Contribution format: Presentation/discussion

Student perceptions of instructor mindset in introductory mathematics

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Summary: Mathematics is a critical foundation for STEM education, yet many students struggle with introductory courses, influencing their persistence in STEM. Research suggests that students' perceptions of their instructors' mindset (i.e. whether they believe intelligence is fixed or malleable) can significantly impact motivation and performance. While studies have explored instructor mindset and students' perception of it, less is known about how accurately students perceive their instructors' mindset and whether this differs between lecturers and teaching assistants (TAs).

This study investigates the alignment between students' perceptions and instructors' self-reported mindset in introductory mathematics courses across five Norwegian universities. We collected survey data from 1082 students and 44 instructors, measuring both mindset beliefs and students' reasoning for their perceptions. Initial findings indicate that students generally perceive their instructors as having a growth mindset, regardless of actual beliefs. Differences were observed between lecturers and TAs, with students more likely to overestimate TAs' growth mindset.

These results provide insights into how students interpret instructor behavior and how mindset beliefs are communicated in the classroom. Understanding these dynamics is important for contributing to professional development for instructors, particularly TAs, and for fostering a learning environment that supports student persistence and success in STEM fields.

Keywords:

Growth mindset, teaching assistants, mathematics education, STEM education, mindset beliefs

1 About the contribution

Introduction

Educating candidates in STEM is important for meeting current and future employment demands (Kunnskapsdepartementet, 2023). Increasing the number of STEM candidates requires attention towards psychological and social factors that influence student motivation, persistence and success.

Research suggests that experiences in introductory mathematics significantly impact persistence in STEM fields (Kopparla, 2019; White, 2024). This relationship particularly holds for women, who are more likely to leave STEM due to experiences in introductory mathematics (Ellis et al., 2016). One factor that may influence student motivation and performance in these courses is mindset beliefs, which refers to whether people believe that intelligence is a fixed trait (*fixed* mindset) or something which can be changed and cultivated through learning (*growth* mindset) (Dweck, 2013).

Instructor mindset can significantly impact students' self-belief, motivation, and academic success (Brown & Cross, 2020; Canning et al., 2019). The same can be seen for students' perceptions of instructor mindset. Students perceiving their instructors to have a growth mindset are more likely to adopt adaptive learning strategies, persist through challenges, and ultimately remain in their study programs (Canning et al., 2022; LaCosse et al., 2021).

However, little research has examined whether students' perceptions of instructor mindset align with instructors' actual beliefs, particularly in the context of introductory mathematics. One previous study found that students agreed somewhat with their STEM instructors' self-reported mindset beliefs, but found no detectable student-instructor alignment for mindset behavior (Muenks et al., 2024). Understanding this alignment between instructor behaviors and student perceptions of mindset may prove critical for improving teaching practices and fostering student success in mathematics-intensive programs.

To our understanding no such research has yet been conducted which differentiates between lecturers and teaching assistants (TAs). Students perceive lecturers and TAs differently. Lecturers are seen as more knowledgeable, authoritative and structured, while TAs are perceived as more approachable, relatable, and interactive (Clements et al., 2022; Kendall & Schussler, 2012; Wheeler et al., 2017). This may lead to students picking up lecturers' and TAs' mindset beliefs differently, and could ultimately inform our professional development efforts supporting TAs.

We aim to fill this gap in the literature by considering how well students pick up on their instructors' (lecturers and TAs) mindset in introductory mathematics across five Norwegian universities. We also aim to identify which thoughts and behaviors lead to forming a perception of mindset.

Our research questions are:

1. To which degree do students pick up on their mathematics instructors' mindset?
    a. Do students pick up lecturers' and TAs' mindsets differently?
    b. Do student demographics (e.g. gender) influence perception of instructor mindset?
2. Which teaching behaviors do students associate with a growth or fixed mindset?

Methodology

We surveyed students in 7 first-year introductory mathematics courses across 5 Norwegian universities. Instructors (lecturers and TAs) were also surveyed. Surveys, distributed through Canvas or SurveyXavt, were distributed mid-to-late November 2024, with the intention that at this point of the semester students were familiar with their instructors, and still participated actively in the class before exams.

