Beliefs about learning

Social background, gender, and classroom environment

by

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Summary

Background: Increasing students' learning and their completion of high school has been a policy challenge for many years. This thesis investigates how the psychological mechanism of *growth mindset* is related to educational outcomes in the Norwegian school context. The theoretical starting point for mindset theory is the assumption that students' beliefs about the nature of intelligence play a larger role for motivation than is generally acknowledged in the education sector.

Aims: The aim was to empirically investigate students' beliefs about the nature of intelligence and how these beliefs are related to outcomes in high school as well as to societal factors already known to be related to inequality in learning outcomes. Specifically, the thesis investigates the relationship between academic mindset and socioeconomic background, gender, and experiences from middle school. Article One investigates how mindset is related to social background and grades in high school while Article Two investigates how it is related to gender and completion. In Article Three, my coauthor Maximiliaan W. P. Thijssen and I investigate how classroom effects on growth mindset in middle-school affect academic choices in high school.

Methodology: This thesis has a quantitative approach. All three studies are empirical investigations of a sample of about 10,000 students in public high schools in two counties in Norway. The data material derives from three sources. First, there are survey data from when the students entered the first year of high school in 2017. Second, the county administrations provided registry data on middle-school grades and results from high school. Third, Statistics Norway, a government

agency, provided data on background characteristics such as parents' education, income, and country of birth.

Results: Article One and Article Two demonstrate that boys and students whose parents have a low level of education express lower levels of growth mindset upon entry to high school than girls and students whose parents have a high level of education. However, these differences are for a large part related to the students' grade-point average (GPA) from middle school. Nevertheless, the level of growth mindset predicts educational outcomes in high school even among similar performing students. In Article Three, my coauthor and I find within-middle-school variation in the classroom effects on growth mindset, and we also find that classroom effects on growth mindset predict academic choices ahead of and in high school.

Conclusion: One finding common to all three articles is the central role played by students' expressed level of growth mindset as a distinct predictor of educational success in high school. Several theories propose that students' beliefs about the nature of intelligence and ability are important for their educational behavior. The empirical investigations contribute to our understanding of the fundamental relationships between mindset and other factors known to be important for inequality in education. Specifically, it is an important mechanism for understanding prevailing differences in educational outcomes across social background and gender. The majority of the findings in the thesis are correlational, and further studies are needed to fully understand the causal mechanisms involved. However, the thesis provides evidence suggesting a relationship between mindset and how students take advantage of learning opportunities in high school.

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1 Introduction

In Norway, 98 percent of students enter high school directly from middle school. However, only around 80 percent of those who start high school complete it with a vocational qualification or a university-admission certificate within five/six years (Statistics Norway, 2023). An extensive research literature has investigated factors relevant to completion of high school. Policy initiatives have focused upon ways to improve learning and well-being among students. In the schools, teachers and leaders have collaborated to identify many actions that work. As a result, completion rates have increased substantially over the past ten years (Statistics Norway, 2023). However, there is room for further improvement.

While we know much about many factors that are important for learning, there is one factor that has been relatively little explored: students' beliefs about learning possibilities. What makes students willing to take on the challenges they face and take advantage of the learning opportunities that are presented to them in high school? The present thesis investigates students' beliefs about learning possibilities through the academic concept of *mindset*.

Beliefs are convictions about what we accept as true. They provide the fundamental framework that we use to understand the world and engage meaningfully with it (Connors and Halligan, 2022). For our present purposes, students may believe that those who are successful in school are naturally endowed with the intellectual capabilities required to do well, or they may believe that each student's talent and intelligence will develop during schooling.

Mindset theory (Dweck, 2006) proposes that students with a *growth mindset* are characterized by a belief that intelligence is a malleable feature, whereas students with a *fixed mindset* believe that intelligence is a stable trait. Students with a growth mindset have a desire to learn because they are focused upon the learning process. They also hold positive beliefs about effort and embrace setbacks as sources of information about the learning process, rather than as signals of inaptness (Dweck, 2017b). Students who hold a growth mindset are found to take more advantage of learning opportunities in school, and they show greater persistence in schoolwork (Yeager et al., 2019). In contrast, students with more of a fixed mindset are found to avoid challenges and relent in the face of difficulties.

A higher level of growth mindset is found to be associated with higher academic achievement (Bettinger et al., 2018; Gouëdard, 2021), with mastery-oriented strategies such as seeking help from teachers, and with lower levels of psychological distress (Burnette et al., 2020), as well as with lower levels of school-burnout symptoms (Nieuwenhuis et al., 2023). Growth mindset is also considered to be important in the labor market. In the past, it may have been sufficient for personnel to be "knowers"—to know facts and have specific skills and then apply them in the labor market (Rege et al., 2021). The new labor market, however, increasingly needs employees with a desire for challenge and an ability to cope with difficulty (Rege et al. 2021).

The growth-mindset concept has received increased attention from international policymakers, and in 2018 the Organization for Economic Cooperation and Development (OECD) included a measure of growth mindset in the Programme for International

Student Assessment (PISA) survey. The OECD argues that PISA aims to critically assess students' competence and not only their content knowledge. This implies a more holistic approach to students' learning experience (Gouëdard, 2021). While policymakers in Norway chose not to include the growth-mindset item in the national version of the PISA survey, 78 other countries did. A positive association between holding a higher level of growth mindset and academic performance was found in 74 of those countries (Gouëdard, 2021).

1.1 Purpose and approach

The main aim of this thesis is to investigate students' expressed view on the nature of intelligence in a Norwegian context and examine how this relates to educational outcomes. In Norway, very little is known about students' beliefs about the nature of intelligence and how they relate to learning. We also have little knowledge about how students' beliefs relate to societal factors already known to be related to inequality in learning outcomes, such as family background and student gender.

The mechanisms that generate performance inequalities among students are often related to features of individuals, families, and societies that are difficult to change (M. Jackson, 2013). A growth mindset, however, is a skill that can more easily be shaped and developed over time (Duckworth and Yeager, 2015). By investigating how students reason about the nature of intelligence and how this relates to grades and high-school completion rates, this

thesis aims to shed some light on a mechanism that could perhaps be used to improve learning in schools.

In this thesis, growth mindset is seen as a socioemotional skill. Socioemotional skills are psychosocial and self-regulatory resources that can be used to select and pursue goals (Lechner, Anger, and Rammstedt, 2019, p. 430). Kraft (2019) states that growth mindset is a widely publicized social-emotional competency which has received considerable attention from policymakers and educators in recent years.

In the international literature, socioemotional skills are important because they allow students to better apply their academic skills and thereby learn more (Jennings and DiPrete, 2010). Jennings and DiPrete (2010) describe two schools of thought within social science. One of them regards socioemotional skills as static—as something that children have or lack on first starting school—and hence as a kind of capital that schools can do little to change. The other school of thought views these skills as something that teachers and schools can enhance through good practice. On this view, schools have an important role in teaching students the social and emotional skills that they need in school (Jennings and DiPrete, 2010). This second school of thought has supplied the underlying assumption of the present thesis.

Social and emotional skills are currently not an integral part of the subject competence in the Norwegian curriculum. Restad and Mølstad (2021) describe how the expert reports that informed the most recent national-curriculum reform in Norway cited research indicating that social and emotional competencies can be influenced and learned throughout life and that such competencies are of particular

importance for students who do not perform well in school. Building on the two official reports, the white paper containing the proposal for the curriculum reform did recognize subject learning and social learning as highly connected. However, the white paper did not support a wider definition of competence including social and emotional skills; instead, it emphasized that "competence is first and foremost about students' subject-learning outcomes" (Ministry of Education and Research, 2017, p. 21, my translation). It argued that, while some aspects of students' social and emotional learning are included in certain subjects, the curriculum should not set goals for students' personal attitudes and opinions (p. 72).

To explore the role of socioemotional skills in the Norwegian context, I use data from 10,000 students in two counties. Mindset theory and other social-science theories are used to discuss the findings. The two overarching questions for my thesis are:

- Does students' level of growth mindset upon entry to high school differ by social background, gender, and middle-school experiences?
- Does students' level of growth mindset upon entry to high school matter for their high-school outcomes?

The three articles that compose the thesis investigate specific research questions within these overarching research questions. Article One (Appendix 1) explores the relationship between students' mindset and their social background, Article Two (Appendix 2) examines gender differences, and Article Three (Appendix 3) investigates effects of the middle-school classroom environment. All three articles investigate how mindset relates to high-school outcomes.

My aim is to contribute to the evidence base regarding the relationship between socioemotional skills and academic achievement as well as to the evidence base regarding inequality in education. This thesis in Social Science is based on an interdisciplinary approach drawing upon psychological, sociological, educational, and economic research.

1.2 Structure and contents

Following this introductory section, Section 2 presents the theoretical framework for the thesis as well as previous research. The methodological approach is presented in Section 3 alongside brief presentations of the Norwegian school system and of the project that provided the empirical data for the thesis: the U-say project. Results are presented and discussed in Section 4. In the final section—Section 5—I discuss empirical implications.

2 Theory

Theories are often regarded as explanatory devices, that is, as responses to the question of *why* something is the case (Sohlberg and Leiulfsrud, 2016). This is also how I use theories in the present thesis.

I start with a description of mindset theory and the mindset concept, outlining how it is theoretically framed and linked to achievement in school. Mindset theory is a psychological theory. Historically, psychologists have paid little attention to the relationship between socioemotional skills and group differences related to, for instance, family background (Gruijters, Raabe, and Hübner, 2023). Since I want to consider differences in mindset related to social groups, I draw from other social-science theories on educational inequality to discuss how beliefs about intelligence or ability are assumed to play a role for educational disparity.

2.1 Mindset as a scientific concept

In recent years, academic mindset has been established as a scientific concept. Concepts are the theoretically loaded elements of theories (Leiulfsrud and Sohlberg, 2017). The metaphor they use is that concepts are the building blocks of theories. The validity and reliability of the mindset concept will be discussed in Section 3. In this section, I will describe the theoretical aspects of it.

A growth mindset is the belief that intelligence is malleable and can be developed over time (Dweck and Yeager, 2019). A fixed mindset,

by contrast, is the belief that people's intelligence is stable and cannot be changed. The development of mindset theory was motivated by a desire to understand the psychology behind challenge-seeking and resilience—why some people run from difficulty, while others embrace it—and possibly to understand why some people fulfill their potential, while others do not (Dweck and Yeager 2019). Dweck (2017b) emphasizes that the ones who start out as the "smartest" are not always the ones who end up the smartest, and the underlying rationale of mindset theory is indeed to explain the processes leading to differences in approaches to learning opportunities.

A key claim in mindset theory is that beliefs are a fundamental part of motivation and development, much more so than has generally been acknowledged.[1] In a broad article, Dweck (2017a) presents an overarching theory of motivation, personality, and development, which forms the foundation for the mindset concept as well. In this theory it is proposed that people, as they pursue need-fulfilling goals (based on basic needs), build *mental representations* of their experiences (beliefs, representations of emotions, and action tendencies) which are fundamental to motivation (Dweck, 2017a).[2]

[1] Some of the major exceptions are attribution theory, self-efficacy beliefs, and the mindset theory. In these theories, beliefs are considered important (Dweck, 2017a)

[2] In this overarching theory, Dweck also includes personality as arising, at least partly, from the pursuit of need-fulfilling goals and the development of representations, and she shows how mindset interventions can change students' Big 5 traits (Dweck, 2017a, p.706)

The concepts of growth mindset and fixed mindset represent implicit theories of intelligence. Implicit theories are "*a priori* beliefs about the features and properties of objects, including humans" (Plaks 2017, p. 261). The term "implicit" is used because the theories tend not to be clearly developed and articulated in people's minds (Plaks, 2017).

The origin of people's mindset is to be found in experiences that have formed their beliefs. Such beliefs are not isolated ideas, but rather capable of serving an organizing function, bringing together goals, beliefs, and behaviors into what might be called a meaning system (Dweck and Yeager, 2019). Mindsets are the core of such meaning systems. Persons with a fixed mindset will have different goals and attributions than people with a growth mindset. Students who view ability as fixed will be more concerned with proving their ability (by pursuing performance goals or by avoiding challenges). They will also more often regard high effort as indicating low ability, and they tend to attribute setbacks to low ability. As a result, they will have lower persistence. This contrasts with students with a growth mindset, who believe that their abilities can be developed through dedication, hard work, and the use of good strategies. Students who view ability as something that can be improved will have an action tendency toward developing that ability (by taking on challenging learning goals), effort is likely be seen as a tool in this process, and setbacks will more often be seen as a source of information about the learning process. These students will have higher persistence. While a growth mindset and a fixed mindset are often presented dichotomously, as polar opposites, Dweck (2017b) emphasizes that

people can have more or less of each mindset and that the relative extent of them can vary across situations in the same individual.

The mindset theory development was followed by research which examined meaning systems, especially the implication of mindsets for students' approach towards challenging learning tasks and persistence when facing setbacks (Dweck and Yeager, 2019). Dweck and her colleagues conducted a series of experiments demonstrating the role of mindsets in students' desire to undertake further learning after a clear failure, as opposed to taking defensive measures that would shore up their sense of their ability but would in no way improve their actual ability (Dweck and Yeager, 2019). For instance, Blackwell, Trzesniewski, and Dweck, (2007) tested the meaning-system model in a longitudinal study (Study 1) and found that students who believe that intelligence is malleable also endorse stronger learning goals, hold more positive beliefs about effort, and make fewer ability-based attributions. As a result, they choose more positive, effort-based strategies in response to failure, and this was found to increase mathematics achievement at the transition to junior high school. Further, a higher level of growth mindset at the beginning of junior high school was related to increased math grades relative to other students after the two years of junior high school (Blackwell, Trzesniewski, and Dweck, 2007).

Messages forming students' mindset can come from for instance parents, teachers and peers (Dweck 2017b). Kamins and Dweck (1999) found that person-focused feedback led to a stronger belief in stable traits that process-focused feedback did. In general, praising children for their intelligence will promote a fixed mindset while praising them for their effort will promote a growth mindset.

The correlation between parents' and their children's mindset has, however, been found to be weak. It has been suggested that adults' theory of how to motivate children and the way parents respond to their children's setbacks predict their child's mindset (Haimovitz and Dweck, 2017). Whether parents believe that failure is motivating or demotivating will determine if they react to their children's success and failure in ways that transmit a growth or fixed mindset (Haimovitz and Dweck, 2017). Several studies have also found that the messages students receive in school is likely to influence their mindset. Auestad (2020) found that being exposed to a math teacher with more of a growth mindset during the last year of middle school positively affected students' level of growth mindset. Kraft (2019) found large teacher effects on students' level of growth mindset.

It is important to note that mindset is not transmitted solely by direct messages, as every word and action can send a message (Dweck 2017b). Hecht et al. (2023) demonstrated a stronger link between students' growth-mindset beliefs and their learning-oriented choices when teachers conveyed that they supported a growth mindset not only through their messages but also in their class policies. Students' beliefs concerning the social goals that others (e.g., parents, teachers, and classmates) expect them to pursue are important in order to understand goal development (Liem and Senko, 2022), and it has been found that teachers whose classroom practice reflects that they recognize students' potential for growth and that they value students for more than just academic success influence students' goals and enhance their motivation and engagement (Smith, et al., 2022).

People's implicit theories are suggested to selectively facilitate how they process information that violates their predominant theory

(Plaks, Grant, and Dweck, 2005). Both those who believe that human attributes are fixed and those who believe that they are malleable showed evidence of selective processing only when their implicit theory of intelligence was violated, meaning that they tried to protect their implicit theories from invalidating information. However, these authors distinguish between theory violation and theory replacement. It appears that the foremost aim is to avoid being "left theory-less." When presented with a viable alternative theory, people were more willing to accept the new alternative (Plaks, Grant, and Dweck, 2005). Hence students will interpret experiences in the light of their current theory unless they are introduced to another theory which is default reasonable and can replace their former theory.

This has led to extensive research aimed at shifting students' mindsets through interventions (Dweck and Yeager, 2019). Most interventions teach students the metaphor that the brain is like a "muscle" which gets stronger with exercise. Interventions typically also convey messages about how people's brains grow as they confront challenging work. In recent years, interventions have shifted from face-to-face to online interventions, enabling scaling and cost-efficiency (Dweck and Yeager, 2019). Several such interventions have shown promising results impacting students' mindset and performance as well as factors such as challenge-seeking (Bettinger et al., 2018; Rege et al., 2021; Yeager et al., 2019). The effects on academic outcomes are modest, and they typically appear for students with higher levels of risk for academic underperformance (Dweck and Yeager 2019). Among high-achieving students the effects are larger for factors such as challenge-seeking.

There have been controversies regarding the concept of mindset in education. Much of the conflicting evidence from meta-studies (Burnette et al., 2022; Macnamara and Burgoyne, 2022; Sisk et al., 2018) regards intervention effects, that is, whether it is possible to change students' mindset through interventions.

However, a consistent finding across several meta-studies is that some students benefit more than others from growth-mindset interventions. Students from lower socioeconomic backgrounds and students considered at risk are the most likely to benefit (Burnette et al., 2022; Sisk et al., 2018). As a result, increased attention has been paid to heterogeneity aspects of the theory, not only to find out how different groups will respond to mindset interventions but also to better understand what contextual factors may explain the heterogeneous effects of interventions (e.g., Hecht et al., 2023; Yeager et al., 2019).

2.1.1 Theoretical origin and relationship with other motivation theories

Dweck and Yeager (2019) state that they have drawn upon earlier research on attribution theory (Weiner, 1986) when developing mindset theory, which also has elements that pertain to locus of control (Rotter, 1966). Indeed, there is a theoretical overlap between mindset theory and other theories (Burgoyne et al., 2018).

One theory resembling mindset theory is that of self-efficacy, which was developed by Albert Bandura. Self-efficacy is an individual's belief in their capacity to act in the ways necessary to reach specific goals. Students' beliefs in their efficacy in regulating their own

learning and mastering academic activities shape their aspirations, level of motivation, and academic accomplishments (Bandura, 1993). According to Bandura, people make causal contributions to their own performance through mechanisms of personal agency. Among the mechanisms of agency, none is more central or pervasive than people's beliefs about their capabilities to control their own level of functioning and the events that affect their lives (p. 119). There are four sources of self-efficacy: mastery experiences that serve as indicators of capability, comparison with the attainment of others, verbal persuasion, and psychological and affective states (Bandura, Freeman, and Lightsey, 1999, p. 79). Wood and Bandura (1989) performed an experiment to explore whether a conception of ability as a stable or acquirable skill affected thought processes and performance attainments through the self-efficacy mechanism. They found that, among students who viewed ability as an inherent intellectual aptitude, perceived efficacy dropped as they encountered problems. In contrast, the students with a malleable view of intelligence upheld their sense of personal efficacy despite struggles, and they continued to set challenging goals and used analytic strategies in efficient ways (Bandura, 1993). Interestingly, prior performance is an important part of the self-efficacy theory, and it has been found empirically that prior performance affects self-efficacy (Wood and Bandura, 1989).

2.2 Possible insights from other social-science theories on how mindsets are formed

Mindset theory is concerned with a specific part of the "explanation chain," namely with explicating the process linking beliefs about the

nature of intelligence to educational outcomes. While students' mindset is assumed to be shaped by their environment, differences by social group is not part of what the theory attempts to explain. However, performance inequalities among students are the subject of a great deal of research activity in other parts of the literature (M. Jackson, 2013). Education is a complex system, and Heggen, Helland, and Lauglo (2013) state that several theories have predictive power when it comes to explaining these differences. In general, performance inequalities are understood to be the consequence of complex interactions between educational institutions and the cultural, economic, and social resources of individuals and their families (M. Jackson, 2013). Six classes of mechanisms might be relevant to the generation of performance differences between groups: (a) genetic, (b) the home environment and its implications for economic, cultural, and social resources, (c) health and nutrition, (d) sibship size, (e) cultural biases exhibited by schools, and (f) psychological mechanisms, particularly those that come into play in the interaction with schools (pp. 12–13). The present thesis aims to investigate a psychological mechanism, as well as its relationship with family background and experiences from school.

