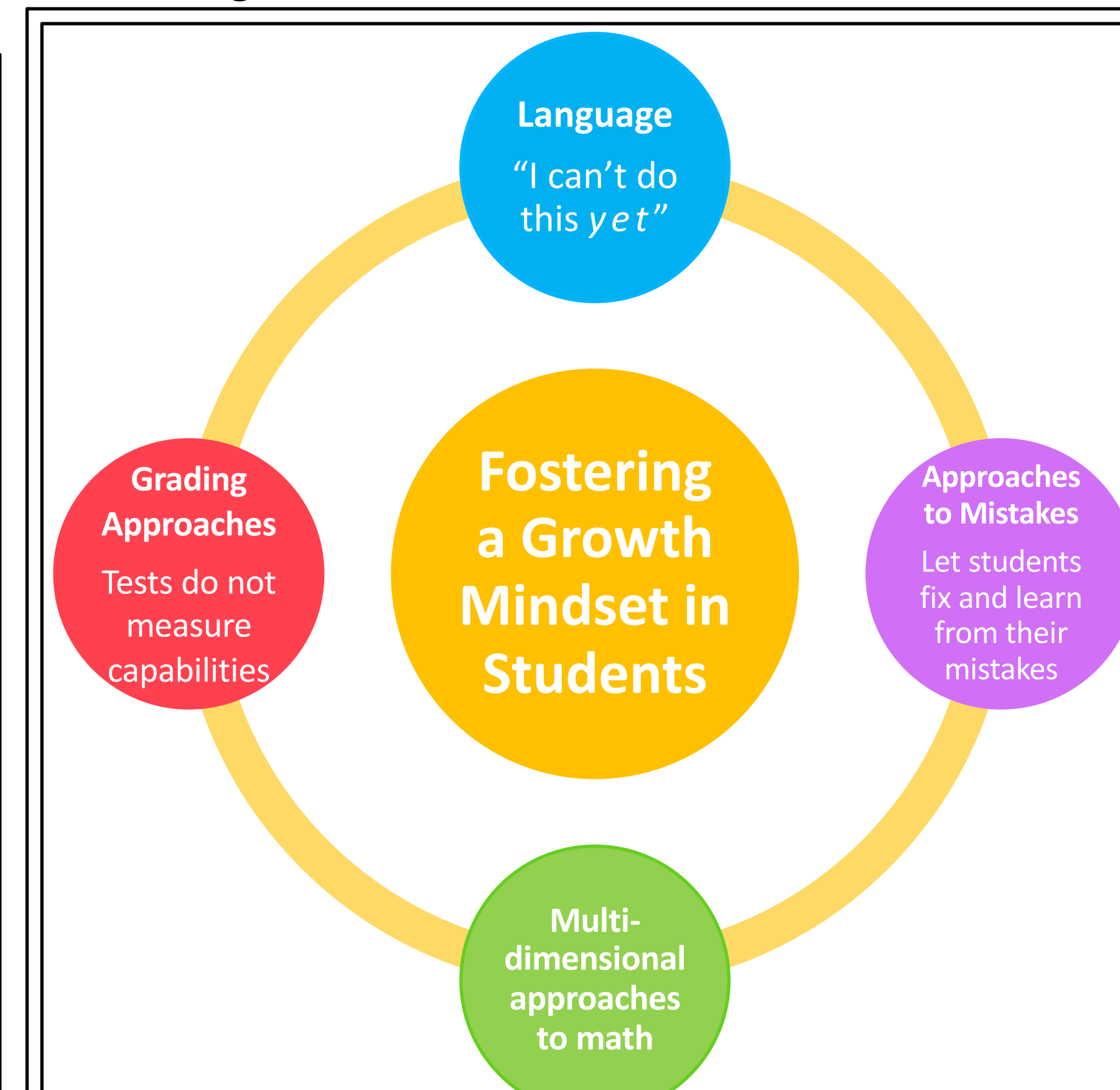


Figure 3. Representation of Neuroplasticity



Stock image from Microsoft PowerPoint

Figure 4. Growth Mindset Methods for Teachers



Created by author and adapted from Masterson & Kochi, 2021

Conclusions

Measuring a Student's Mindset

- Researchers utilize self-assessments of mindset statements to measure students' mindsets.
- Analyzing students' improvement of their GPA, test scores, and the progression of their attitudes towards learning over a period enable teachers to gauge their mindsets.

Fostering a Growth Mindset

Benefits

- Existing research discovered that students who possess a growth mindset are less susceptible to the trap of damaging stereotypes.
- Students use a mastery goal approach to learning, which enriches their education and deepens their knowledge

Methods (see Figure 4)

- Educators need to use a multi-dimensional approach to mathematics
 - Acknowledging multiple ways to solve a problem or teaching a concept using different strategies (e.g. game-based learning).
- Adopting a growth mindset regarding language, approaches to mistakes, and approaches to grading significantly benefits students.

Limitations and Future Work

Limitations

- We cannot generalize some studies from niche populations.
- Online learning prohibits various growth mindset teaching strategies.
- Survey-based studies may be inaccurate.
- Teachers' self-proclaimed mindsets may not align with their teaching practices.
- Growth mindset interventions do not work on students with obstinate attitudes.

Future Work

- Evaluate long-term effects of growth mindset interventions
- Investigate which methods teachers can generalize that are conducive to learning
- Develop mastery-based learning techniques specifically for middle school mathematics topics
- Extend studies on specific groups that will benefit the most from growth mindset interventions (e.g. low socioeconomic groups and females)
- Evaluate the differences in effects of a growth mindset on boys vs. girls

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