To measure mindset quantitatively, we used two items from the Theories of Intelligence Scale (Dweck, 2013). The wording of these items was slightly altered to better fit the current context. These two items were used in order to be consistent with previous related research (Muenks et al., 2024), where the same items were used to measure faculty mindset. The items used were:

1. "Students have a certain amount of intelligence, and they really can't do much to change it."
2. "Your intelligence is something about you that you can't change very much."

Instructors were asked to state their agreement to these statements using a Likert scale from 1 (completely disagree) to 7 (completely agree). Students were asked to state their own agreement as well as how they believe their lecturer and primary TA would respond. Students were also asked in open-ended questions to justify why they believed that their lecturer and TA would respond in the way that they had previously stated.

We also collected personal information such as gender (for instructors and students) and whether one or more of a participants' parents had attended higher education (students only).

A sequential mixed methods framework was used to analyze the data, analyzing quantitative items first before elaborating on these using the qualitative items. Quantitative analysis was performed using R (R Core Team, 2024) while qualitative analysis was performed manually.

Results

1082 students and 44 instructors (12 lecturers and 32 TAs) consented to take part in the study. This section presents quantitative and qualitative results from initial analyses of the dataset.

Occasionally the scores on the two mindset items will be treated as one average score. Cronbach's alpha showed high internal consistency $\alpha = 0.88$ to $\alpha = 0.93$, which justifies this decision.

Quantitative results on perceptions of mindset

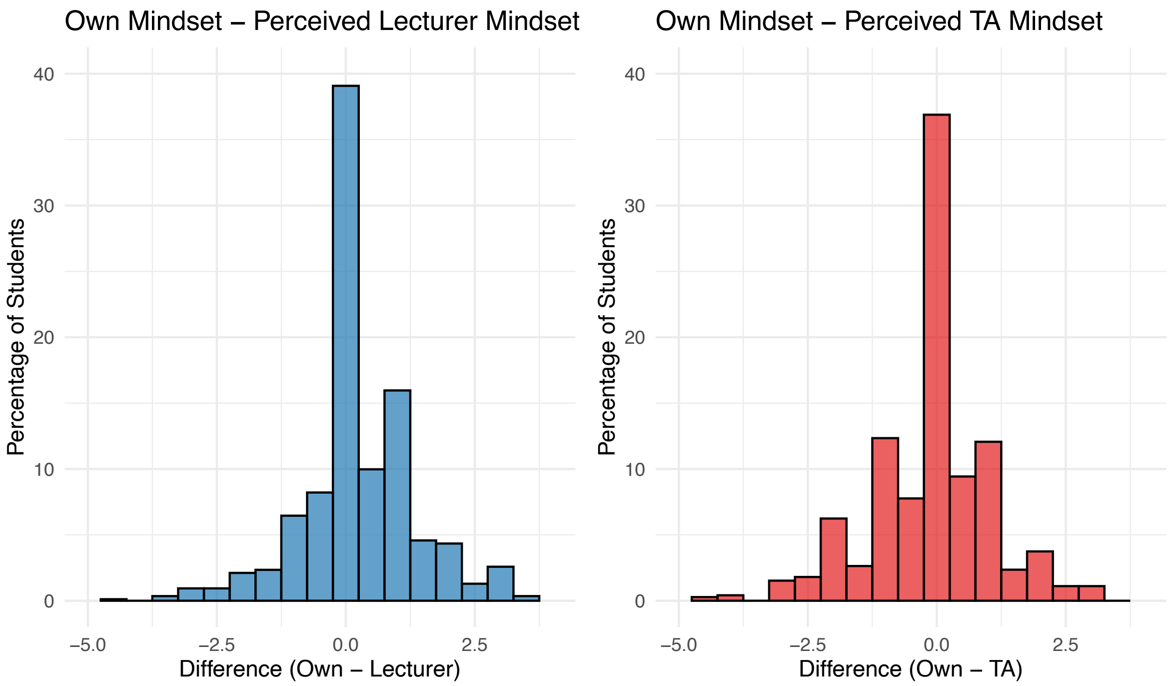

Figure 1: Histograms showing the difference between students' own mindset and their perceived lecturer (left) and TA (right) mindset.

Figure 1 shows that students tend to perceive their instructors' mindset as similar to their own. For example, 57,2% percent of students perceive a difference of less than one point between their own mindset and their lecturer's mindset. This was 54,1% for students and their TAs.