There are several theories that attempt to explain why boys and students whose parents have a low level of education perform less well, on average, than girls and students whose parents have a high level of education (Heggen, Helland, and Lauglo, 2013). I describe some of these theories and present how they regard beliefs as an inequality-generating factor. I discuss theories where beliefs are seen to evolve as a result of messages and theories which focus upon the role of academic performance.

Explanations for working-class underachievement and middle-class success that draw upon class-specific cultures or norms very often include explicit references to beliefs (Breen, 1999, p. 466). Beliefs are also often seen as an essential ingredient of action (Boudon, 1996), explaining behavior.

Martinussen (2016) identifies two main categories of sociological explanations for meaningful behavior: choice explanations and adjustment explanations. The basic model is that individuals, with varying degrees of consciousness, seek to make the best of the situation in which they find themselves. The theories used to describe social phenomena can be placed on a continuum from structure theories, dealing with social life *conditions*, to agency or actor theories, focusing on the *intentions* of social actors (Martinussen, 2016).[3] Gambetta (1987) points out how the dominant tendency in studies of educational behavior has been to embrace either the idea that reproductive forces are overwhelming, and that people are pushed into given destinations, or the idea that people are rational and choose what attracts them the most. Choice explanations are on

[3] In addition to the "agency–structure continuum of theories," there is also a "holism–atomism controversy" concerning whether societal patterns should be regarded as complex social wholes with their own logic, or merely as the sum of the "atoms" (actions, individuals, groups, etc.) of which they are composed (Martinussen, 2016). The theories that I present here all belong to the atomism side.

the "agency" side: they suggest that actors compare their various options in specific situations and select the action that yields the best outcome, given the costs involved. On the "structural" or adjustment side, actions are instead regarded as socialized and automated to a much greater extent (Martinussen, 2016). For simplicity, I will use the concepts of "structural" and "agency" theories in the following. It is worth noting that both categories belong among theories proposing that social patterns of development or reproduction are the sum of individual actions in different social groups and categories. In other words, they are not holistic theories (see footnote 3)—which can also be either structure- or agency-oriented (Martinussen, 2016).

2.2.1 Structural theories

Pierre Bourdieu's work is a comprehensive theory of educational inequality which theorizes the relationship between the "social" and the "cognitive" (Lizardo, 2019).[4] In Bourdieu's theory, the practical beliefs of individuals will be closely related to their habitus and their cultural capital. In parts of the literature, this is termed "embodied cognition" (Lizardo, 2019). Here I will focus only upon how family background shapes *beliefs*.

4 I place Bourdieu in the structural approach, but I am fully aware that others, for instance Martinussen (2016), argue that Bourdieu, in his theory of the reproduction of educational inequality, attempts to bridge the gap between structure and agency theories.

Bourdieu and Passeron (1979) take a very specific view of how cultural reproduction works. They describe how a mother from the lower classes imposes damage upon her son when she says, for instance, that "he's not good at math" in front of him (p. 72). She then intensifies the child's sense that he is bad at math by nature by using simple test scores as the basis for definitive conclusions. Finally, she also makes an individual destiny out of what is only the product of education and could still be corrected.

This reasoning suggests that having fewer socioeconomic resources will be associated with a tendency to develop more of a fixed mindset when encountering educational struggles, because the messages that such students receive from their parents will intensify their sense that they are low performing by nature. Bourdieu claims that the further down you go on the social scale, the more likely people are to believe in natural talent: that those who do well in school are naturally endowed with intellectual capacities to do so (Eagleton and Bourdieu, 1992). Bourdieu's theory is on the reproduction of educational inequality (Martinussen, 2017).

Other structurally oriented theorists go a step further and argue that schools do not simply *reproduce* the inequality that has been generated in the home environment but rather *intensify* it (Downey and Condron, 2016). Within the domain of critical sociology of education, education is often viewed in relational terms, as a competition with winners and losers (Reay, 2009). Reay suggests that, within the highly individualized and competitive cultures that characterize modern society, large sections of the working classes are pathologized as unmotivated, unambitious, and underachieving. She points to what she calls the psychosocial dimension of class in education and

illustrates it with quotes from working-class students who experience teachers who look down on them and think they are dumb. This in turn leads working class children to see themselves as losers in the educational competition. Hence, Reay (2009) identifies the schools as the main inequality-generating—or inequality-exacerbating—mechanism.

Gender differences are also theoretically understood in terms of structure or agency theories. Nielsen (2017, p. 270) describes how Bourdieu proposed that the gendered body should be seen as a social construction produced by the symbolic violence of gender domination, employing his concept of habitus in the sense of learned bodily dispositions. A more common approach today is to view gender as a social process where it is difficult to distinguish between gendered individual preferences and the independent impact of cultural beliefs about gender (Reisel and Seehuus, 2023). While some scholars have argued that, at a structural level, schools are not adapted to boys' needs, Backe-Hansen, Walhovd, and Huang (2014) conclude that explanations at the systemic level, especially explanations related to the feminization of school, seem to have become less frequent in recent years.

2.2.2 Agency or actor theories

A different perspective is reflected in agency-oriented theories such as the rational-choice approach. Boudon (1996) opposes the socialization explanation and argues that socialization can never be the only cause of beliefs. When students form beliefs based on what they are taught, this is because they consider those beliefs to be grounded in solid reason

(regardless of whether they can be validated or not). In agency theories, the focus is upon the reasons that students have for their behavior. Most rational-choice models argue that beliefs about academic ability influence the expected benefit or utility of different educational decisions (Holm, Hjorth-Trolle, and Jæger, 2019).

The rational-choice models have been criticized for having little to say about how collective beliefs can be explained (Boudon, 1996). Against this background, Breen (1999) has proposed a theoretical model for how beliefs evolve in the light of experience, showing how this theory may be relevant in explaining social reproduction as well as the gender gap.

Breen employs a Bayesian learning model in which people act in accordance with the beliefs they hold about the nature of the world and modify their beliefs based on observation of the outcomes of their actions. One starting point in this context is that students have imperfect information about the way the world works. They act on the basis of provisional beliefs, and these beliefs are modified over time according to the mechanism of "Bayesian learning" in the light of their experience.

Breen examines beliefs regarding the relative importance of ability and effort for the probability of success in school. He then models how these beliefs are adjusted through the outcomes of educational performance. Since educational performance is dependent, among other things, on students' effort, those who believe effort is not important will perform poorly. If there is a transmission of beliefs over generations, the parents' beliefs will become those of their children's when they enter school. This implies that students of

parents with a low level of education start their educational careers with somewhat weaker beliefs in the importance of individual effort. This, in turn, leads to class differences in rates of educational success—not because of poorer ability[5] but because of the differing beliefs about the role of effort. This reasoning also resembles mindset theory, in which a key point is that students who believe that intelligence is malleable will show higher effort. However, in mindset theory, beliefs are not modified on the basis of signals from performance.

In other agency theories, students' motivation is considered important. For instance, these theories question the universality of the performance norm, instead suggesting that some students are content with achieving lower grades and that students from lower socioeconomic backgrounds value education less than students from higher socioeconomic backgrounds do (Heggen, Helland, and Lauglo, 2013). These views are more in line with economic theories on *motivated beliefs and reasoning*, suggesting that people hold certain beliefs in part because they attach value to them as a result of an often implicit compromise between accuracy and desirability (Bénabou and Tirole, 2016). Such beliefs are resistant to many forms of evidence and result in non-Bayesian behavior. Further, Eil and Rao (2011) suggest that positive signals lead to a tighter adherence to Bayesian rationality (confirming beliefs), while unfavorable signals are heavily discounted.

[5] Breen (1999) claims that any ability differences that might exist between classes would not affect the model.

As mentioned above, Breen (1999) presents beliefs regarding the relative importance of ability and effort as relevant also for the gender gap in achievement. Burton and Bartlett (2020) claim that boys' motivation, attitudes, and performance have been particularly highlighted in research on the gender gap. As a group, girls seem to be more motivated to study than boys (Backe-Hansen, Walhovd, and Huang, 2014). It has also been found that, on average, girls have better self-regulation than boys (NOU, 2019:3). In a study of adolescents, Ommundsen (2003) tested the theoretical assumption that motivational beliefs about intelligence can lead to different patterns of cognitive engagement and achievement. He found that a belief in the malleability of intelligence was positively related to students' use of self-regulatory learning strategies in physical education. Boys in this study were more likely to believe that ability is a natural gift than girls were (Ommundsen, 2003).

DiPrete and Buchmann (2013) present research confirming that girls have higher levels of social and emotional skills that are valuable in attaining higher levels of academic performance. Girls, on average, put forth more effort than boys and show greater levels of attachment to school. This may give them stronger incentives to do well in school because stronger attachment to school means that gratification from school performance is also stronger. These advantages reinforce each other as children become adolescents (DiPrete and Buchmann, 2013).

In early works, Dweck claimed that girls with a high IQ and strong school performance were especially likely to have a higher level of fixed mindset, but this has not been found to be the case in later empirical investigations (Macnamara and Rupani, 2017). Research

has found mixed results in terms of gender differences in mindset (Joy et al., 2023). However, the messages that boys and girls receive may be important in this context. Oyserman et al. (2017) present an identity-based motivation framework and research in which it is found that children imagined more school-focused future identities if educational success was presented as characteristic of their own gender. These students were presented with different messages: one showed that men have higher earnings than women (the "men succeed" condition) while another showed that women graduate at higher rates than men (the "women succeed" condition). Walkerdine (1990) claimed that attributions of boys' and girls' performance are highly gender-specific. Yee and Eccles (1988) found that parents are more likely to attribute successful math performance to effort for their daughters and to talent for their sons, a finding replicated by Räty et al., (2002). This could imply that boys and girls receive different messages for similar school performance.

2.3 Rounding up the theoretical approach

Mindset theory proposes that beliefs play a role for motivation and behavior tendencies which in turn affect learning outcomes. While this theory refers to socialization and messages from parents or teachers as important for the mindset that students develop, there is no particular reference to one of them being more important, nor to any group differences in the likelihood of developing certain kinds of mindset orientations.

I have shown that in other social-science theories, the processes presented that may account for the reproduction or exacerbation of

educational inequality are often consistent with the view that the *messages* students receive will differ according to gender or family background. The theories focusing on social reproduction claim that the messages students receive at home from their parents will contribute to the students' beliefs regarding their learning abilities, while the critical perspective places greater emphasis on the messages that students receive from their teachers. While none of these theories concerns the mindset concept as such, there are similarities in the processes they describe for how students form beliefs about their learning possibilities.

In the other theoretical approach that I have presented, it is claimed that beliefs about ability evolve in light of experience (school performance). I have also presented theories suggesting that people hold certain beliefs because they attach value to them, which is likely to make these beliefs more resistant to evidence. In the present thesis, I have relied on these contributions to develop my research hypotheses and research questions regarding the relationship between social background/gender and academic mindset.

3 Methodology

The articles in this thesis are all based on data from the Norwegian high-school context. This section first gives a brief introduction to the Norwegian education system and the U-say project, which provided the data material for my thesis. This is followed by a description of the statistical analyses performed as well as a discussion of the validity and reliability of the mindset concept, ethical considerations, and limitations of the research.

3.1 The Norwegian education system

Formal schooling in Norway starts in the fall of the calendar year in which children turn six years old.[6] Education is free and founded on the principle of equity and adapted education for all students. Compulsory education is provided by municipalities and lasts for ten years: seven years of primary education and three years of middle school (also called lower-secondary school). At the end of middle school, all students must be drawn to a central, written exam.

Those having completed middle school may enroll in high school (or upper-secondary school), for which counties are responsible. High school is not mandatory, but middle-school graduates are entitled to

[6] This presentation is based on the Eurydice overview of the Norwegian education system https://eurydice.eacea.ec.europa.eu/national-education-systems/norway/overview

three years of high-school education on the academic track or four years on the vocational track.

The process for admission to high schools is determined by the County Council, a political body. There are essentially two regimes that may be used. Under one of them, students are admitted to the high school closest to their home that offers their preferred education program. Under the other regime, students compete for places based on their grade-point average (GPA) from middle school, either within the county or within school districts in the county. Both of the counties represented in the data material for this thesis follow the latter regime—admission based on grades—but within regional subdivisions of the respective county.

Under each admission regime, students are entitled to be admitted to one of the top three education programs that they apply for. Students apply to high school during their last year of middle school and rank their preferred education programs in their application. In 2017, students entering the first year of high school could choose among five education programs on the academic track and eight programs on the vocational track. Starting in the fall of 2020, the number of education programs on the vocational track was increased to ten.

Studies on the academic track consist of three years spent in school and lead to a university-admission qualification. Vocational education and training normally lasts for four years, of which the first two years are school-based and the last two are work-based in the form of an apprenticeship.

Approximately 50 percent of all students enroll in a vocational study program when they enter high school. However, many of them eventually obtain a general university-admission qualification by completing "supplementary studies." Around 20 percent of students on vocational study programs begin a one-year Supplementary Studies program after the second year. Students may also take ther course of Supplemental Studies after they have completed the apprenticeship period and passed their trade or journeyman's examination.

Compulsory school and high school are governed by the (Primary and Secondary) Education Act and the national curriculum. The Norwegian parliament sets overall national goals for the education sector, but the administrative structure is decentralized, with considerable authority and financial freedom of action being delegated to the municipal and county levels. County and municipal authorities determine their activities in accordance with the existing legislation and regulations; they allocate resources that they receive as block grants from national authorities.

3.2 The U-say project

The data material for the three articles in this thesis was collected as part of the U-say project, a project concerning innovation in the public sector which was funded by the Research Council of Norway. The Rogaland County Council received funding from the Research Council's "FINNUT" program for the project in 2016. The University of Stavanger carried out the research project in collaboration with researchers from other institutions. Two counties

participated in the project, providing data on their entire populations of students in the first year of high school (subject to school agreement). All schools (N=58) except one participated in the project.

The transition to high school can be a new start and a turning point for many students. The psychological intervention made in the project was intended to increase students' motivation and instill the confidence that they would need to go through the transition. For this reason, it targeted experiences of difficulty or confusion in the crucial first few months of high school.

The U-say project is a large, randomized control trial (RCT) designed to foster a growth mindset in students. The intervention had been developed in the United States (Yeager et al., 2016) but was carefully adjusted to suit the Norwegian culture and context. Students participated in the first session during the first two weeks of their first year of high school. The intervention was delivered as a web-based computer program and infrastructure as part of instruction, during school hours. Before starting the intervention program, students stated whether they consented to participate in the study; 90.8 percent of them gave their consent. U-say consists of two online sessions, administered approximately four weeks apart and each lasting for about 45 minutes. The intervention sessions of the program are now available for all high-school students in Norway, free of charge.

The intervention sessions in U-say communicates the growth mindset to students. It teaches students about research in neuroscience that demonstrates the brain's potential to grow and change, as well as the

implications of this fact—that it is a normal part of the learning process to be confused or stumble. U-say teaches students that, by coping with difficulty and confusion, you can in fact grow new connections in your brain. To communicate this message, U-say uses a metaphor, which teaches the students to think of their brains as muscles that become stronger as they are exercised. U-say visualizes how new neuronal connections grow as students complete hard math problems. The research project included a control group, whose members also underwent a website session, but one focusing on the memory function of the brain.

To analyze the effects of the intervention in the U-say project, a large data material was collected. The data material consists of survey data from the intervention study and registry data. In the present thesis, I use only survey data from the time prior to the intervention. The registry data come from Statistics Norway and the county administrations. From Statistics Norway, the researchers received information about the students (number of siblings, birth order, etc.) and their parents (country of birth, level of education, income, marital status, etc.) in cases where students consented to participate in the study and their parents did not actively withdraw their consent. Very few parents refused to let this information be used. The county administrations delivered data on grades from middle and high school as well as information on completion of high school, also only for those students who consented to participate in the study. Data were provided by the counties at the start of the project (August 2017), after the first semester (January 2018), after the first year (July 2018), after the second year (July 2019), and after the third year (July 2020). In Figure A1, the data points I use from the data

material are plotted. These data were all collected after the survey data, and the students' consent had been secured.

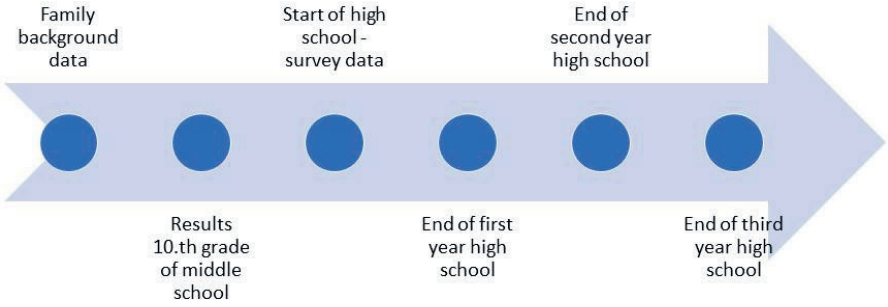

Figure 1 Timeline for the data points in the data material

3.3 Statistical analyses

The aim of the present thesis is twofold. On the one hand, it is to investigate how factors such as social background and gender are associated with students' level of fixed or growth mindset. On the other hand, it is to investigate high-school outcomes through factors that have previously been investigated in relation to inequality, but with the additional inclusion of mindset as an independent variable. In this sense, I have studied factors that have previously been examined in relation to the dependent variables, but not in relation to mindset as an independent variable.

The articles describe specific exclusion criteria for each study. In Articles Two and Three, a data set consisting only of those students who transitioned directly from middle school to high school in the starting year of the study was used.

In Articles One and Two, my focus is on individual-level relationships, while in the Article Three my coauthor and I focus on

within middle-school classroom effects. The data are inherently multilevel since they are hierarchical. Examples of hierarchical data include students within schools, or survey respondents within countries (Gelman, Hill, and Vehtari, 2020). What counts as a group depends on context. In my first article I use random effects at the middle- and high-school levels, and in my second article I use random effects at the high-school classroom level. In the third article, my coauthor and I use middle-school classrooms nested within middle schools.

The underlying assumption that the observations are independent is violated if the data are hierarchically structured, and there is in fact reason to believe that the context may influence the outcomes: the shared context introduces a correlation between two individuals from the same school or classroom (Leyland and Groenewegen, 2020). Ignoring the clustering of individuals within higher-level units leads to an overestimation of the effective sample size and hence to a tendency to find more relationships that are significant at a given significance level than the data can really support (p. 31). For Article Three, the choice of a multilevel approach is an obvious one, since we examine classrooms within middle schools. For Articles One and Two, I used tests to determine whether a multilevel approach would be better than the pooled estimators. In Article Two, the decision was based on the log-likelihood ratio test of rho. This test was significant, suggesting that multilevel logistic regression which takes into account the panel structure of the data is a better choice than logistic regression on the population as a whole. This is also the finding made in Article One, where the LR test of the multilevel

model versus a linear model showed that the multilevel approach is a better fit.

In all articles, I use regressions with multiple predictors. This is sometimes described in shorthand as comparing two students (or, more generally, two observational units) that differ in one variable with all the other predictors held constant (Gelman, Hill, and Vehtari, 2020). I have used variables known to predict grades and high-school completion. For social-background investigation, parents' level of education was used. The variable provided by Statistics Norway was recoded into four categories: less than high-school education, high-school education, bachelor's degree and master's/Ph.D. In Article One, I used the parents' highest education level; in Article Three, we used only the mothers' education level. In Article Three, the mother's level of education was recoded into a binary variable: "high" socioeconomic status when the mother held a bachelor's degree or higher and "low" socioeconomic status when the mother's highest level of education was lower than a university degree. In the first two articles, I used students' GPA from middle school as an independent variable. GPA includes both grades awarded by teachers and grades earned on exams, but the majority of the grades included are awarded by teachers. In Article Three, we used only exam grades to measure classroom achievement.

All three articles can be said to use both a cross-sectional and a longitudinal panel design. While GPA from middle school is from the end of tenth grade and mindset is measured in the first few weeks of high school, and hence typically one summer vacation apart, I treat these measures as being from the same measurement occasion.

3.4 Mindset measure: Validity and reliability

Construct validity is high when what we measure is (more or less) exactly what we want to measure. Students' mindset is a construct that cannot be measured directly, meaning that there is a need to rely on the students' self-reports. One precondition for high validity is high reliability; trustworthiness in that repeated measures would yield the same result (Ringdal, 2018). The items measuring mindset in the "Implicit Theories of Intelligence Questionnaire" have been found to have high reliability across several studies (Burgoyne and Macnamara, 2021). This is the questionnaire used in the U-say project.

To build a mindset measure in Articles One and Two, I use students' responses to two items: "You have a certain amount of intelligence, and you really can't do much to change it," and "Your intelligence is something about you that you can't change very much." The correlation between these two items is .7 and Cronbach's alpha is .83. In Article Three we added a third item: "Being a 'math person' or not is something that you really can't change. Some people are good at math and other people aren't." Students responded to all three items on a six-point scale ranging from "strongly agree" to "strongly disagree." Cronbach's alpha for the measure with three items is .72. Both Cronbach's alpha scores suggest a good level of internal consistency.

Reliability can also be affected by the quality of data collection. In this project, the students answered the questions themselves, and their response data were directly linked to their ID number in the

database. Consequently, there is reason to believe that the accuracy of the measurement is very good.

While reliability concerns the traits of the indicators used, validity concerns the relationship between the indicators and the theoretical construct of interest (Ringdal, 2018). High construct validity implies that we measure the theoretical concept that we want to measure. Duckworth and Yeager (2015) present research findings on the process by which students answer research questions, describing how threats to validity can arise as a result of potential failures at each stage of this process. Students must read and understand the question, then search their memories for relevant information, then integrate whatever information comes to mind into a summary judgment, and finally translate this judgment into one of the response options given. These authors refer to expert claims that validity is not an inherent feature of the measure itself, but rather a characteristic of a measure with respect to a particular end use. High content validity implies that the indicators cover the most important aspects of the concept (Martinussen, 2016). In their article, Duckworth and Yeager (2015) claim that all measurements have weaknesses, and this is of course true. In the present case, I think the validity of the mindset concept is high when it comes to measuring the *beliefs* that the students hold, but that it may be questionable whether the items used also measure the narrative frameworks following from mindset theory, with meaning systems affecting how students approach challenges, etc. These are assumptions following the theoretical framework, but they are not directly measured here. This also implies that my thesis primarily provides empirical

descriptions of differences in the beliefs that students hold about intelligence, not in how students act upon these beliefs.

3.5 Ethical considerations

The overarching research project was approved by the Norwegian Center for Research Data (NSD)—now known as Sikt–Norwegian Agency for Shared Services in Education and Research (project number 47205). As part of the approval process, a Data Protection Impact Assessment was developed.

The sessions with the computer program were mandatory for the students and constituted part of the instruction they received. However, prior to the sessions, the students were informed that participation in the research project was voluntary. The students gave their consent as to whether their answers and registry data could be used for research. Their parents were also offered the opportunity to refuse to let the project use the data from Statistics Norway on family-background variables.

In 2023, the research group of the U-say project applied to extend the period during which the data set can be used for research from 2024 to 2030. A letter was sent by Rogaland County Council to all participants, asking them to confirm their consent. Most informants did so, but 47 individuals withdrew the consent that they had given in 2017. The extended project period has now been approved by Sikt.

3.6 Limitations of the research

One clear limitation of this research is that it does not detect causal relationships. My first two articles are correlational, and while the third one does have a causal approach, this is conditional upon several assumptions. Further, classroom effects in Article Three are evaluated relative to the average quality of classrooms within the same school, with similar students, not relative to the overall population.

It is also a limitation that students' expressed level of academic mindset was measured only once. The thesis does not detect if students' views on the nature of intelligence change or remain the same in high school relative to the start of the first year.

What is more, I focus on the students' beliefs about the nature of intelligence, but I do not measure the narrative framework expected to follow from those beliefs. For instance, I do not measure whether students with a fixed mindset really are concerned with proving their ability rather than improving it and have lower effort beliefs than students with a growth mindset. In the third article, my coauthor and I investigate choices made ahead of and in high school, and we find signs that students from classrooms with a higher level of growth mindset are more inclined to take on challenges, but this is not a validation of the theory as such.

It can also be regarded as a limitation that I focus only on mindset. Ideally, it would be of interest to test a broader set of socioemotional variables, including for example perseverance and self-efficacy. This

could have been useful in order to increase our understanding of gender differences as well as differences according to social background.

On a similar note, the thesis does not analyze aspects of intersectionality, as could have been preferable given the theoretical recognition of the importance of the intersection of multiple inequalities (Walby, Armstrong, and Strid, 2012). This would have meant analyzing, for instance, how interactions between gender and family background matter. It has been claimed that boys whose parents have a low level of education are at a "double disadvantage" in the education system (NOU, 2019:3): on average, they have a lower GPA both because they are boys and because their parents are less educated. Investigating intersectionality would have required a different approach from the one I use in this thesis, but this could be an issue for further research. Further, although I have not focused on interactions between gender and family background in any published results, this issue has in fact been investigated in supplemental analyses where no interactions of relevance to my research questions have been found. Such supplementary analytical findings include, for instance, that the relationship between mindset and middle-school GPA on predicted completion in Article Two was the same for boys and girls whose parents had the same level of education.

4 Results and discussion

In this section, I first present the findings from the articles in the thesis, which examine specific research questions concerning social background, gender, and classroom environment. Following this, the overall research questions presented in the Introduction are discussed. The aim of my research was to empirically investigate students' beliefs about learning possibilities: whether they believe that intelligence is a stable trait or something that is developed during schooling. I used mindset theory to investigate how students' mindset upon entry to the first year of high school relates to their high-school outcomes. In addition, I investigated the relationship between the level of growth mindset and various factors known to be relevant for inequality in education, mainly social background and gender. I also investigated how these aspects are associated with performance in middle school. Empirically, this has been straightforward to investigate. Theoretically, however, it has been more challenging, since mindset theory does not include a theory concerning the processes that may account for the observed inequality according to gender and socioeconomic background. During my work on the thesis, I have tried to obtain a better understanding of the fundamental relationships and I have used mindset theory as well as other theories to develop research questions and to discuss the findings.

4.1 Specific research questions

4.1.1 Summary of findings, Article One

Mindset as a potential link between family background and high-school achievement

The investigates how academic mindset is related to family background and performance in middle and high school. It is well documented that, on average, students whose parents have a low level of education perform less well in middle and high school (Andersen and Hansen, 2012; M. Jackson, 2013). While the persistence of inequality in school performance according to family background has been a policy concern for many years, the mechanisms invoked to explain differences in academic performance often relate to properties of individuals, families, and societies that are difficult to change (M. Jackson, 2013). Based on a growing literature suggesting that that the relationship between family background and academic achievement is mediated in part by psychological mechanisms (Destin et al., 2019), I investigate the mindset concept, which is supposed to be malleable, and which can be taught. The specific research questions in this study are:

1. How are family background and middle-school grade point average (GPA) related to the level of fixed mindset when students enter high school?

2. Is there a relationship between the level of fixed mindset when students enter high school and their achievement after the first year?

The study is based on multilevel regression analysis and investigates the relationship between parents' education and students' GPA from middle school in predicting the level of fixed mindset when students enter high school. Next, I investigate how mindset and middle-school GPA relate to high-school achievement.

Concerning the first research question, I found that the predicted level of fixed mindset was higher for students whose parents had a low level of education. However, I also found that there was a significant interaction between family background and middle-school GPA in predicting the level of fixed mindset. Students who were high-performing in middle school expressed low levels of fixed mindset irrespective of parents' education. Among low-performing students, the predicted level of fixed mindset was higher among students whose parents had a low level of education. These findings parallel findings in the literature pertaining to the rational-choice framework, suggesting that signals about academic ability, communicated via GPA, are stronger for students from families with low socioeconomic status than for students from families with high socioeconomic status (Holm, Hjorth- Trolle, and Jæger, 2019).

Concerning the second research question, a higher level of fixed mindset on entering high school is related to lower achievement after the first year. Further, I found that the level of fixed mindset interacts with parents' education in predicting high-school GPA in models without conditioning on prior performance, but not when students with similar GPA from middle school are compared. This finding may potentially reconcile discussions in the literature (Claro, Paunesku, and Dweck, 2016; Destin et al., 2019) on whether or not holding a growth mindset is more beneficial for students from low

socioeconomic backgrounds, namely by suggesting that this matter is related to students' prior educational outcomes.

4.1.2 Summary of findings, Article Two

Growth mindset, prior performance, and high-school completion for boys and girls.

In Article Two, I investigate differences according to another social category: gender, that is, boys versus girls. Here the mindset measure is inversed, so that I investigate the level of *growth mindset*. It is well known that, on average, girls outperform boys, and this gender achievement gap is also a policy concern. We know that GPA from middle school is a strong predictor of high-school completion. However, less is known about how students' level of growth mindset is associated with GPA and completion. The article seeks to answer the following research questions:

1. At the start of high school, what is the relationship between academic achievement in middle school and students' level of growth mindset? Is the relationship different for boys and girls?

2. To what extent is the level of growth mindset at the start of high school predictive of completion of the first year of high school? Is the relationship different according to prior performance and gender?

In the article, I further examine the relationship between GPA from middle school and the level of growth mindset when students enter

high school which was found in Article One. Second, multilevel logistic regression is used to investigate how GPA from middle school and the level of growth mindset when students enter high school predict completion.

I find that a higher GPA from middle school is associated with a higher level of growth mindset among boys as well as girls. This association is cross-sectional and could be due to a higher level of growth mindset in middle school causing higher performance in middle school, as proposed by mindset theory (Dweck, 2017b). However, higher levels of academic mindset could also be due to experiences in middle school, or to the case that GPA may reflect more than basic skills.

Next, this study shows that students' level of growth mindset is positively associated with completion of the first year of high school. Since the level of growth mindset is higher among students who were higher-performing in middle school, the relationship between growth mindset and completion is weaker when similar-performing students are compared. Nevertheless, the growth-mindset measure does contain information that is independent of academic achievement (C. K. Jackson, 2018). A higher level of growth mindset upon entering high school significantly predicts high-school completion, even among students with similar GPA from middle school. Moreover, the average marginal effect of a one-unit change in growth mindset on predicted completion is highest among the students who were lowest-performing in middle school. The average marginal effect of growth mindset is also similar for boys and girls with the same GPA from middle school. The results suggest that while low-performing students, on average, express low levels of growth mindset, the ones

who do express more of a growth mindset have a higher predicted completion rate in high school than other low-performing students.

This article does not follow the often-used focus upon average differences between boys and girls. Rather, it explores and describes how a growth mindset is positively associated with a higher performance in middle school among boys as well as among girls. As Nielsen (2017) notes, the variation within each gender group is often larger than the average difference between boys and girls. This is also a finding in my study, and the findings indicate that low-performing students with low levels of a growth mindset may benefit less from learning opportunities in school regardless of their gender. I think more studies focusing on gender differences could include analyses of variation among boys and girls, as this might help us understand more about the emergence of the gender achievement gap.

4.1.3 Summary of findings, Article Three

Long-Term Classroom Effects on Academic Choices. Coauthor: Maximiliaan W. P. Thijssen

In Article Three, my coauthor and I examine the impact of classroom effects on mindset within the same middle schools and explore how those effects influence students' choices in high school. It is well-known research finding that social effects—the average behavior in a group influences the behavior of the individuals in the group—exist for academic achievement (Manski, 1993). A broad literature documents that the classrooms attended by students influence their academic skills (Rivkin and Schiman, 2015; Rockoff,

2004). Recent research has also investigated such effects for growth mindset (Kraft, 2019), but less is known about how these effects benefit future academic success. Hence, our understanding of how classrooms promote social and emotional skills remains limited. Important factors found to shape classroom effects in the literature are teacher effectiveness, the relationships between teachers and students, the classroom climate, and the organization of the classroom. Teachers can influence all these factors, and they also teach socioemotional skills to the students. However, teachers vary in their capacity to promote academic skills and can also be expected to vary in their ability to promote socioemotional skills (Jennings and DiPrete, 2010). We investigate the classroom effects on growth mindset and achievement during middle school and how classroom effects on mindset predict academic choices in high school. In this study, we seek to answer the following research questions:

1. Are there differences in classroom effects on growth mindset and academic achievement across classes within middle schools? Is there a correlation between classroom effects on growth mindset and classroom effects on academic achievement?

2. Do classroom effects on growth mindset affect long- term choices in high school? Do these effects differ across socioeconomic background and gender?

Previous studies have used a similar approach as this study to investigate research question 1 as pure teacher effects, while stressing that the effects they investigate cannot be distinguished from peer effects or other effects (C. K. Jackson, 2018; Kraft, 2019).

Those studies applied a framework where the teacher is identifiable. They also studied lower grade levels, where students are exposed to the same teacher most of the time. In Norwegian middle schools, teachers will vary by subject, but the students belonging to the middle-school classrooms in our sample still spent 85 percent of all periods together as a unit, suggesting that the classroom environment does produce social effects relevant not only for academic achievement but also for socioemotional skills. The effects we measure in this analysis may be attributable to the teachers, to peers, and to other factors in the students' classroom environment. A key assumption for identifying these effects is that the students are randomly assigned to classrooms within schools. We test this assumption and find no evidence of sorting within schools.

The study reveals that classrooms vary in their capacity to cultivate students' growth mindsets. The overall correlation between classroom effects on growth mindset and academic achievement is positive. However, this correlation is modest, and some classrooms that strongly foster growth mindsets do not strongly impact exam scores and vice versa. Further, an increase of one standard deviation in classroom effects on growth mindset is found to increase the probability of choosing academic track over the vocational one in high school and the probability of choosing advanced math. The effects on choice of track in high school are particularly evident for girls. On the other hand, students from households with lower socioeconomic status exhibit a reduced likelihood of high-school dropout when exposed to a one standard deviation increase in classroom effect on students' mindset.

4.2 Overarching research questions

While the individual articles discuss specific research questions, this section attempts to provide a more integrative discussion of the results in relation to the overall research questions of the thesis.

4.2.1 Does students' level of growth mindset when they enter high school differ according to social background, gender, and middle-school experiences?

The thesis provides empirical evidence of students' beliefs regarding the nature of intelligence. I document in Articles One and Two that, upon entry to high school, boys and students whose parents have a low level of education express significantly lower levels of growth mindset than girls and students whose parents have a high level of education. However, I also describe that this is related to their performance in middle school. Students who were high performing in middle school express high levels of growth mindset regardless of their gender and their parents' level of education.

The first two articles in the thesis are correlational in nature and do not aim to draw causal conclusions. However, the PISA 2018 report found the same associations between higher levels of growth mindset and performance. It is noted that these findings would seem to support theories which maintain that instilling a growth mindset in students can result in stronger academic performance, but that other interpretations are also possible (OECD, 2019). For instance, it is suggested that holding a growth mindset could be the result of high

academic achievement, rather than the other way around. High achievers may be more likely to know—precisely because they are high performing—that human intelligence is malleable. They are also more likely to be conscious of how their intelligence has grown over time (OECD, 2019). I share these reflections, and I discuss in Articles One and Two how other social-science theories would suggest that prior performance serves as a signal to students about their ability and is likely to influence their beliefs. However, both of those articles suggest that students' level of growth or fixed mindset is worthy of further investigation in the education sector and could potentially be identified as an inequality-generating mechanism relevant to the gender achievement gap as well as to the achievement gap related to parents' education.

Article Three investigates growth mindset in the framework of skill formation. In this article, we investigate whether some classrooms within middle schools cultivate a growth mindset in students more than what can be explained through random variation. The study shows that classrooms produce multiple educational effects. This suggests that socioemotional skills are important educational outcomes. If human capital is defined as the skills capable of generating a return in the education sector and the labor market, socioemotional skills must necessarily be seen as a form of human capital, not dissimilar to mathematical or reading skills (Jennings and DiPrete, 2010). However, the competence and contextual factors needed to foster different types of skills may of course differ (Jennings and DiPrete, 2010).

As noted in the Theory section, the part of the explanation chain that mindset theory purports to elucidate is the relationship between

mindset and educational outcomes. However, it is also a fundamental part of this theory that schools can develop students' mindset. Dweck (2017b, p. 5) refers to Alfred Binet, the inventor of the IQ test, who (without denying individual differences in intellect) firmly believed that schools could bring about fundamental changes in children's intelligence. It is well documented that even gene expressions are mediated by context, as genes need sufficiently rich environments to fully express themselves (Heckman and Mosso, 2014). In a recently published study, Cheesman et al. (2022) document that higher-performing primary schools in Norway compensate for genetic effects among students with a genetic disposition for learning difficulties. In lower-performing schools, however, the starting differences in genetic endowment were magnified and students with a genetic disposition for learning difficulties attained a substantially lower level of achievement. This implies that schools can make a major difference to the achievements of students with a genetic predisposition for learning difficulties (Cheesman et al., 2022). It would have been interesting to investigate whether differences in how schools teach students socioemotional skills that are important for making use of learning opportunities could play a role for these processes.

Current policy does not include social and emotional skills as an area which could be strengthened in order to reduce educational inequality. In a white paper (Ministry of Education and Research, 2019a p.21), the government presents the following statement:

"The government is clear that it is the pupils' efforts, engagement and talent that should determine how well they do at school, not their

gender, where they live, their parents' education or income or which country their parents were born in."

This seems to imply a view that efforts, engagement, and talent are independent of social background and gender. However, the results of this thesis suggest that students' beliefs about learning possibilities are not independent of gender and social background. Rather, they suggest that addressing students' beliefs about intelligence could influence their levels of effort and engagement. This, in turn, could affect students' performance as well as their intelligence, and possibly reduce inequality. As noted in Article Two, Restad and Mølstad (2021) claim that Norwegian policymakers have a narrow understanding of socioemotional skills and underestimate these aspects of students' learning. While many teachers enhance students' beliefs and learning through their approaches to help students solve challenging tasks and problems, we also know that there is large variation in such instructional support in Norwegian middle schools (Lerang, Ertesvåg, and Virtanen, 2021). Allodi (2010) claims that the characteristics of the psychosocial environment of educational settings have been neglected in educational policy and practice. This finding has been made repeatedly despite extensive evidence of the role played by classroom climate in improving educational results and inclusive education, as well as in preventing school failure, bullying, dropout and psychological illness (Allodi, 2010). This is due to a "dualistic" view where classroom climate is regarded as somehow opposite, and also subordinate, to the goals of increased learning quality and good results. Jennings and DiPrete (2010) discuss how teachers vary in their valuation of academic and socioemotional skills, which generates differences in how much they emphasize the

teaching of each type of skill. The empirical findings in this thesis suggest that socioemotional skills are more important than is commonly acknowledged in current policy and practice.