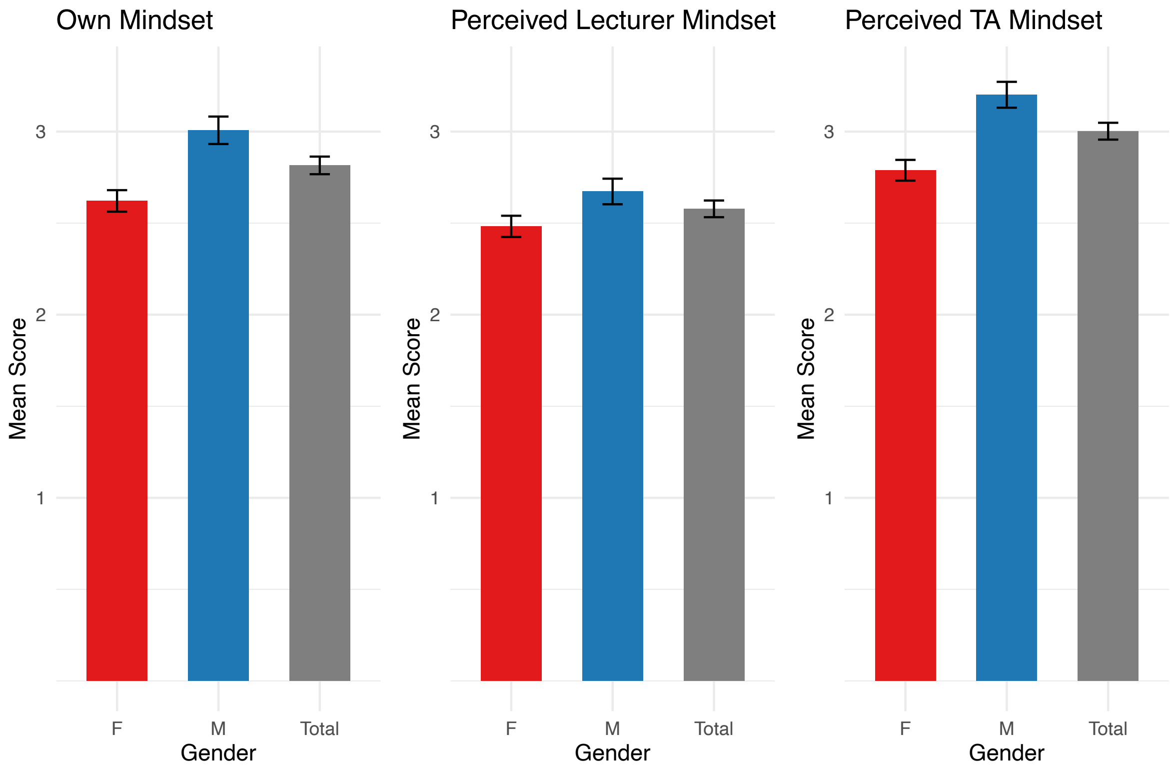

Figure 2: Bar charts showing average scores of own mindset, perceived lecturer's mindset and perceived TA's mindset for female (F) and male (M) students.

Considering now gender differences, female students scored lower than male students on all three metrics, as shown in Figure 2. A lower score corresponds to more of a growth mindset. The difference was significant for students' own mindset $(p < 0{,}001)$ and perceived TA mindset $(p < 0{,}0001)$, but not for perceived lecturer mindset.

Alignment between instructor mindset and perceived instructor mindset

Out of 12 lecturers who were surveyed, we were able to match 7 lecturers' answers to their students' perceived answers. Figure 3 shows the spread of students' perceived mindset answers compared to the lecturer's actual answer. The results show that students tend to perceive their lecturer as having a growth mindset (average score ~ 2), regardless of their lecturer's actual mindset. The exception is lecturer 4, where students agreed with the lecturer's average score of 4.