4.2.2 Does students' level of growth mindset upon entry to high school matter for their high-school outcomes?

In summary, the present work provides empirical support for academic mindset as a factor predictive of grades and completion in high school in the Norwegian context. Students who hold a higher level of growth mindset (or a lower level of fixed mindset) when they enter high school are predicted to attain higher grades in high school, and graduate from it to a larger extent, even compared with students who had a similar GPA in middle school. Mindset theory proposes that beliefs about the malleability of intelligence shape students' motivation and action tendencies, and the associations found in this study support such a view, although the analyses do not detect causal relationships.

The empirical findings could suggest that low-performing students benefit less from learning opportunities in high school since, on average, they have more of a fixed mindset. While students with a growth mindset believe that they can develop their competence by working hard, using good strategies for learning, and asking for help, students with a fixed mindset tend to relent when facing challenges. Less help-seeking among low performers has been found in other parts of the literature. For instance, Ryan, Hicks, and Midgley (1997) document that the students who need help the most are the least

likely to seek it. When low-performing students in the study by Ryan, Hicks, and Midgley (1997) endorsed performance-oriented goals (as opposed to a mastery-oriented goals), the difference became even greater (Ryan, Hicks, and Midgley, 1997).

In Article Two I also find that the average marginal effect of growth mindset on the predicted probability of completion is higher among low- performing students. Article Two does not shed any light on who these students are. However, it is an empirical finding from Article One that, among the low-performing students, the proportion holding more of a growth mindset is higher among the students with highly educated parents.

Further, in Article Three, my coauthor and I document long-term effects in high school of classroom effects on growth mindset. The study shows that such classroom effects on students' level of growth mindset matter for long-term, consequential choices in high school. The mindset literature proposes that students with more of a growth mindset will have action tendencies toward challenge-seeking and higher perseverance in education (Dweck, 2017a). We find that students from classrooms that have excelled in cultivating growth-mindset skills show a higher probability of opting for the more academically challenging choices in high school. While we do not imply that it is "better" to choose the academic track or advanced math, those choices reflect action tendencies in line with what we would expect from mindset theory. Further, from the mindset theory presented in the Theory section, we expected the classroom effects to increase challenge-seeking more for groups that are traditionally high performing: girls and students from a high socioeconomic background. And to predict completion more for boys and students from

low socioeconomic background. We found the effect of a one standard deviation increase in classroom effects on growth mindset to increase the probability of choosing academic track more for girls than for boys. We found no such difference according to socioeconomic status. On the other hand, we discovered that students from low socioeconomic backgrounds are less likely to drop out of high school when exposed to an increase of one standard deviation in classroom effects on students' mindset. In the latter case, the classroom has a substitutive effect.

As mentioned in Section 3.6, one limitation of this thesis is that it uses data where the level of growth mindset is measured only once, when students enter high school. Hence the extent of socioemotional learning *in* high school is not examined. Given that we have documented differences in the production of growth mindset within middle school, it is likely that high schools and high-school classrooms also differ in the extent to which they foster a growth mindset in students. Further research could investigate socioemotional learning in high school, perhaps especially to determine whether it differs by track (academic vs. vocational). In Article Two, my analysis shows that the average marginal effect of holding a growth mindset on the likelihood of completion is larger for students on the academic track than for those on the vocational one. It would be interesting to examine if the amount of socioemotional learning is higher on vocational programs than on academic programs. Vocational programs have fewer students in the classroom and more students experience a positive grade development there, probably mainly due to differing evaluation regimes (Grøgaard and Arnesen, 2016). However, socioemotional learning could also be higher. Jackson et al. (2020) showed that attending a

school with a one standard deviation higher predicted test-score value-added or with a corresponding self-reported socioemotional-development value-added increased students' test scores in ninth grade. What is more, including both of these value-added measures more than doubled the explained variance of students' test scores compared with using only schools' test-score value-added. This finding indicates that socioemotional development may be essential for academic success (Jackson et al., 2020).

The empirical investigations of high-school outcomes showed important relationships in models with and without middle-school GPA included. It is a modelling choice whether or not to include prior performance in educational analyses. For my analyses, including GPA from middle school in the analysis helped to better isolate what happens in high school. However, I think one contribution of my thesis is the insight that by "controlling for" middle-school GPA, one may control not only for academic competencies but also for important socioemotional skills which are related to the GPA. Witherby and Carpenter (2022) also point to this fact. They emphasize that, while prior knowledge is typically viewed as a variable to be controlled or eliminated in many research designs, prior knowledge can have important predictive effects on new learning that should be measured and modeled to better understand when and why prior knowledge contributes to successful learning.

4.3 Theoretical considerations

In my thesis, students' own expressions of their beliefs regarding the nature of intelligence have been the main object of investigation, and I think this gives a unique opportunity to discuss some of the assumptions in theories aiming to explain inequality. In the rational-choice framework, it is often assumed that the reason why students from higher socioeconomic backgrounds have higher completion rates in education than students from lower socioeconomic backgrounds also when they attained lower grades is that they want to avoid downward social mobility (Bernardi and Triventi, 2020). I have suggested in Article One that another mechanism that could explain this relationship is that low-achieving students with a low socioeconomic background are more likely than their peers with a high socioeconomic background to have a fixed mindset and therefore to relent when faced with academic difficulty.[7] The findings in Articles Two and Three further point to mindset being involved in choice effects. Social background is not included as a variable in Article Two, but in a supplemental analysis I investigated the relationships by parents' education as well, finding that the average effect of a growth mindset is the same for students whose parents have a low or high level of education (but also that more low-performing

[7] It could also be likely that higher-educated parents of students with academic difficulties will mobilize more resources than less educated parents in the same situation. This will provide students who are the children of highly educated parents with more opportunities to learn outside school, for instance from help with homework and use of private tutors (Bernardi and Triventi 2020; Herbaut 2021). This is also an important mechanism in the rational-choice framework.

students with highly educated parents hold a higher level of growth mindset, as mentioned above). In Article Three, we do not investigate effects according to different levels of academic achievement in middle school, but this could be done in future research.

Mindset theory does not distinguish between the home environment and the school environment as factors affecting the development of students' mindset. In other social-science literature, and also in the policy debate, whether the home or the school is the (main) source of educational inequality has been a very large question. Ever since the 1966 Coleman Report (Coleman, 1966) concluded that variation in academic performance was strongly linked to family environment but hardly at all to measurable school characteristics, scholars have debated whether schools reproduce preexisting inequalities, magnify them, or help reduce them (Downey and Condron, 2016). Hanushek (2016) states that while no analysis of school performance which neglects differences in family background can be taken seriously today, subsequent research has proved that most of the variation in teacher effectiveness is found within schools (i.e., between classrooms) rather than between schools (what Coleman focused on), hence establishing the critical role of the teacher. Downey and Condron (2016) have called for a more contextual understanding of how schools matter, by comparing the magnitude of exacerbatory school mechanisms against that of compensatory ones.

In Article One, I empirically show that, on average, students have a stronger belief in natural talent when their parents' level of education is low, as we would expect from the theory of Bourdieu and Passeron (1979) presented in the Theory section. However, if the home environment were the main driver for students' mindset, there

should not be a difference by middle-school achievement between students of similar family backgrounds. And if the school were the only relevant mechanism, there should not be a difference by parental education, as I find among the lowest performing students. As we suggest in Article Three, the answer to this conundrum could be very simple: those students who do not learn how to deal (constructively) with educational struggles at home instead need to learn this in school. In Norway, unlike internationally, where according to Downey and Condron (2016) a critical view of schools has come to dominate the sociology of education, with scholars identifying a wide range of school mechanisms thought to reproduce or exacerbate inequality, the domestic policy debate has been dominated by a view that the home and students' gender the most are important factors behind educational inequality. Downey and Condron (2016) claim that schools have a compensatory role with regard to inequality in academic achievement and a neutral role with regard to inequality in socioemotional skills. In Article Three, my coauthor and I suggest that classrooms (within middle schools) have a compensatory or substitutive role with regard to the socioemotional skill growth mindset for students from low socioeconomic households.

As confirmed in the previous literature, middle-school GPA is a very important predictor of high-school GPA and high-school completion (e.g., Andersen and Hansen, 2012; M. Jackson, 2013). One contribution made by this thesis is its description of the association between higher performance in middle school and a higher level of growth mindset upon entry to high school. Such an association has been found to obtain in several studies of mindset (Bettinger et al., 2018; Blackwell, Trzesniewski, and Dweck, 2007;

Gouëdard, 2021). However, the mindset theory does not include mastery experiences as relevant for the development of mindset. If we understand more about the descriptive associations related to mindset and academic performance, it will also be easier to understand the effects of interventions aiming to change students' mindset. Burnette et al. (2022) conclude their investigation of the effects of growth-mindset interventions by stating that more theoretical effort should be devoted to a more precise understanding of who can be expected to benefit most from such interventions. Specifically, they ask whether the participants with the most potential for developing a stronger growth mindset are those who benefit the most, or whether it is rather those with the most room for change in their end result—suggesting that the answer could in fact be some combination of both. This is indeed what my empirical findings suggest as well: that the students with the most potential for developing higher levels of growth mindset are low-achieving students, who also have a lower level of growth mindset on average, and whose potential for improving grades and completion is highest. This would imply, among other things, that it will be unlikely for large treatment effects on mindset to be seen in samples of university students, whose past achievement will tend to be rather high and who will tend to already have a high level of growth mindset.

5 Implications

Based on my findings, in this section I will discuss practical implications of my research for policy and for teachers.

5.1 Implications for teachers

One implication of this thesis is that teachers should be recommended to consider student mindset as a factor which may cause fixed beliefs about learning possibilities among students and may lead to underutilization of learning situations. While education is a complex system and many factors will have predictive power for learning inequalities (Heggen, Helland, and Lauglo, 2013), students' beliefs and their exploitation of learning opportunities may be one factor that could be worthy of further investigation for teachers. The yearly national student-satisfaction survey ("The Student Survey") measures students' motivation and well-being in school, but it is often difficult to understand why students report that they are or are not motivated. Mindset theory proposes that beliefs play a much larger role for motivation than most motivation theories account for (Dweck, 2017a). I find mindset theory to be an interesting contribution to the scholarly and practical debate on what motivation is and how it is shaped, and teachers could use the approach from the theory to investigate if it can be used to further increase motivation in school.

Articles One and Two suggest that, on average, students who have a low GPA from middle school have a much higher belief in natural talent— that a person's intelligence is fixed and not likely to change.

These articles also show that the beliefs held by students when entering high school predict their high-school GPA and completion, and it follows from the theory that teachers can work on modifying these beliefs. This can be done in different ways, for example using computer programs such as the U-say intervention designed to teach students that intelligence is malleable. As noted, this program is available free of charge to all high-school students in Norway. It can also be done through a knowledge-based teaching practice, where teachers are conscious of the types of feedback and support that encourage a growth mindset among students. Students' concerns about how they are viewed by teachers in school is a particularly important issue for educators to address, especially when it comes to students from groups marginalized in education (Smith et al., 2022). Two social processes are found to be especially relevant for students' academic motivation: whether teachers see them as limited in their academic potential and whether they are narrowly labeled by teachers according to their academic success (Smith et al., 2022). Article Three suggests that some classroom environments foster a growth mindset more than others, and it is likely that teachers are important for the culture that emerges in any given classroom. Results from a middle-school intervention in Norway suggest that awareness of the fact that learning is a *process* is important for developing a growth mindset among students (Tharaldsen and Vangsnes, 2023).

We know that students from low socioeconomic backgrounds on average perform less well in school than students from high socioeconomic backgrounds. In branches of the social sciences other than psychology, it is quite well documented that students with less

educated parents are more responsive to failures than students with highly educated parents (Bernardi and Triventi, 2020; Gambetta, 1987). If this is because students with less educated parents receive more fixed-mindset messages at home, it can be compensated for in school, but it is important to understand the students' reasoning and probably also the environment they are exposed to at home and elsewhere in order to address their beliefs about learning possibilities.

It follows from this that schools can do a great deal to develop a growth mindset among students. This can be done by focusing upon learning as a process, as noted, and it can also be done through the messages that educators—often unintentionally—send to students about what it takes to be successful in school. That being said, however, Dweck (2017b) has also warned against what she calls a *false growth mindset*, where the messages intended to promote a growth mindset are oversimplified. Examples include when people believe that success is *only* about effort and hard work, or when children are told that they can do anything. Dweck also warns strongly against the tendency to blame students for holding a fixed mindset. Educators must take seriously their responsibility to create growth-mindset-friendly environments where students feel safe from judgment and understand that their educators believe in their potential to grow and will collaborate with them on their learning progress (Dweck, 2017b).

5.2 Implications for policy

My findings can inform policy in several key ways. As already mentioned, socioemotional skills do not seem to be an integral part of the strategy to increase students' learning in Norway. Policymakers may overlook an important social-policy tool by leaving socioemotional skills out of the study of educational outcomes (Jennings and DiPrete, 2010). One purpose of education, according to the Education Act, is to "develop knowledge, skills and attitudes so that students and apprentices can master their lives and can take part in working life and society."[8]

The core curriculum (Ministry of Education and Research, 2019b) describes the learning process as a process in which students should understand their learning and development in subjects in order to become independent and experience a sense of mastery. Teachers are supposed to monitor students' development and give them support appropriate for their age, maturity, and functional level. Very little is said about how students should learn to overcome educational difficulties. In the principles for education and all-round development, the following quote from Section 2.4, "Learning to learn," describes learning challenges:

"In spite of their personal efforts and use of learning strategies, some students will have learning challenges. There are often many and complex reasons for this. The ambition of developing the life-long

[8] Cited on p. 4 of the Core Curriculum (Ministry of Education and Research 2019b)

learning ability in all students thus requires a broad approach from the school."

Learning is often presented as easy and straightforward, and struggles related to learning are only vaguely referred to. The quote above can be read as relating to students who have learning challenges that are so comprehensive that the school should investigate their need for special education. Struggles related to learning for "ordinary" students are not mentioned, and this may give teachers fewer tools to use when they encounter students who struggle to learn. Not viewing struggles as normal may also demotivate students who encounter educational struggles and give rise to a more fixed mindset.

The OECD included questions on growth mindset in the PISA 2018 study, and 78 of the participating countries included these questions in their national survey. Norway chose not to, but in the PISA 2022 study these questions are included for Norway. After the results have been published in December 2023, this might give rise to a policy debate on these skills in the Norwegian context as well.

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Attachments

Appendix 1 Mindset as a potential link between family background and high-school achievement.

Appendix 2 Growth mindset, prior performance, and high-school completion for boys and girls.

Appendix 3 Long-Term Classroom Effects on Academic Choices

Appendix 1: Mindset as a potential link between family background and high-school achievement.

Article

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Mindset as a potential link between family background and high-school achievement

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Abstract
The link between students' family background and their school achievement is well documented. The recent literature has also investigated how social and emotional skills and mindsets relate to educational outcomes. Here I examine how mindset—that is, whether students believe more in that intellectual abilities are fixed or capable of growth—is related to family background and school achievement in Norway. I find that students with higher-educated parents have lower levels of a fixed mindset on entering high school. I also estimate heterogeneity in this association using multilevel modeling. The predicted level of students' fixed mindset is low for higher-performing middle-school students, irrespective of parents' education. Furthermore, low middle-school performance predicts higher levels of a fixed mindset, particularly for students with lower-educated parents. A higher level of fixed mindset on entering high school is related to lower achievement after the first year. The results suggest that students' belief in "natural talent" is a mechanism worthy of further investigation as it is more malleable than the mechanisms traditionally used to explain differences in academic performance according to family background.

Keywords
Mindset, academic performance, high school, educational inequality, SES achievement gap

Introduction

In a knowledge economy with a rapidly changing labor market, education is increasingly important for people's opportunities. The persistence of inequality in school performance according to family background remains a policy concern. In sociology, the mechanisms used to explain differences in academic performance often relate to properties of individuals, families, and societies that are *difficult to change* (Jackson, 2013). However, the recent literature has also investigated how social and emotional skills and mindsets (also known as soft or noncognitive skills) relate to educational performance and life outcomes (Jackson et al.,

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2020). Several studies suggest that noncognitive skills are more malleable than cognitive skills in later childhood (Carneiro et al., 2013; Cunha and Heckman, 2008). It has also been established that mindsets can be taught (Haimowitz and Dweck, 2017). Research indicates that social and emotional skills or traits such as determination, perseverance, and tenacity are fundamental for success in school (Heckman, 2006). For example, a person with high perseverance will stay focused on challenging tasks, will work hard, and will not give up—all of which are critical for learning (Bettinger et al., 2018).

A growing literature proposes that the relationship between family background and academic achievement is mediated in part by psychological mechanisms (Bernardo, 2021; Destin et al., 2019; King and Trinidad, 2021). One such mechanism is a belief in "natural talent"—that only certain people can be successful in school. In mindset theory, people lean toward a "fixed mindset," according to which attributes such as intelligence or personality are simply fixed, or a "growth mindset," according to which such attributes are instead capable of being shaped and developed (Dweck and Yeager, 2019). However, the socioeconomic dimension of students' mindset has not been extensively explored (Destin et al., 2019).

In this article, I investigate how students' beliefs about the nature of intelligence—whether they believe more that intellectual abilities are fixed or that they are capable of growth (Yeager et al., 2019)—relate to family background and performance in middle and high school. I investigate two questions. First: How are family background and middle-school grade-point average (GPA) related to the level of fixed mindset when students enter high school? Second: Is there a relationship between the level of fixed mindset when students enter high school and their achievement after the first year, and does this relationship vary across family backgrounds?

I study this in the context of Norway. Family background and grades in 10th grade (the final year of middle school) are strong predictors of high-school graduation in Norway (Grøgaard and Arnesen, 2016; Markussen et al., 2017). There is also a strong relationship between family background and middle-school and high-school grades (Andersen and Hansen, 2012). Achievement gaps attributable to socioeconomic status (SES) have grown over the past 50 years in many countries, and Norway is one of those where this gap has grown the most (Chmielewski, 2019). The main challenge when it comes to ensuring that Norwegian young people obtain a high-school education is not to make middle-school students go to high school, because they nearly all do. Instead, the challenge is to make them stay there and leave with a qualification. This suggests that social and emotional competencies might be a factor worth exploring. One type of social and emotional competency that may be of particular importance is students' mindset.

I use a large dataset from multiple data sources pertaining to students in public high schools in two counties in Norway (Rege et al., 2020). The dataset consists of survey data, registry data on parents' education, and administrative data from the students' last year of middle school and their first year of high school. Very few studies have investigated how students' mindset relates to learning in Norway, and to my knowledge no studies have examined its relationship to family background. The relationships I study have previously been investigated in a U.S. context by Destin et al. (2019). In a sample of 4828 ninth-grade students in public high schools, they found that, on average, students with a university-educated mother had fewer fixed beliefs about academic ability. Further, they found student's mindset to be a significant but small factor in explaining the relationship between SES and achievement among high-school students. My analyses extend these results by exploring how family background interacts with prior performance in predicting the level of fixed mindset, and I also examine the interaction between family background and mindset in predicting high-school GPA in an additional model.

Conceptual framework

Mindset as a potential link between family background and high-school achievement

I propose a conceptual framework (Figure 1) that can help us understand the interrelationships between family background, achievement, and mindset by combining sociological and psychological theories and building on

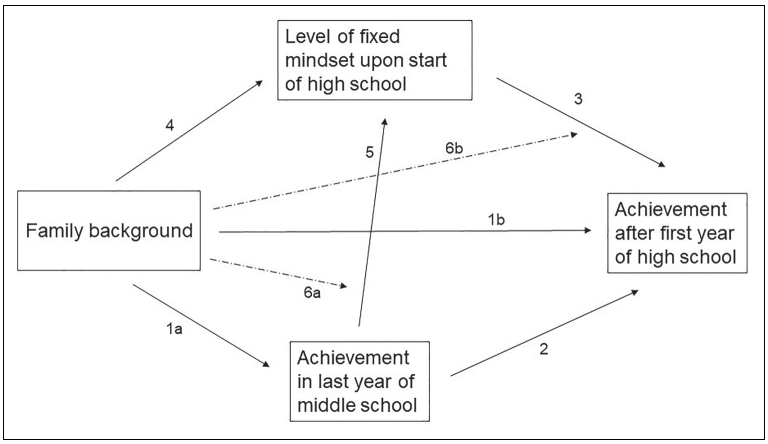

Figure 1. Conceptual model: mindset as a potential link, alongside prior achievement, between family background and achievement. Arrow numbers represent relationships discussed in the Conceptual Framework section.

prior empirical research. The expected relationships are visualized in the figure. Some of them have been extensively studied in the literature—for instance, how family background predicts performance in middle and high school, and how prior performance predicts future performance (arrows 1a, 1b, and 2). Regarding the remaining relationships (arrows 3, 4, 5, 6a, and 6b), we have limited evidence; those relationships reflect the key hypotheses that will be investigated in this article. The two dependent variables in the present study are level of fixed mindset and grades after the first year of high school. The study will investigate whether and how parents' education and students' prior performance predict the level of fixed mindset when students enter high school (arrows 4 and 5), and whether and how students' mindset, parents' education and students' prior performance predict grades after the first year of high school (arrows 3, 6a, and 6b).

Family background and achievement

Family background is a strong predictor of educational achievement (Chmielewski, 2019; Jackson, 2013) (arrows 1a, 1b in Figure 1). When it comes to explaining why family background causes inequality in achievement, von Hippel et al. (2018) outline that an enduring research tradition assumes that much of this inequality is caused by schools while an equally venerable tradition argues that the bulk of the inequality is due to nonschool influences, especially the family. Jæger and Breen (2016) claim that cultural reproduction is among the most influential explanations for why inequalities in educational and socioeconomic outcomes persist over generations. In recent years, some scholars have argued that schools also help to compensate for inequality (Downey and Condron, 2016; von Hippel et al., 2018).

A starting point for the conceptual model is that family background is indeed related to performance in middle and high school (arrows 1a and 1b). Several studies confirm that these relationships exist in a Norwegian context as well. For example, Anderson and Hansen (2012) found that the higher social classes tend to perform best in both middle and high school, and Markussen and Grøgaard (2020) identified a slight tendency for grade differences by family background to increase in high school but found that the large differences are established in compulsory education. Numerous explanations for why these differences exist have been proposed, and Heggen et al. (2013) conclude that explanations related to students'

environment (family and school), abilities, and motivation all have some explanatory power when it comes to explaining performance differences and that it is likely that many mechanisms are at play at the same time. However, few studies have examined how students' beliefs about the nature of intelligence and about what it takes to do well in school may relate to their family background and performance.

It is also well known from the literature that educational experiences as manifested in prior performance are related to future performance (arrow 2). Cunha et al. (2006) argue that skills beget skills via complementarity and self-productivity. This implies that skills produced at one stage raise productivity at later stages, and that skills produced at one stage augment skills attained at subsequent stages (Cunha et al., 2006).

Mindset and achievement

People form beliefs based on their experiences, and various theories try to explain how, in turn, beliefs can guide motivation and behavior (arrow 3 in Figure 1). Dweck suggests that mindsets create meaning systems (Dweck and Yeager, 2019) (Figure 1. Mindsets might organize goals, attributions, and helplessness into one meaning system. To these variables, she adds the concept of "effort beliefs"—believing that effort is a positive thing that helps grow your ability, or a negative thing that demonstrates deficient ability. All these variables may be ascribed different importance or meaning depending on whether a person has a fixed or growth mindset. When people view ability as fixed, *validating* their own ability (by pursuing performance goals or by avoiding challenges) may take on more importance, high effort may indicate low ability, and setbacks are more easily attributed to low ability. This may reduce persistence. By contrast, when people view ability as something that can be improved, *developing* their ability (by taking on challenging learning goals) may become more important, effort may be seen as a tool in this process, and setbacks are more readily seen as providing information about the learning process. This may strengthen persistence (Dweck and Yeager, 2019).

For the sake of convenience, researchers often refer to people with a fixed mindset and people with a growth mindset as two distinct groups, but data are typically analyzed as a continuum (Plaks, 2017). Mindsets tend not to be clearly developed and articulated in people's minds (Plaks, 2017): they are not fixed entities but are continually influenced by messages and experiences in a person's context (Haimovitz and Dweck, 2016). Indeed, Yeager et al. (2019) found that a growth-mindset intervention teaching students that intellectual abilities are capable of development improved grades, more so among lower-achieving students. Several other studies also show that holding a growth mindset correlates with better learning and higher grades over time, compared with holding a fixed mindset (Claro et al., 2016; Yeager and Dweck, 2012). Destin et al. (2019) characterize the negative relationship between a fixed mindset and lower academic achievement as well documented. The mechanisms at work are that students with more of a fixed mindset tend to avoid challenges and relent when faced with academic difficulty, leading to lower academic achievement relative to students with more of a growth mindset. In the conceptual model, this relationship is marked by arrow 3 in Figure 1.

Lately, mindset theory has also been criticized. In a meta-study, Sisk et al. (2018) found that the association between mindset and school achievement was inconsistent across studies. For studies using GPA as an achievement measure, they found an average correlation between growth mindset and academic achievement of $r = 0.08$, 95% confidence interval (CI) = (0.05, 0.11), $p < 0.001$. Because of these inconsistent findings, the present study in a Norwegian context represents a highly relevant contribution to our knowledge about mindsets and their (potential) relationship with academic achievement.

Family background and mindset

The mindset literature hypothesizes that many students are socialized into believing that only certain people can be successful academically (Dweck, 2017) (Figure 1). Messages fostering a growth or fixed mindset can come from parents, teachers, or coaches (Dweck, 2017).

There are several possible mechanisms through which parents may influence their children's mindset in response to academic failure (arrow 4 in Figure 1). An important one is communication about family traits, such as "nobody in our family ever understood math." This can push children into a fixed mindset. Haimovitz and Dweck (2016) found that parents' beliefs about failure as motivating or demotivating, and their responses to their children's failures, predicted their children's mindsets. Parents who saw failure as enhancing were less likely to worry that their child did not have enough ability and more likely to respond with a focus on the process of learning—by engaging the children in discussions about what they could learn from the experience, how they could study their mistakes to improve, and how they might consider asking for help from their teacher (Haimovitz and Dweck, 2017).

This can also be aligned with Bourdieu, who gave an example of how we would expect family background to affect mindset in an interview where he exemplified "doxa" (what people take for granted): "When you ask a sample of individuals what the main factors of achievement at school are, the further you go down the social scale the more likely they believe in natural talent and gifts—the more they believe that those who are successful at school are naturally endowed with intellectual capacities. And the more they accept their own exclusion, the more they believe they are stupid, the more they say 'Yes, I was no good at English, I was no good at French, I was no good at mathematics'" (Eagleton and Bourdieu, 1992: 114). Bourdieu and Passeron (1979: 72) describe how a mother from the lower classes imposes damaging influence in three different ways when she says for instance "He's no good in French" in front of her son: " First, (…) she makes an individual destiny out of what is only the product of education and can still be corrected, at least in part, by educative action. Secondly, (…) she uses simple test scores as the basis of premature definitive conclusions. Finally, (…) she intensifies the child's sense that he is this or that by nature." This is tantamount to suggesting that having fewer socioeconomic resources will be associated with a tendency to develop more of a fixed mindset when encountering educational struggles. In other works, Bourdieu (1998) finds that students with high levels of cultural capital are the most inclined to invoke natural talent to account for their success and hence have a fixed mindset. Nonetheless, a key point is that individuals' explanations for their own success or failure differ by social position. While Bourdieu is often associated with embodied cultural capital acquired in the home environment, Bourdieu and Passeron (1979: 73) also point to the fact that the techniques and habits of thought required by school could have been taught where the most disadvantaged could acquire them, that is, in school.

Prior educational outcomes and mindset

In the conceptual model, it is hypothesized that students' achievement in middle school may be related to their mindset at the start of high school (arrow 5 in Figure 1). Several studies find that mindset predicts performance (Yeager and Dweck, 2020), but fewer address how prior achievement predicts mindset. Bettinger et al. (2018) note that the presence of a growth mindset in baseline data from the first year of high school seems significantly more likely for students with a high GPA. Snipes and Tran (2017) found that students' level of growth mindset varied significantly by prior academic achievement: students with lower prior achievement had lower levels of growth mindset. The authors suggest that the differences in growth mindset can be the result of differences in prior academic experiences and outcomes. For instance, if low-achieving students have had more difficult or less rewarding academic experiences, they may have grown discouraged and developed beliefs that are more consistent with a fixed mindset. A study of undergraduate college students in Georgia, USA (Limeri et al., 2020), found that those who struggled with the course taken tended to shift toward viewing intelligence as a stable trait, that is, toward a fixed mindset.

Interaction between family background, mindset and achievement?

In the conceptual model, two possible interactions are proposed. The first (arrow 6a in Figure 1) is an interaction between family background and middle-school grades in predicting the level of fixed mindset.

In the literature examining school-continuation decisions, a widespread finding is that students from different family backgrounds respond differently to previous school performance when making educational transitions. Holm et al. (2019) conclude that signals about academic ability, communicated via GPAs, matter for educational decision making such as enrolling in and completing upper-secondary education in Denmark. The effect of such signals is stronger for students from low socioeconomic status (SES) backgrounds than for those from high-SES ones. Bernardi and Triventi (2020) found that students with poor previous grades were more likely to complete high school and enroll in university if their parents were highly educated. Similarly, regarding higher education, Herbaut (2021) found that students from low-SES backgrounds were more likely to drop out after academic failure than students from more advantaged backgrounds.

On the analysis presented in those studies, the inequality-generating mechanism operates mainly among the upper-class students, who move on despite poor educational performance in order to avoid downward mobility (Bernardi and Triventi, 2020; Holm et al., 2019). According to the compensatory-advantage framework, higher-educated parents of students in academic difficulty will mobilize more resources than lower-educated ones (Bernardi and Triventi, 2020; Herbaut, 2021). However, another explanation, in line with mindset theory, could be that students with a low-SES background more often have a fixed mindset and so relent when faced with academic difficulty. I will investigate whether there is an interaction between students' previous school performance and parents' level of education in predicting students' mindset.

The second possible interaction proposed (arrow 6b in Figure 1) is between family background and level of fixed mindset in predicting high-school GPA. It could be that a fixed mindset at the start of high school is more negatively associated with achievement after the first year among low-SES students. In a study from Chile, Claro et al. (2016) found evidence that students from lower-income families were less likely to hold a growth mindset than their wealthier peers, but that low-income students who had a growth mindset were buffered against the deleterious effects of poverty on achievement. Further, Jia et al. (2021), studying a subsample from PISA 2018 of 79 countries with information on students' expressed mindset, found that mindset interacted with SES to predict academic achievement for science and reading scores, and that the effect of a growth mindset was stronger among low-SES than high-SES students. However, a recent study from the United States (King and Trinidad, 2021) found that a growth mindset positively predicted mathematical achievement only among high-SES students. By contrast, Sisk et al. (2018) analyzed SES as a moderator variable, finding that academic-risk status and SES did not moderate the relationship between mindset and academic achievement in the studies reviewed in their meta-study. Similarly, Destin et al. (2019), in their US study, found a negative association between a fixed mindset and achievement regardless of SES.

These inconsistencies may be due to the use of different analytic strategies or outcome measures. While Claro et al. (2016), Jia et al. (2021), and King and Trinidad (2021) examined the relationship between mindset and performance at the same timepoint, Destin et al. (2019) analyzed the relationship between mindset and performance across time and conditioning on prior achievement. I reconcile some of these differences by examining the relationship across time with and without conditioning on prior achievement.

Context

Compulsory education in Norway starts at the age of 6 and covers 10 years of education, with years 8 to 10 constituting middle school. Young people who have completed their compulsory education are entitled to receive up to 4 years of either vocational or academic upper-secondary education and training in high school. Nine-tenths of Norwegian high-school students are enrolled in public high schools (Norwegian Directorate for Education and Training, 2019). Vocational education and training usually consists of 2 years spent in school followed by 1 year worth of in-service training. Since in-service training as an apprentice at a training establishment is usually combined with productive work, in which case

the apprenticeship lasts for 2 years, vocational high-school programs tend to cover 4 years (Eurydice, 2020/21). Academic programs last for 3 years and provide general eligibility for admission to university. Students who have completed at least the first 2 years of a vocational program may complete a supplementary 1-year program to obtain general eligibility for admission to university. The high-school completion rate is lower in Norway than in similar countries, especially for vocational programs (OECD, 2020). In fact, only 67.7% of students entering high school in 2015 completed it within the standard timeframe while another 12.7% completed it within 2 years of their expected graduation date (Statistics Norway, 2020).

Data

A large randomized controlled trial relating to a mindset intervention was conducted in 2017/2018 (Rege et al., 2020). It covered all but one of the public high schools in two Norwegian counties ($N = 58$) and all first-year students had to participate. When logging in for the first session of the intervention a few weeks into their first semester, students were asked for their consent to participate in the research project, which 90.8% of them gave. Data from a questionnaire completed during that session were matched with administrative data on tenth-grade GPA retrieved from county records, with data on parents' socioeconomic background obtained from Statistics Norway, and with administrative data on GPAs after the first year of high school.

The final analytic sample consisted of 10,091 students. Out of that sample, 691 students (6.8%) were excluded from this study. To begin with, 394 students were excluded because they quit school during the year and so did not obtain a high-school GPA. Further, 159 were excluded because of missing middle-school grades (they had obtained no grade points from middle school or had completed their lower-secondary education in another country) and 36 were excluded because of missing information on their high-school GPA. In addition, 26 students with missing information on what middle school they had attended, 67 students who were special-education students or were in adapted training over several years, 4 students who changed to a school not in the sample, and 5 students with missing information on the mindset variable were excluded. The 394 students who quit, on average, were lower on middle-school GPA, lower on parents' education, and higher on fixed mindset. However, even if these students are included and their first-year high-school GPA is set to 1.0, the results are very similar to the ones reported here. The above yielded a final analytic sample of 9400 students, of whom 3229 (34.35%) were enrolled on vocational programs and 6171 (65.65%) on academic programs.

Key measures

Level of fixed mindset was calculated using two questionnaire items from the first intervention session. Participants responded on a six-item scale ranging from 1 ("strongly disagree") to 6 ("strongly agree") to two statements: "You have a certain amount of intelligence and you can't really do much to change it" and "Your intelligence is something about you that you can't change very much." The correlation between these two items was 0.7 (Chronbach's alpha: 0.83). An average score was computed for each participant. This type of measure of mindset, based on two or more statements, is used in the international literature (Yeager and Dweck, 2020).

GPA high school: GPA after the first year of high school, which ranges from 2 to 60.

Highest education is an indicator of the parents' highest level of education, with a breakdown into four categories. The variable is assigned the value 1 if the highest level of education obtained by a student's mother and father is less than high school. For the values 2 to 4 the highest level of the mother or father is used; 2 indicates that the highest level of education is high school, 3 represents a bachelor's degree, and 4 denotes a master's or PhD degree.

Female: Indicator for gender; 1 represents female.

GPA middle school: Tenth-grade GPA, which ranges from 11.6 to 60.

Vocational track: 1 represents vocational track. Students on vocational programs generally have a more positive grade development from middle school to high school than academic-program students, which is why I include this variable in the regression predicting high-school GPA.

Both parents non-Western immigrants: Both parents born in a non-Western country.

Analytic strategy

The aim of the article is to describe the fundamental relationships between the study variables. The study does not detect causal relationships; rather, its purpose is to investigate heterogeneity in descriptive associations. First, I used descriptive analyses to assess correlations between the continuous study variables. Then I used multilevel-regression analysis to predict fixed mindset as measured at the start of high school and GPA after the first year. In the regression focusing on the results from the first year of high school, I control for treatment status.[1] Ringdal (2018) suggests that multilevel modeling should be used if the intra-class correlation coefficient (ICC) of an empty model exceeds 0.05. This is the case here when high-school GPA is the dependent variable (ICC = 0.14), but not when fixed mindset is (ICC = 0.02). To ensure consistency, and because the data have an inherent multilevel structure (middle and high school), I use multilevel modeling in both regression analyses.

The continuous independent variables are grand-mean centered. Parents' highest education is used as a categorical variable and not mean centered, as this would change the interpretation of the results. According to Enders (2013), there is a potential for confounding in multilevel models when the interaction between a pair of grand-mean-centered level-1 variables is examined. I have performed additional analyses (in a model using parents' education as a mean-centered continuous variable) for the model with high-school GPA as a dependent variable, as recommended by Enders (2013: 102). The joint significance tests of the additional parameters show that there are no contextual effects or confounded interaction effects when middle-school GPA is included in the model. When GPA is not included, there are such effects; the reason is that much of the variation between high schools (the level-2 variance) is related to the students' grades from middle school. This implies that the validity of the results is lower when GPA from middle school is not included in the models.

In visual presentations of the results, the dependent variable is centered by subtracting the mean.

One limitation of the study is that mindset is only measured at a single point in time. Hence the data do not allow investigation of the development of mindset throughout compulsory education or in high school.

Results

Descriptive statistics relating to the sample studied are presented in Table 1. Girls make up 52%, and 12% have non-Western immigrant parents. The mean fixed-mindset score is 2.65, with a standard deviation of 1.14.

Bivariate correlations between key variables are reported in Table 2. The level of fixed mindset is negatively correlated with grades from both middle and high school.

How are family background and GPA from middle school related to the level of fixed mindset when students enter high school?

To address research question 1, I first look at the bivariate relationship between parents' highest level of education and students' expressed level of fixed mindset. Figure 2 shows levels of fixed mindset by parents' highest education level. On average, students whose parents' highest education is high school or less than high school express levels of fixed mindset above the mean, while students with at least one university-educated parent express levels below the mean.

Next, this association is explored in multilevel models that account for the clustering of students within middle schools (Table 3).

Table 1. Descriptive statistics relating to the sample studied ($N = 9400$).

Variable	*Mean*	*SD*	*Minimum*	*Maximum*
Parents' highest education level				
Less than high school	0.12	0.32	0	1
High school	0.30	0.46	0	1
Bachelor's degree	0.38	0.48	0	1
Master's or PhD degree	0.20	0.40	0	1
Level of fixed mindset	2.65	1.14	1	6
GPA middle school	42.52	7.57	11.6	60
GPA high school	42.15	7.7	2	60
Female	0.51	0.5	0	1
Both parents non-Western immigrants	0.13	0.33	0	1

Notes: This table reports descriptive statistics concerning the students in the sample. Data on the level of fixed mindset are obtained from a student survey. Those on parents' highest education and country of origin are obtained from Statistics Norway. Data on gender and GPA in middle and high school are obtained from the counties' administrative records. GPA, grade-point average.

Table 2. Bivariate correlations between study variables.

	1	2	3
1. *Level of fixed mindset*	–		
2. *GPA middle school*	−0.22	–	
3. *GPA high school*	−0.19	0.73	–

Note: All correlations are statistically significantly different from zero ($p < 0.001$). GPA, grade-point average.

Model 1 in Table 3 shows that students whose parents have at least a high-school education have a significantly lower predicted level of fixed mindset than students whose parents have less than a high-school education. In Model 2, this association weakens when students with similar GPAs are compared: students whose parents have a high-school education do not differ significantly from students whose parents have less than a high-school education. In Model 3, I investigate whether there is an interaction between parents' education and middle-school grades when predicting fixed mindset. The interaction term is significant, and the relationship in question is further illustrated in Figure 3. Finally, Model 4 shows that gender is not a significant predictor of mindset for otherwise similar students, but students with non-Western immigrant parents have a higher predicted level of fixed mindset even when the other predictors are controlled for.