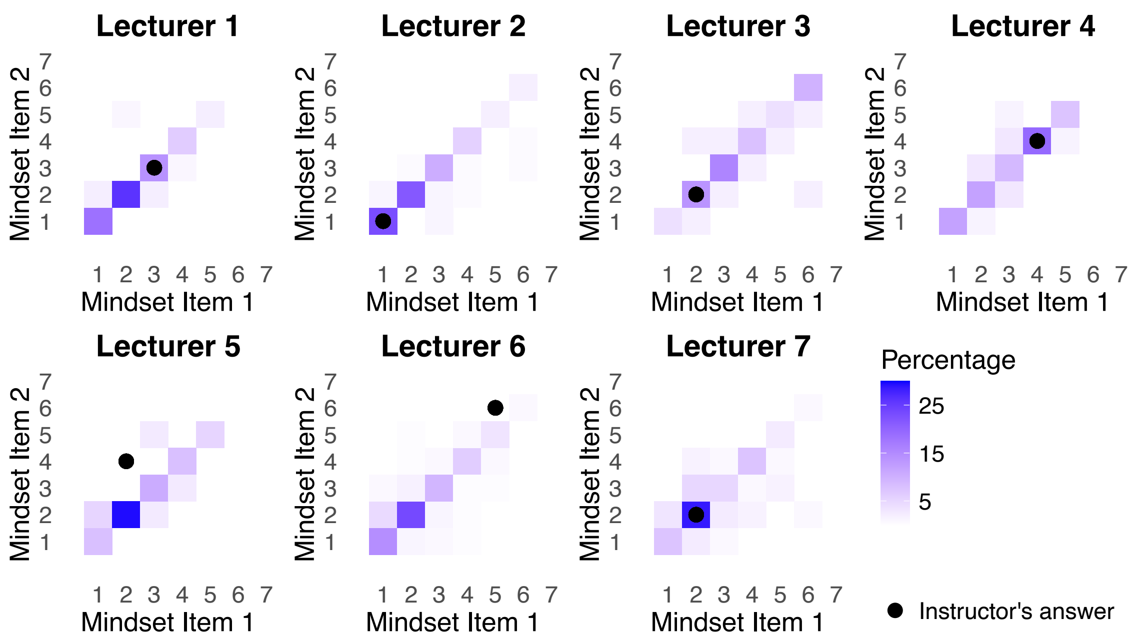

Figure 3: Heatmaps displaying how students perceived their lecturer's answers to the two mindset items, compared to how the lecturer actually answered.

We consider now the same measure for TA's. Figure 4 shows a different pattern for TA's than for lecturers. While most TA's report a low score (i.e. a growth mindset) there are several cases where their students overestimate this score, which can be seen for example for TA 1, TA 7, TA 8 and TA 9.