To illustrate the interaction between parents' level of education and students' middle-school GPA, Figure 3 presents predicted means for fixed mindset among students with low, medium, and high middle-school GPAs, respectively, by parents' highest level of education. Among students who were high performing in middle school, the predicted level of fixed mindset is below the mean and there is no difference by family background. Among students who were low performing in middle school, the predicted level of fixed mindset is above the mean, and higher among students with less-educated parents. Hence even students from more privileged backgrounds are predicted to express a higher level of fixed mindset if their performance in middle school was weak, but to a much lower degree than students with low-educated parents.

It should be noted that the proportion of high performers (with GPAs one standard deviation or more above the mean) is 31.3% among students who have at least one parent with a master's or PhD degree but 6.6% among students where both parents have less than a high-school education, while the corresponding proportions of low performers (GPAs one standard deviation or more below the mean) are 5.4% and 39.8%, respectively (Figure A1 in the Appendix). Hence the comparison of the groups is based on selective samples of, for instance, low-performing students with highly educated parents. Still, this reflects the composition of the students' GPA from middle school, which is strongly related to their parents' level of education.

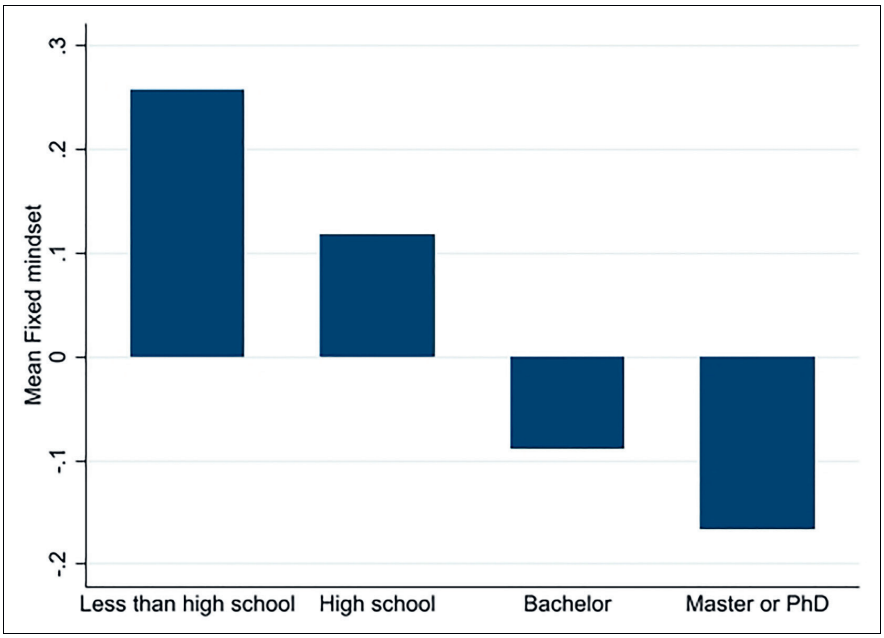

Figure 2. Mean level of fixed mindset (centered by subtracting the mean) by parents' highest level of education ($N = 9400$).
Notes: The y-axis shows centered fixed-mindset scores based on a regression similar to Model 3 in Table 3. The x axis shows three GPA categories: high, medium, and low GPA. These categories are constructed based on the following thresholds: low GPA is defined as one standard deviation or more below the mean; average GPA as between one standard deviation below and one standard deviation above the mean; and high GPA as one standard deviation or more above the mean. Using parental education, the average predicted level of fixed mindset within each of these GPA categories is computed ($N = 9400$).

Is there a relationship between the level of fixed mindset when students enter high school and their achievement after the first year, and does this relationship vary across family backgrounds?

In the next set of analyses, I address research question 2 by investigating whether the level of fixed mindset when students start high school is related to their achievement after the first year. To do this, I perform a series of multilevel models (students nested within high schools) of high-school GPA as a function of mindset, adjusting for the relationship with parents' level of education and students' prior performance (Table 4).

First, as suggested by earlier research, relative to the baseline of "less than a high school education," parents' highest level of education is a significant predictor of high-school GPA (Model 1). Next, a higher level of fixed mindset was found to significantly reduce predicted high-school GPA among students with similarly educated parents when introduced in Model 2. In Model 3, students with similar middle-school performance are compared, and this turns out to reduce the coefficients for parents' education and mindset.

Table 3. Estimates from multilevel-regression models predicting level of fixed mindset.

	1	2	3	4
Parents' highest level of education				
Less than high school (ref)				
High school	−0.145*** (0.040)	−0.065 (0.040)	−0.026 (0.046)	−0.022 (0.048)
Bachelor	−0.345*** (0.039)	−0.143*** (0.040)	−0.098* (0.044)	−0.043 (0.047)
Master/PhD	−0.409*** (0.043)	−0.132** (0.045)	−0.125* (0.050)	−0.069 (0.053)
GPA middle school (gpaMS)		−0.031*** (0.002)	−0.041*** (0.004)	−0.041*** (0.004)
Parents' education*gpaMS				
High school			0.006 (0.005)	0.007 (0.005)
Bachelor			0.011* (0.005)	0.012* (0.005)
Master/PhD			0.019*** (0.006)	0.020*** (0.006)
Female				0.030 (0.024)
Non-Western immigrant parents				0.121** (0.038)
Constant	2.912*** (0.036)	2.756*** (0.036)	2.709*** (0.041)	2.662*** (0.044)
Variance components				
School	0.018 (0.005)	0.016 (0.004)	0.016 (0.005)	0.016 (0.005)
Residual	1.271 (0.019)	1.226 (0.018)	1.224 (0.018)	1.222 (0.018)
Number of students	9400	9400	9400	9400
Number of middle schools	266	266	266	266

Notes: *p < 0.05, **p < 0.01, ***p < 0.001. Dependent variable: level of fixed mindset. Each column presents a separate regression and reports the estimated coefficient (standard error) for included covariates. The independent variables are mean centered. $N = 9400$. A test of the interaction term in Models 3 and 4 confirms that it is overall significant (prob<chi = 0.0054 and 0.0036, respectively). GPA, grade-point average.

As mentioned in the Conceptual Framework section, earlier research has yielded inconsistent results when it comes to whether mindset is a stronger predictor of achievement among low-SES than high-SES students. In Models 4 and 5, I include an interaction term between parents' education and fixed mindset to investigate this relationship, and I investigate it without (Model 4) and with (Model 5) conditioning on prior achievement in middle school. Relative to students whose parents have less than a high-school education, the interaction in Model 4 is significant among students with university-educated parents. The interaction term in Model 4 is significant and consistent with the finding in other studies (Claro et al., 2016; Jia et al., 2021) that the positive association between holding less of a fixed mindset and a higher predicted high-school GPA is stronger for students whose parents are less educated. However, consistently with Destin et al. (2019), the interaction term in Model 5 is found not to be a significant predictor when students who performed similarly in middle school is compared. I consider it likely that this difference is due to the strong relationship between the level of fixed mindset and middle-school performance described in Table 3 and Figure 3.[2] The relationships from Models 4 and 5 are illustrated in Figures A2 and A3 (in the Appendix).

Finally, in Model 6, gender and having parents with a non-Western background are included. Girls are predicted to have a lower GPA in high school than boys who are otherwise similar. A non-Western immigrant background does not predict high-school achievement when the other predictors in the model are controlled for.

Discussion

The present study shows that students who were high achievers in middle school express a lower level of fixed mindset when entering high school regardless of their family background. For those who were low

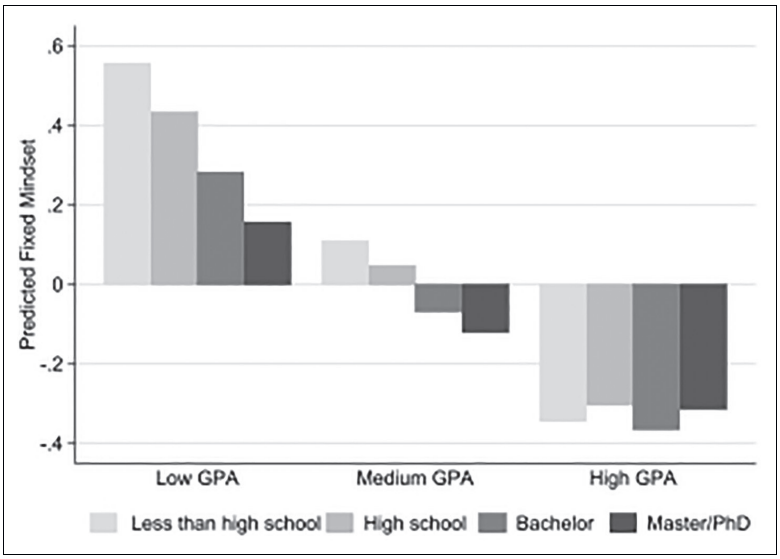

Figure 3. Mindset by middle-school performance and parental education.

performers in middle school, the predicted level of fixed mindset is higher when their parents have a low level of education. In high school, a higher level of fixed mindset at the beginning of the first semester is negatively related to achievement after that year even among students who performed similarly in middle school and have similarly educated parents.

The article contributes to our understanding of the relationship between family background and achievement in four important ways. First, in line both with the quote from Bourdieu included in the Conceptual Framework section and with findings reported in the international literature (Destin et al., 2019), I have found that Norwegian students with less-educated parents are more likely to believe in natural talent and hence to have higher levels of fixed mindset.

Second, in line with Snipes and Tran (2017) and Bettinger et al. (2018), I find that students who were high performing in middle school have a lower level of fixed mindset when entering high school. My study presents only descriptive patterns and cannot determine whether students were low performing in middle school because they had a higher level of fixed mindset or whether they have a higher level of fixed mindset because they were low performing in middle school. However, it is likely that these aspects mutually reinforce each other. In panel data, DiPrete and Jennings (2012) found that, as children progressed through education, the contribution from noncognitive skills grew smaller as more of this effect became indirect through its impact on intermediate academic outcomes.

These estimates are meaningful in terms of their practical significance. Following Lorah (2018), I standardized the coefficients to investigate the magnitude of the mindset differences in the models not involving interaction. The relationship not conditioning on middle-school GPA (Model 2 in Table 4) shows that an increase of one standard deviation in the fixed-mindset variable is related to an expected decrease of 0.129 standard deviations in high-school GPA, while in the model conditioning on prior performance (Model 3 in Table 4) the same relationship is related to an expected decrease of 0.031 standard deviations in high-school GPA.

Table 4. Estimates from multilevel regression models predicting high-school GPA.

Model	1	2	3	4	5	6
Parents' highest level of education						
Less than high school (ref)						
High school	2.475*** (0.246)	2.368*** (0.244)	0.423* (0.167)	2.261*** (0.248)	0.377* (0.170)	0.312 (0.180)
Bachelor	4.215*** (0.244)	4.002*** (0.242)	0.654*** (0.168)	3.897*** (0.245)	0.615*** (0.170)	0.520** (0.183)
Master/PhD	5.692*** (0.275)	5.469*** (0.273)	1.337*** (0.191)	5.418*** (0.276)	1.313*** (0.193)	1.204*** (0.205)
Level of fixed mindset		-.864*** (0.063)	−0.211*** (0.044)	−1.311*** (0.176)	−0.356** (0.121)	−0.350** (0.121)
Parents' education*fixed mindset						
High school				0.408 (0.209)	0.230 (0.143)	0.231 (0.143)
Bachelor				0.466* (0.203)	0.090 (0.139)	0.086 (0.139)
Master/PhD				0.763*** (0.226)	0.209 (0.155)	0.202 (0.155)
GPA middle school			0.940*** (0.009)		0.940*** (0.009)	0.945*** (0.009)
Female						−0.243* (0.103)
Non-Western immigrant parents						−0.161 (0.161)
Vocational track	−1.712*** (0.205)	−1.437*** (0.204)	5.520*** (0.154)	−1.416*** (0.204)	5.519*** (0.154)	5.513*** (0.154)
Constant	39.011*** (0.385)	39.082*** (0.378)	39.830*** (0.239)	39.185*** (0.380)	39.867*** (0.241)	40.090*** (0.260)
Variance components						
School	5.002 (1.003)	4.776 (0.96)	1.681 (0.344)	4.772 (0.959)	1.685 (0.345)	1.677 (0.343)
Residual	47.635 (0.7)	46.709 (0.683)	21.807 (0.319)	46.652 (0.683)	21.798 (0.319)	21.783 (0.319)
Number of students	9400	9400	9400	9400	9400	9400
Number of high schools	57	57	57	57	57	57

Notes: *p < 0.05, **p < 0.01, ***p < 0.001. Dependent variable: high-school GPA. Each column presents a separate regression and reports the estimated coefficient (standard error) for included covariates. The continuous independent variables are mean centered. Treatment status is included as a control variable. $N = 9400$. A test of the interaction term in Model 4 confirms that it is overall significant (prob<chi = 0.0094). GPA, grade-point average.

Third, an innovation in this article is the identification of an interaction between family background and middle-school performance in predicting students' expressed level of fixed mindset when entering high school. Specifically, the relationship between low performance in middle school and a higher level of fixed mindset is stronger among students with low-educated parents. If this relationship is present throughout the education system and influences intermediate academic outcomes, it can clearly constitute an inequality-generating mechanism. This is an issue that should be further explored.

What is more, this interaction parallels findings in the literature on educational decision making to the effect that students' response to previous school performance differs by family background (Bernardo and Triventi, 2020; Holm et al., 2019). However, those authors' views on the beliefs underpinning students' decisions differ from the theoretical framework of this article. They draw upon the compensatory-advantage framework, in which the assumed mechanism is a desire among high-SES students (and their parents) to avoid downward mobility. Another mechanism that could explain this relationship is that low-achieving students with a low-SES background are more likely than their high-SES peers to have a fixed mindset and therefore to relent when faced with academic difficulty.

The ramifications of a strong belief in "natural talent" could also be investigated in the context of choice effects to further examine whether mindset can be a mechanism relating to primary as well as secondary effects. The probabilistic relationships identified in the present study do not in and of themselves demonstrate that students' beliefs about the nature of intelligence is a mechanism of relevance to the explanation of inequality in achievement. Nonetheless, the subjective beliefs expressed by the students as well as the issue of how they are formed and acted upon are worthy of further investigation. It is clear that what students think about the nature of intelligence when they start high school is strongly related to their middle-school performance. However, it is also clear that their performance level is strongly related to their family background. We need to know more about the processes shaping these fundamental relationships. For instance, further research could investigate how approaches to coping with educational struggles relate to these differences.

Fourth, this study helps to reconcile inconsistencies in the literature on whether there is an interaction between mindset and family background leading to a stronger effect of mindset on achievement among students with lower-SES backgrounds. It does so by suggesting that this matter is related to students' prior educational outcomes. Concretely, I have found that the level of fixed mindset interacts with parents' education in predicting high-school GPA in models without conditioning on prior performance, but not when prior achievement is included in the model. In the literature, the unconditional interaction has been interpreted as evidence of a stronger positive effect of holding a growth mindset among low-SES students. However, the fact that this relationship disappears when similarly performing students are compared suggests that the association with school performance is an important mediating factor.

On the one hand, conditioning on prior performance when analyzing relationships across time more credibly isolates academic processes when the mindset measure was collected, but it may also "control away" influences of SES and mindset on academic performance that operate prior to high school (Destin et al., 2019). On the other hand, not conditioning on prior performance may overestimate the role of mindset and parents' education by not relating them to the students' educational experiences. Longitudinal studies might be the best choice here, but in studies analyzing the interaction at a single timepoint, one solution could be to perform separate analyses on low-performing and high-performing students.

The present study also prompts certain general conclusions about suitable avenues for future research and about appropriate teacher practice. While mindset theory hypothesizes that many students are socialized into believing that only certain people can be successful in school, and that these beliefs guide their motivation and behavior, it devotes little attention to differences by family background. In fact, when social class is measured in psychological studies, it is often relegated to being a control variable instead of a key variable (Diemer et al., 2013). Controlling for social class may reduce the bias of estimates, but it also makes it impossible to draw conclusions about whether the relationships among the study variables are mediated or moderated by social class (Diemer et al., 2013). Insights from sociology could be exploited to add to the mindset-theory literature by examining how mindset relates to family

background and educational experiences. This might contribute to a deeper understanding of the fundamental relationships involved.

As stated in the Introduction section, the mechanisms used in the sociological literature to explain differences in performance by family background often relate to properties of individuals, families, and societies that are difficult to change (Jackson, 2013). However, as noted by Heggen et al. (2013), several perspectives taken in the sociological literature have explanatory power in predicting performance inequality by family background and it is likely that many mechanisms are at play at the same time. A shift in focus toward examining presumably more *malleable and teachable* social and emotional skills and mindsets may be a promising step, especially given that these skills are also more policy amenable.

Teachers can promote a growth mindset by focusing on the learning process instead of on students' performance, and by framing failures and setbacks as opportunities for students to increase their understanding—not as indicative of shortcomings (Haimovitz and Dweck, 2017). DiPrete and Jennings (2012) found that children from high-SES backgrounds have stronger noncognitive skills. However, the same authors also argue that these skills can clearly be taught and that teachers evidently differ in their ability to transmit them to their students (Jennings and DiPrete, 2010). There is a need for further research to examine how teachers and the school environment can teach—low-performing students in particular—about their potential to grow and about how they can handle educational struggles. The findings from such research could be beneficial for the development of better practices in schools and for the targeting of interventions to reduce inequality and help more students fulfill their potential.

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Notes

1. When only the control group is analyzed, the same relationships are found.
2. Additional analyses show that students' level of fixed mindset when entering high school predicts their high-school GPA similarly in the vocational and academic tracks.

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Author biography

Elin Svensen graduated with a master's degree in sociology in 1998. Currently she is a public sector PhD candidate employed by Rogaland County Council, Norway, pursuing a doctoral degree in social science at UiS Business school, University of Stavanger. Her current research focuses upon high school education, especially the role of socioemotional skills and academic achievement.

Appendix

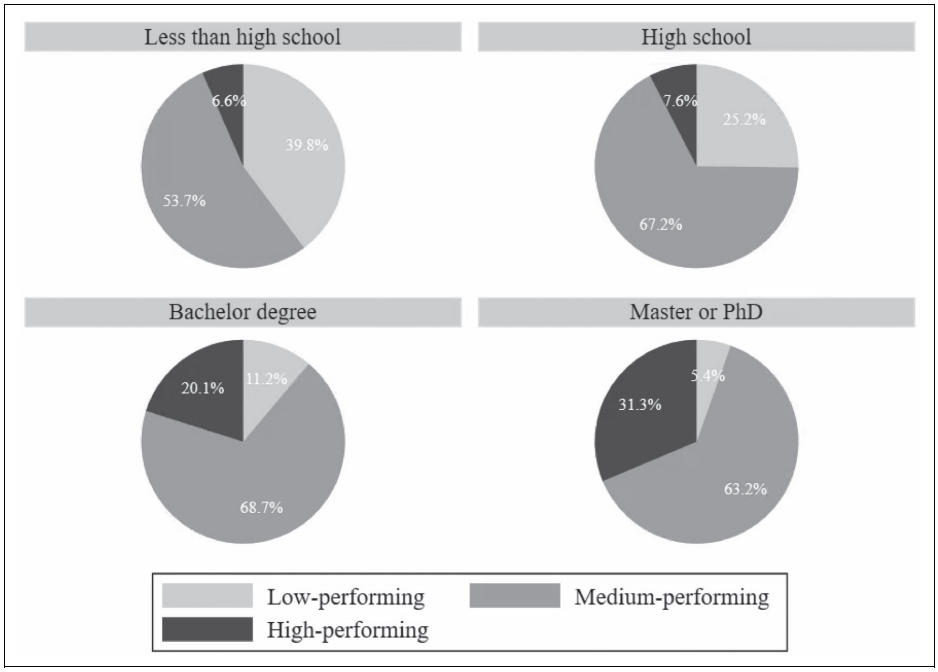


Figure A1. Proportions of low-performing, medium-performing, and high-performing students by parental education. Middle-school grade-point average is grouped at one standard deviation (STD) below and above the mean, with the medium-performing group consisting of those performing +-1STD from the mean.

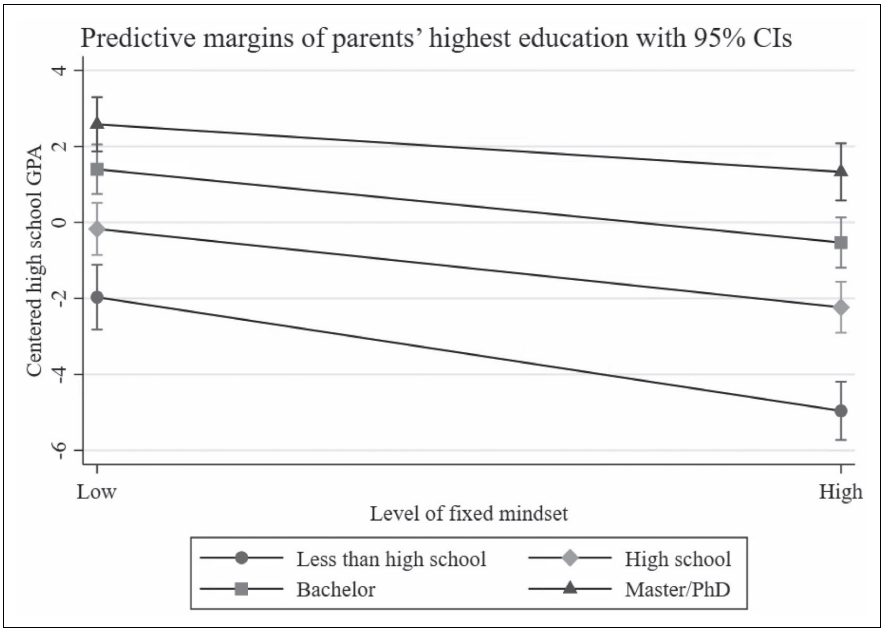


Figure A2. Predictive margins of parents' highest level of education with 95% confidence intervals from multilevel regression with mean-centered high-school grade-point average (GPA) as dependent variable. The regression is similar to Model 4 in Table 4 (not conditioning on middle-school GPA). Fixed mindset is plotted at one standard deviation below and above the mean. The figure shows that a lower level of fixed mindset is associated with a higher high-school GPA (centered) among all students, but the difference between students with a low and high level of fixed mindset, respectively, is larger among students whose parents' highest level of education is less than high school.

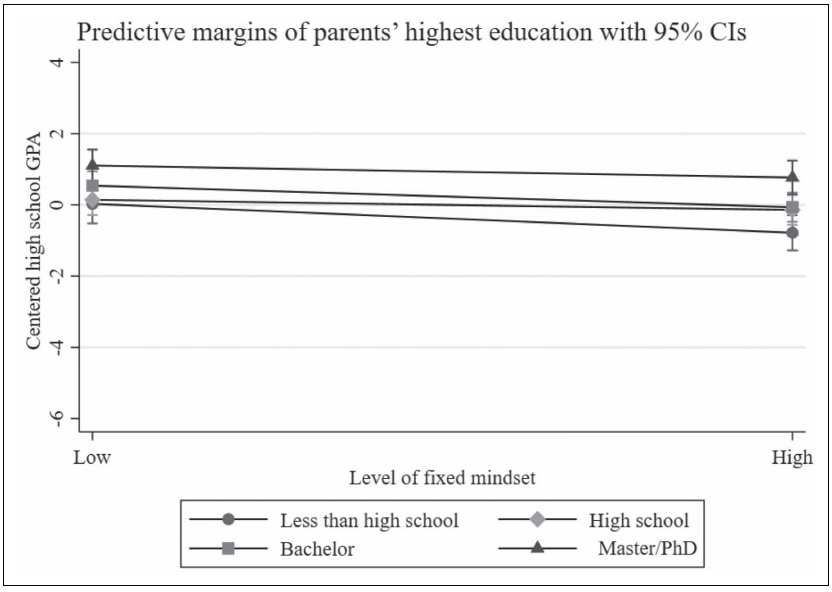


Figure A3. Predictive margins of parents' highest level of education with 95% confidence intervals from multilevel regression with mean-centered high-school grade-point average (GPA) as dependent variable. The regression is similar to Model 5 in Table 4 (with conditioning on middle-school GPA). Fixed mindset is plotted at one standard deviation below and above the mean. The figure shows that, among students with similar middle-school performance, there is no interaction between parents' level of education and students' level of fixed mindset in predicting high-school GPA.

Appendix 2: Growth mindset, prior performance, and high school completion for boys and girls

Growth mindset, prior performance, and high school completion for boys and girls

By Elin Svensen

Abstract:
While grade point average (GPA) from middle school is known to predict high school completion, less is known about how students' level of growth mindset is associated with GPA and completion. In this study, I examine the relationship between GPA from middle school and growth mindset. Further I use multilevel logistic regression to investigate how GPA and growth mindset predict high school completion. I find that a higher GPA from middle school is associated with a higher level of growth mindset among boys as well as girls. A higher level of growth mindset upon entering high school significantly predicts high school completion, even among students with similar GPA from middle school. Moreover, the average marginal effect of growth mindset on completion is highest among the students who were lowest performing in middle school. These relationships are similar for boys and girls.

Key words: growth mindset, high school, completion, gender achievement gap, prior performance.

Introduction

Students' academic achievement from middle school is a strong predictor of high school completion in Norway (Andersen and Hansen, 2012; Markussen et al., 2017;). Further, high school completion strongly predicts the likelihood of having a job at the age of 30 (Markussen et al., 2020). Based on this evidence, nationwide interventions in the transition between middle and high school in Norway have targeted students' basic skills, particularly among the lowest performers (Tvedt, 2022). However, this emphasis on strengthening basic skills has not yielded the intended effects for students at the lowest achievement levels (Huitfeldt et al., 2018). Tvedt (2022) suggests that such interventions should also target aspects related to the learning environment of schools.

International research suggests that children who enter school with strong socioemotional skills are more likely to profit from schooling; for example, by learning the most from classroom instruction (DiPrete and Jennings, 2012; Duncan et al., 2022). Research also points to the fact that socioemotional skills become increasingly important for educational success, especially as a child gets older (Cunha and Heckman 2008, Steinberg 2014).

While we know that grade point average (GPA) from middle school is an important predictor of high school completion, we know less about the role of socioemotional skills in predicting educational outcomes in the Norwegian context, and we have scarce knowledge of how GPA

from middle school relates to students' level of socioemotional skills. The aim of this study was to empirically investigate how achievement from middle school and level of growth mindset upon entering high school relate to each other and to what extent they are predictive of high school completion. I focused on one specific aspect of socioemotional skills: growth mindset. According to Gouëdard (2021), growth mindset might explain why certain students thrive when facing difficulties while others deteriorate.

Students with a growth mindset believe intelligence is a malleable feature, whereas students with a fixed mindset believe intelligence is a stable trait (Dweck and Yeager, 2019). These beliefs are crucial for motivational orientation. Students who hold a growth mindset take more advantage of learning opportunities in school and show higher persistence in schoolwork (Yeager et al. 2019). They also ascribe positive beliefs about effort and embrace setbacks as information about the learning process rather than a signal of inaptness (Dweck, 2017).

I investigated the relationships for girls and boys. Girls in Norway—as in most countries—perform on average better than boys in both middle- and high school. Several studies find that girls have higher levels of socioemotional skills than boys (DiPrete and Jennings, 2012).

The role of social and behavioral skills in producing gender differences in educational outcomes is left largely unaddressed in the literature on gender gaps in achievement (DiPrete and Jennings, 2012). Furthermore, the literature documenting differences in social and behavioral skills has largely remained separate from the literature documenting academic performance differences between boys and girls (DiPrete and Jennings 2012). One of the few studies combining both aspects finds that academic returns on social and behavioral skills are roughly the same for boys and girls. However, since girls on average start school with more advanced social and behavioral skills, their skill advantage grows over time (DiPrete and Jennings, 2012).

The current study, based on 10,000 youngsters in a Norwegian context, contributes to the literature by empirically investigating the relationship between performance from middle school and growth mindset in high school. I describe how boys as well as girls who were low-performing in middle school express, on average, a lower level of growth mindset when they entered high school than did students who were high-performing. A higher level of growth mindset positively predicted completion of the first year of high school even among similar performing students. Moreover, low-performing students who did hold a higher level of growth mindset when they entered high school had a higher predicted probability of completing the first year of high school than their low-performing peers with a more fixed mindset. These relationships are similar for boys and girls.

Conceptual Framework

GPA from middle school as a predictor of learning

A broad range of literature documents how prior academic achievement is one of the most important predictors of future performance. There are several possible mechanisms through which past achievement operates as a strong predictor for future learning.

First, a strand of economic literature accentuates how skills beget skills. A higher stock of academic competencies in one period raises the stock of next period skills through self-productivity (Cunha and Heckman, 2008). Self-productivity implies that skills acquired in one period persist into future periods, and that they will have positive spillover effects on other skills (Cunha and Heckman, 2008). The idea that learning begets learning posits that those who already have high skills can take better advantage of learning opportunities in the classroom. Psychological literature finds that prior knowledge is positively related to new learning of domain-relevant information, and curiosity to learn the information appears to mediate this relationship (Witherby and Carpenter, 2022).

Second, it may be that grade point average (GPA) from middle school reveal more than mastery of content. Bowen et al. (2009) suggest that GPA also reveals qualities of motivation and perseverance – as well as the presence of good study habits and time management skills – that tell us a great deal about the chances that a student will complete a program. In a US study, Bowen et al. (2009) found that high school grades had much higher predictive power on bachelor's degree graduation than SAT test[1] scores, indicating that GPA reveals more than mastery of content, and that the factors related to such socioemotional skills are more important for completion than the basic skills revealed in tests.

In other parts of the literature, GPA is considered an important signal to the students about their academic ability and expected to strongly influence their educational decisions (Holm et al. 2019, Gambetta 1987). In this literature, GPA signals to the students whether they possess higher or lower skills than the other students and this affects the choices they make, especially when it comes to following more demanding educational routes, and staying on or dropping out of education. It is implied that students adjust to the GPA-signals through estimates of the likelihood of success and estimation of costs (Gambetta, 1987).

Growth mindset as a predictor of learning

Socioemotional skills can be seen as psychosocial and self-regulatory resources which can be utilized to select and pursue goals (Lechner et al., 2019). The belief that intelligence is fixed—that either you have it, or you do not—can lead people to attribute academic setbacks to inability

[1] SAT test is a standardized test used for assessing and evaluating students, often used for college admissions in the US

and reduce motivation (Walton and Wilson, 2018). Holding a growth mindset is one particular socioemotional skill (Kraft, 2019).

The aim of the mindset theory is to understand the psychology behind challenge seeking and resilience—why some people run from difficulty, while others embrace it—and thereby understand why some people fulfill their potential and others do not (Dweck and Yeager, 2019). The mindset theory expresses how people form beliefs based on their experiences and how these beliefs can guide their motivation and behavior. Students with a fixed mindset believe that intelligence or talent is an innate ability that is stable over time (Dweck and Yeager, 2019). In contrast, students with a growth mindset believe that intelligence is malleable and can be developed through hard work, asking for help, and using good strategies for learning. Students with a growth mindset are considered to hold a more positive effort belief—believing that effort is something positive that helps grow their capacity instead of a negative factor that shows a lack of ability.

Mindset is assumed to be a result of socialization and messages from, for instance, parents and teachers (Dweck, 2017). Recently, peer mindsets have also been suggested to influence individual mindset (Sheffler and Cheung, 2020). In general, it is found that personal feedback leads to a greater belief in stable traits in contrast to process feedback (Kamins and Dweck, 1999). For instance, praise for intelligence is found to lead students to believe more in intelligence as a stable trait (Mueller and Dweck, 1998). Auestad (2020) found that being exposed to a math teacher with more of a growth mindset during the last year of middle school positively affected students' level of growth mindset. Kraft (2019) also found large teacher effects on students' level of growth mindset.

Extensive prior research has investigated the causal relationship of growth mindset on academic performance and challenge seeking (Yeager et al., 2019; Rege et al., 2020; Bettinger et al. 2018) in large scale, randomized control trials. Other studies have examined the descriptive relationships between level of growth mindset and other factors like educational experiences and prior performance. In PISA 2018, a positive relationship between holding a higher level of growth mindset and academic performance was found in 74 out of 78 countries (Gouëdard, 2021). Norway participated in the PISA survey but chose not to include this measure. Claro and Loeb (2018) found that a higher level of growth mindset predicted achievement gains among fourth to seventh grade students in California even with controls for previous achievement, students' background, and other socioemotional variables.

The gender gap in achievement and growth mindset

While most studies have found no or only negligible gender differences in general intelligence (Spinath et al. 2014), girls generally perform better than boys on teacher-assigned school marks throughout mandatory schooling in most countries (Voyer and Voyer, 2014). In Norway, girls, on average, perform better than boys in all subjects except physical education (The Norwegian Directorate for Education and Training, 2022). The national gender gap in GPA in Norway after

completing compulsory education (middle school) was 4.3 grade points in 2022, with girls obtaining on average 45.6 grade points (GPA) and boys 41.3. The GPA includes both teacher-assigned grades and exam grades.

Findings from the PISA study in 2015 show that gender gaps in middle schools in Norway in favor of girls are very pronounced when considering attitudinal and motivational aspects of learning (Borgonovi et al., 2018). Norwegian boys in the PISA study reported putting less effort than girls into their studies, and they were more likely to believe that trying hard in school does not matter. The PISA findings on gender differences in attitudinal and motivational aspects of learning among boys and girls in Norway were not analyzed in relation to academic performance.

In early works, Dweck (2007) describes stereotypes about women being bad at math and science as harmful and leading to a more fixed mindset among girls. Thus, two assumptions have become suggested in the mindset literature. One is that girls are more likely to have fixed mindsets than boys, and the second is that girls and women with high IQs are especially likely to have fixed mindsets (Macnamara and Rupani, 2017). However, little evidence supports these assumptions and, across three studies, Macnamara and Rupani (2017) conclude that there is no difference between adult women's and men's mindset. On the contrary, in the study of adolescents (mean age = 18 years old) they found that women are more likely to hold a growth mindset than men. In PISA 2018, girls are slightly more likely than boys to express a growth mindset (Gouëdard, 2021).

Context

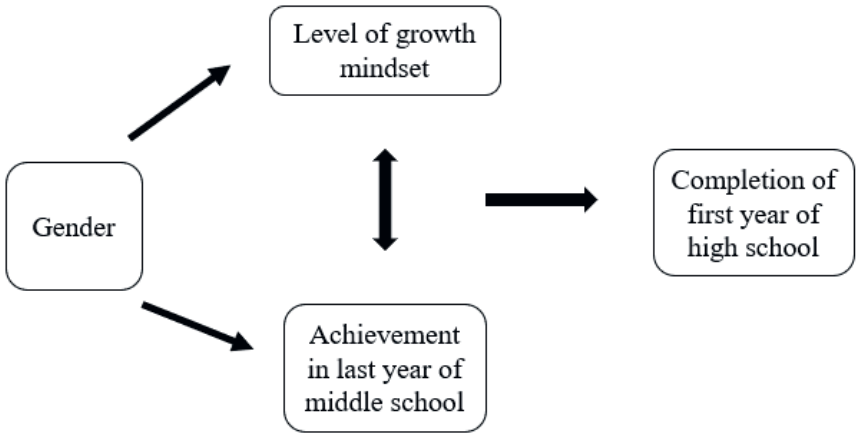
High school education in Norway starts from age 16, after 10 years of compulsory education. While not being mandatory, 98 percent of students who graduate from middle school are in high school education the following school year. In high school, students can choose between academic and vocational education programs. Students are entitled to be admitted to one of three ranked education programs, and the admission for students in this study was based on GPA from middle school. After three years in academic track, students will obtain a university admission certificate if they pass all the subjects. In vocational track, the model is two years in school and two years in apprenticeship to obtain a trade certificate, but the students also have the option to apply for a one-year program of supplementary studies leading to university admission certification after year two or after obtaining a trade certificate.

Research questions and conceptual model

Guided by the literature review, I developed a conceptual model that connects the variables in the study. Figure 1 presents the conceptual model for the analysis. In the model, it is suggested that gender relates to achievement in the last year of middle school and to the level of growth mindset. I expected to find a higher GPA and a higher level of growth mindset among girls.

Further, it is suggested in the model that level of growth mindset and GPA from middle school may be interrelated and that both factors are likely to be associated with completion of first year of high school. In this correlation study, I did not aim to detect causal relationships. The measures for GPA and mindset are from end of middle school and start of high school. Hence, I cannot conclude whether achievement in middle school affected the level of growth mindset or vice versa. My aim was rather to investigate the descriptive associations as a basis for further inquiry. A substantive body of empirical work shed light on how socioemotional skills contribute to educational outcomes (Lechner et al., 2019). Lately, studies have also asked how educational factors, in turn, contribute to the formation of socioemotional skills (Lechner et al., 2019).

Figure 1: Conceptual model



In light of the conceptual framework and model, this article seeks to answer several questions:

1. At the start of high school, what is the relationship between academic achievement from middle school and students' level of growth mindset? Is the relationship different for boys and girls?
2. To what extent is the level of growth mindset at the start of high school predictive of completion of the first year of high school? Is the relationship different according to prior performance and gender?

I examine these research questions through high-quality data material from two counties in Norway. The data consists of survey data on self-reported level of growth mindset from 10,000 students at the start of high school, and registry data on achievement from middle school and completion of high school. I focus upon the first year of high school, because prior research has shown that failing to complete the freshman year is highly predictive of eventual graduation from high school (Allensworth and Easton, 2007).

Empirical approach

Data

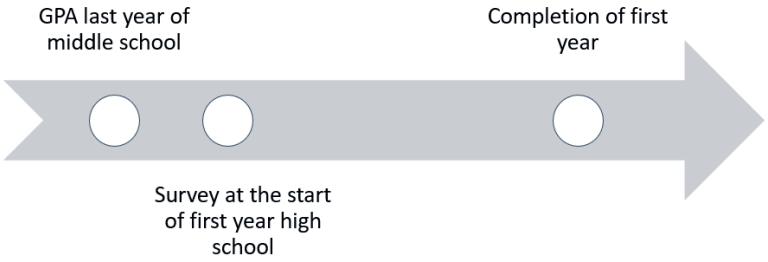
The data material in this study is from a large, randomized control trial testing a mindset intervention undertaken in the first weeks after entering high school (Rege et al., 2020).[2] Students from 58 high schools were invited to participate in the study, conducted in two counties in Norway.[3] The treated students received a growth mindset intervention while the control group was taught basic information about the brain. The survey measures were gathered prior to the first section of the intervention. The sessions were mandatory for the students to attend as part of the instruction, but they gave consent as to whether the answers and registry data could be used for research. The consent rate was 90.8 percent. Survey data was matched with administrative data on grades from middle school and at the end of the first year. In addition, data from Statistics Norway on parents' education, income, and birth year was matched on the individual level. Figure 2 describes the timeline for the collected data.