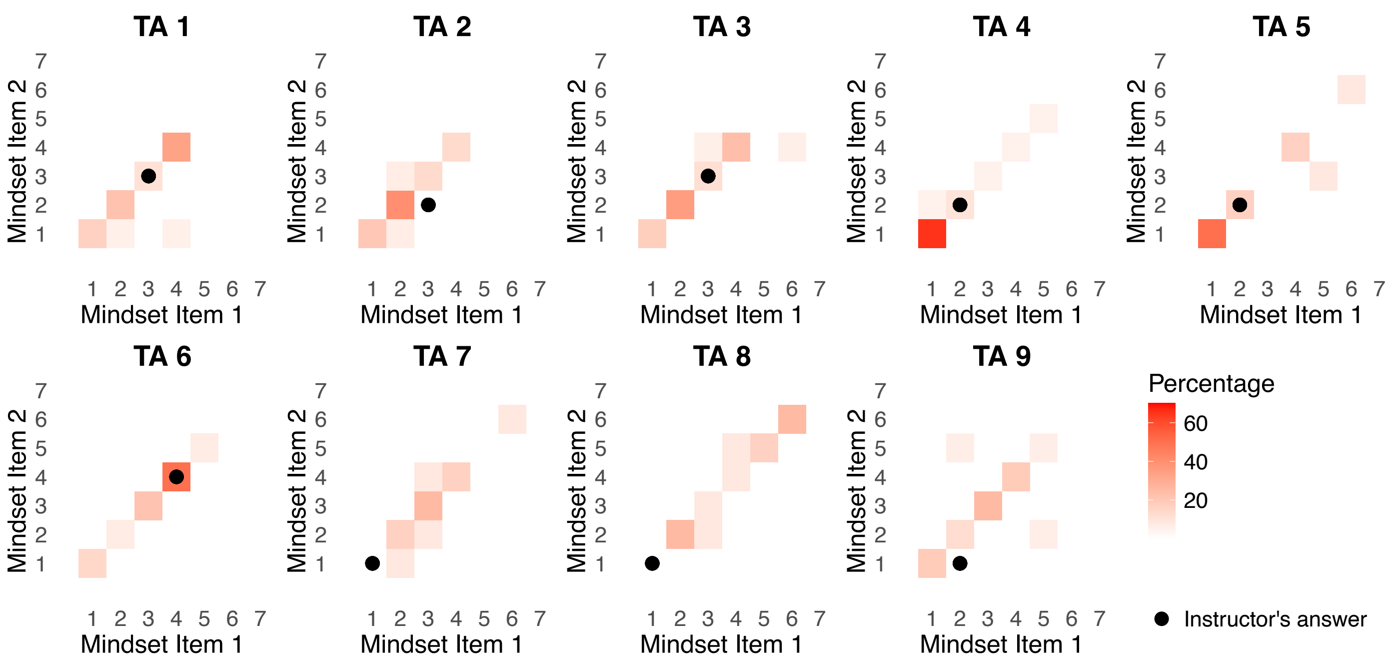

Figure 4: Heatmaps displaying how students perceived their primary TA's answers to the two mindset items, compared to how the TA actually answered.

To quantify the alignment between instructors' mindset scores and students' perceived scores, a Mean Square Error (MSE) was computed for each instructor (Tables 1 and 2). There was no statistically significant difference between the MSEs for lecturers and TAs.

Table 1: A comparison of lecturers' average mindset scores with students' perceived scores, with computations of MSE for each lecturer.

Lecturer	Actual Average Score	Perceived Average Score	Mean Square Error (MSE)
1	3,0	2,319	1,848
2	1,0	2,377	3,851
3	2,0	3,566	4,836
4	4,0	3,060	2,800
5	3,0	2,571	1,429
6	5,5	2,426	10,966
7	2,0	2,500	1,402
Average MSE for lecturers			**3,876**

Table 2: A comparison of TAs' average mindset scores with students' perceived scores, with computations of MSE for each TA.

TA	Actual Average Score	Perceived Average Score	Mean Square Error (MSE)
1	3,0	2,750	1,486
2	2,5	2,200	0,950
3	3,0	2,676	1,544
4	2,0	1,725	1,563
5	2,0	2,333	2,833
6	4,0	3,286	1,857
7	1,0	3,458	8,479
8	1,0	4,000	11,458
9	1,5	2,969	3,641
Average MSE for teaching assistants			**3,757**

Identifying reasons for perceiving a growth or fixed lecturer mindset

Looking now at the open-ended questions on students' justification for their perceived instructors' answers, we consider perceptions of lecturer mindset. In total, 702 students gave answers to the open-ended question on lecturer mindset. We separate these into those who perceived their lecturer as having a growth mindset (average score ≤ 3) and a fixed mindset (average score ≥ 5). We thus discard those who gave an average score between 3,5 and 4,5.

76,9% of open-ended answers belonged to students perceiving their lecturer to have a growth mindset. We can classify the source of a perception as internal (i.e., of the form "I believe my lecturer gave this score because I think that…"), or external (i.e., of the form "I believe my lecturer gave this score because of their behavior, such as…"). Table 3 summarizes the findings and gives example student quotes.

Table 3: An overview of students' reasons for perceiving their lecturer to have a fixed or a growth mindset. Answers which could not be identified as external or internal where discarded.

Total open-ended answers: 696			
n=535: Perceived growth mindset (76,9%)		**n=62: Perceived fixed mindset (8,9%)**	
n=339 (63,4%): Internal Example quote: *"I think that if lecturers believed they couldn't influence students' intelligence, they wouldn't spend so much time teaching us. They stand there because they believe they can make a difference and have an impact. That's why I think the lecturers would also strongly disagree with these statements."*	**n=167 (31,2%): External** Example quote: *"My lecturer understands that not everyone grasps everything taught in class. They sit down with students, explain things thoroughly, and address topics that others might also be wondering about. They always try to explain things in a simple and clear way while also encouraging us to think critically. I don't believe they think that those who don't understand something will never be able to learn it. Rather, I think they believe that everyone can learn, and they want to help as much as they can."*	**n=42 (67,7%): Internal** Example quote: *"I think maybe the lecturers see a group of students each year that they know will not be able to complete the course. You need a certain amount of intelligence to be able to follow along even when you are struggling with the course."*	**n=14 (22,6%): External** Example quote: *"[the lecturer] interacts with us in a way that gives the impression that you need to understand the basics and have to keep up to get anything out of the lectures. In my mind, this is interpreted as them somewhat agreeing that intelligence is fixed."*

Out of those who believed their lecturer to have a growth mindset, the majority reported internal reasons for their beliefs. The selected quote illustrates a recurring theme found among students in all 7 classes, which is seeing a growth mindset as something fundamental to being a lecturer. Out of those who reported internal reasons for a growth mindset belief, 18,9% reported this fundamentality as their only reason.

Further research

Analysis of the data is still ongoing and will look deeper into qualitative data on perceived lecturer and TA mindset, as well as differences between these. Results will be shared with the participants.

Questions for discussion

The results of these initial analyses raise several questions about how students perceive instructor mindset, which in turn might influence their motivation and persistence in STEM. The following discussion questions invite reflection on the role of mindset in STEM education:

1. Many students reported having a growth mindset as something fundamental to being a STEM instructor. To which degree is this true?
2. The results indicate a difference in how students perceive lecturers and TAs. What factors might contribute to this distinction?
3. Should training for TAs focus more on how their mindset-related behaviors are perceived? Which strategies could help align perceptions with actual beliefs?
4. How can instructors more explicitly communicate a growth mindset in their teaching practices?

2 Contribution format

Relevance for the MNT conference

Ensuring that students have competency in mathematics is a key factor for achievement, success and retention in all fields of STEM education. By considering how students interpret instructor behavior and how this differs between lecturers and TAs, we provide valuable insights into teaching practices that can enhance competency development. These findings can inform the re-design of educational programs by emphasizing mindset-supportive teaching strategies, particularly in early STEM courses where retention rates are low.

Our study also contributes to discussions on how instructors can foster an inclusive and motivating learning environment. Through professional development initiatives that promote growth mindset communication, we can enhance students' learning experiences, improve retention, and ultimately strengthen STEM education.

Plan for the presentation and audience engagement

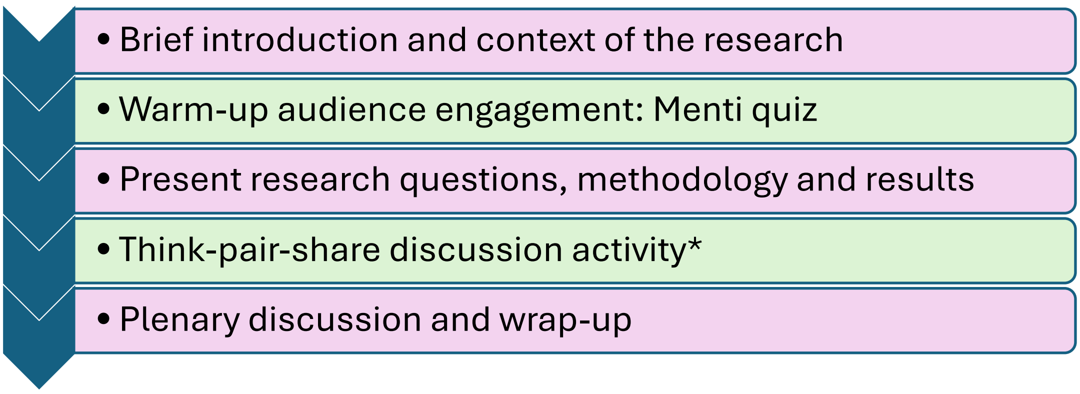

Figure 5: A visualization of the structure of the presentation of this research.

The presentation (as shown in Figure 5) will be interactive, encouraging audience participation and discussion. The goal is for the audience to have an opportunity to reflect on their own experiences and perspectives of communicating mindset while teaching, while studying this case of introductory mathematics.

*A specific activity has not yet been chosen, but an example is for the audience to study quotes from our dataset, identifying student beliefs and discussing their implications on teaching behavior.

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