The total data sample of students who started their first year in ordinary programs was 9,696. From this sample, 179 students were deleted. These included students who took the first grade over two years or students in special education (81 observations) as well as other students not following ordinary education (14 observations). Also, students with 0 GPA from middle school were deleted (71 observations) since some of them could have high competence, but not a GPA score due to illness or because they went to a private school with a non-grading practice. Five students with missing values on the mindset variable were deleted as well as eight students with missing values on the completion variable. The sample size was thereby reduced to 9,517.

[2] The study is approved by Sikt, project number 47205

[3] All public high schools in the counties, except one, were included in the sample.

Figure 2: Data timeline



Variables

Completion of high school was measured after the first year and showed if the student had completed the year and passed all the subjects.

The GPA from middle school was computed as the tenth grade GPA (values ranging from 11.6 to 60). Further, I included a gender dummy (female = 1) and a dummy variable for which educational track students are in (vocational track = 1).

The level of growth mindset was calculated using two questionnaire items. Participants responded on a six-item scale ranging from 1 ("strongly disagree") to 6 ("strongly agree") to two statements: "You have a certain amount of intelligence, and you can't really do much to change it" and "Your intelligence is something about you that you can't change very much." The correlation between these two items was 0.69 (Chronbach's alpha: 0.83). An average score of the two questions was computed for each participant. The scale was inversed to represent growth mindset as the higher score. This type of measure of mindset, based on two or more statements, is often used in international literature (Yeager and Dweck, 2020).

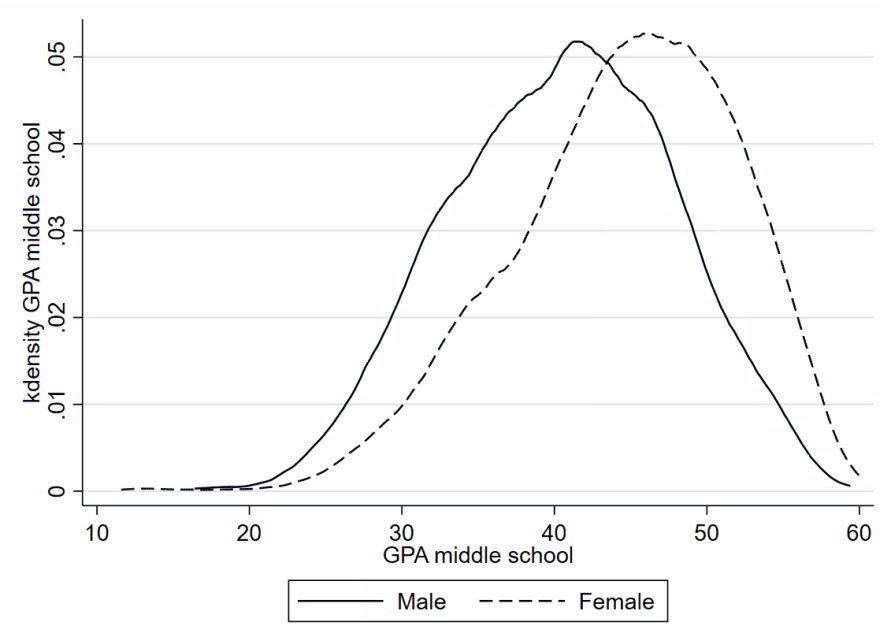
Table 1 shows mean scores of the variables in the analysis for all students and separately for boys and girls as well as the result from a T-test examining the difference between boys and girls. Of these, 93 percent completed the first year, and there is not a significant difference between boys and girls. As expected, girls have a higher GPA after middle school. Girls also have a significantly higher average level of growth mindset than boys. Of all the participants, 34 percent are in vocational track, and this share is higher among boys than among girls.

Table 1: Summary statistics for boys and girls separately

	All students		**Boys**		**Girls**		**Difference**	**P-val**
	Mean	SD	Mean	SD	Mean	SD		
Completed first year	0.93	0.26	0.92	0.27	0.93	0.25	-0.01	0.029
Growth mindset	4.34	1.15	4.29	1.2	4.39	1.09	-0.10	0.000
GPA middle school	42.50	7.60	40.42	7.3	44.51	7.35	-4.38	0.000
Vocational track	0.33	0.47	0.39	0.49	0.28	0.45	0.12	0.000
N	9517		4674		4843			

In addition to the mean GPA from middle school, it can be informative to also look at the distribution of GPA for boys and girls. Figure 3 presents a kernel density plot for the distribution of GPA from middle school for boys and girls. More girls than boys are in the upper part of the distribution, and more boys are in the lower part.

Figure 3: Kernel density plot of GPA from middle school for boys and girls. N = 9,517



Correlations among the study variables are shown in Table 2. GPA from middle school is positively correlated with growth mindset. Moreover, growth mindset and GPA from middle school are positively related with completion of first year. Being a student in vocational track is negatively correlated with growth mindset, GPA from middle school, completion of first year, and gender (female).

Table 2: Correlations among the study variables

	1	**2**	**3**	**4**	**5**
1. Female	-				
2. Growth mindset	0.04	-			
3. GPA middle school	0.27	0.23	-		
4.Track (vocational)	-0.13	-0.15	-0.59	-	
5. Completed first year	0.02*	0.08	0.25	-0.05	-

Note: All correlations are statistically significantly different from zero ($p<0.01$ for all values except the one marked * where $p<0.05$) N = 9,517

Analytic strategy

To answer research question 1, I examined the relationship between performance in middle school and growth mindset using binned scatterplot with separate series for boys and girls. The intent was to examine expressed level of growth mindset among boys and girls according to their performance in middle school. In the scatter plot, the x-axis is divided into evenly spaced bins and then the mean x and y values are plotted within each bin. The proportion of boys versus girls in each bin constructed from GPA middle school can differ. For instance, there are 2.3 times more boys than girls (320 vs 137) in the lowest performing bin and 3.6 times more girls in the highest performing bin (380 vs 105). The proportion of boys and girls is closer to 50-50 in the medium performing bins.

The plot shows a linear fit line using OLS, which represents the best linear approximation to the conditional expectation function. If the binned scatterpoints are dispersed around the regression line, the slope is imprecisely estimated, implying that standard error is large (Stephner, 2014).

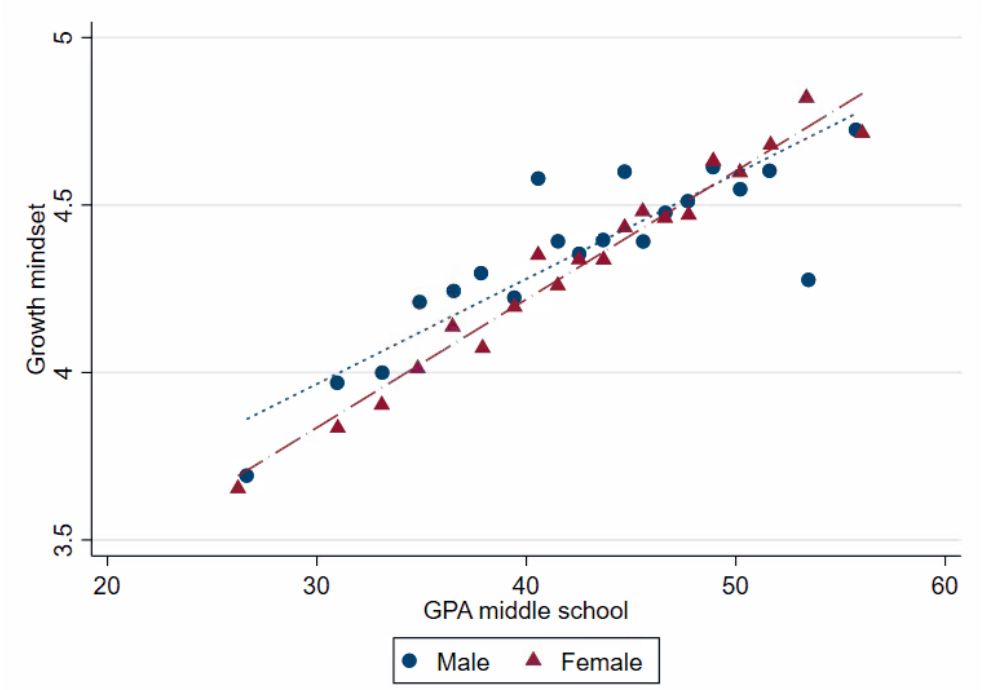
To answer research question 2, I used multilevel binary logistic regression analysis with random effects investigating how students' level of growth mindset and prior academic achievements when they entered high school are predictive of high school completion. High school class is specified as panel variable. Treatment status is controlled for in the regressions, and the visual presentations display predicts values for untreated students only.

Results

What is the relationship between performance in middle school and level of growth mindset for boys and girls?

To analyze the first research question, I examine the distributions of GPA from middle school and the corresponding levels of the students' expressed growth mindset when they entered high school (Figure 4).

Figure 4: Relationship between GPA from middle school and level of growth mindset for boys and girls



Note: *Binned scatterplot showing mean growth mindset for boys and girls in each bin for GPA. GPA from middle school is divided into 20 bins.* N = 9,517

Figure 4 presents a positive relationship between grades from middle school and students' expressed level of growth mindset. The higher GPA that students had at the end of middle school, the higher average score they expressed of growth mindset. Students who were low-performing in middle school expressed levels of growth mindset well below the mean and agreed more that their intelligence is fixed. Boys and girls with a similar GPA from middle school expressed, on average, similar levels of growth mindset. In the second-highest performance bin, the mean level of a growth mindset is lower among boys than among girls, indicating that some high-performing boys tended to have a more fixed view of intelligence. Since this scatter point is far from the regression line, it also indicates a large standard error in this bin. The positive relationship between mindset and GPA has also been found in prior studies (Bettinger et. al., 2018; Blackwell et al., 2007).

To what extent is level of growth mindset predictive of high school completion?

Now that we know more about the relationship between growth mindset and prior performance, I move on to investigate how level of growth mindset predicts completion of first year of high school. In Table 3, I examine two different models, one with growth mindset in addition to gender and track, and one with GPA from middle school included in the model.

Table 3: Odds ratios of multilevel logistic regression predicting completion of first year of high school.

	Model 1	Model 2
Female	1.13	0.69***
Growth mindset	1.24***	1.09*
GPA middle school		1.21***
Vocational track	0.75*	3.78***
N	9,517	9,517

Note: *Notes*: * p < 0.05, ** p< 0.01, *** p < 0.001. Dependent variable: completion of first year of high school. Multilevel logistic regression, panel variable: high school class. Each column presents a separate regression and reports the odds ratio for included covariates. Treatment status is controlled for in the regressions. The LR test confirms that the panel-level component is important and different from the pooled estimator. N = 9,517.

The odds ratio shows the odds of an event for two individuals differing by one unit on the independent variable, and it measures the ratio of odds, not the ratio of probabilities (Niu, 2020)

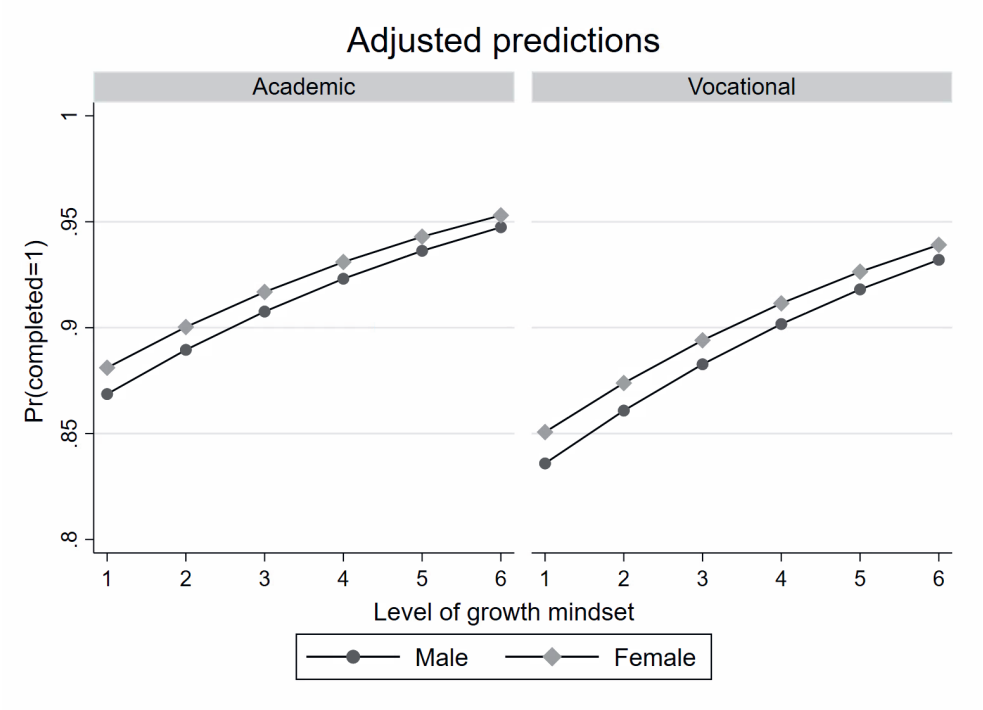
In Model 1 in Table 3, I find that a higher level of growth mindset positively predicts completion, while attending vocational track is associated with a lower predicted completion rate. There is no significant difference between boys and girls. In Model 2, GPA from middle school is included. A higher GPA from middle school as well as growth mindset positively predict completion of the first year while girls are predicted to have a lower completion rate than otherwise similar boys. Students in vocational track have a higher predicted completion rate than otherwise similar students in academic track.

The coefficients in logistic regression cannot be compared across the models in Table 3. This is partly due to the fact that the dependent variable gets rescaled as different variables are included (Williams and Jorgensen, 2023). The relationships are instead examined in visual presentations. To quantify the strengths of the relationships, I estimated adjusted predictions at representative values (Williams, 2012) to examine the probability of completing the first year of high school depending on different levels of the independent variables.

First, I explore the relationships in model 1 to illustrate how students' level of growth mindset predicts completion of first year of high school. Figure 5 shows how the predicted completion rates differ for students according to their level of growth mindset in both academic and vocational track. The difference in predicted completion rates between students with the highest and lowest level of growth mindset in academic track is 10 percentage points for girls and 9 for

boys. In vocational track, the difference is 7 percentage points for girls and 8 for boys. Model 1 in Table 3 shows insignificant gender differences. A separate test contrasting boys and girls shows that there are no significant differences between boys and girls at any level of levels of growth mindset.

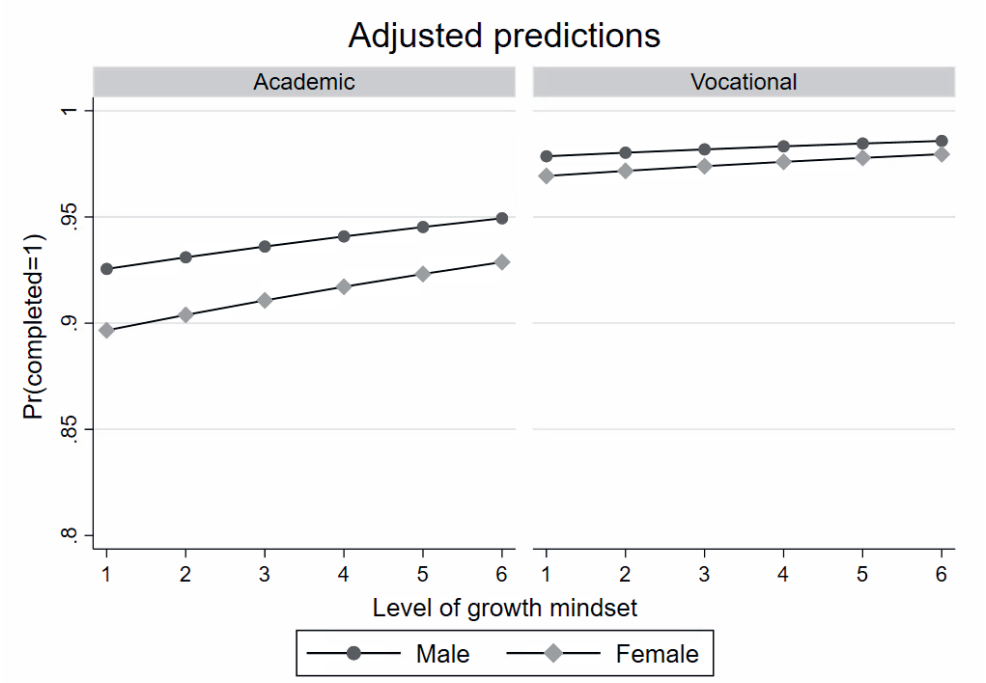
Figure 5: Predicted completion rates for students with different levels of growth mindset



Note: Predicted completion rates for boys and girls in academic and vocational track at representative values of growth mindset (1 to 6). Figure based on model 1 in Table 3.

The relationships in Figure 5 show the predicted completion rates without considering that level of growth mindset varies by prior performance (as shown in Figure 4). In Figure 6, I use the coefficients from model 2 in Table 3, where the relationship for similar performing students is examined. The figure presents predicted completion rates for students with mean GPA from middle school (42.5 grade points) according to their level of growth mindset. Among mean performing students, the difference in completion according to level of growth mindset is smaller; in academic track the difference is around 3 percentage points for boys and 4 for girls. In vocational track, the difference is around 2 percentage points for boys and 1.5 for girls. Mean performing students have a higher predicted completion rate in vocational track than in academic track.

Figure 6: Predicted completion rates for similar performing students with different levels of growth mindset



Note: Predicted completion rates for boys and girls in academic and vocational track at representative values of growth mindset (1 to 6). Figure based om model 2 in Table 3 for students with mean GPA from middle school.

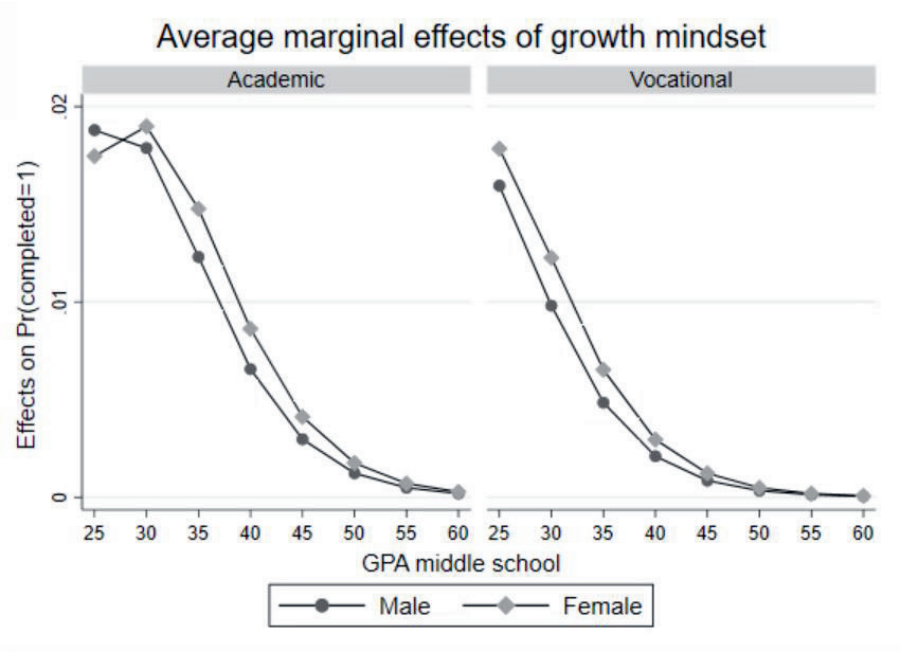
The analysis so far has shown that students with a low level of growth mindset have a lower predicted completion rate than students with a high level of growth mindset and that this difference is smaller when we compare students with mean GPA from middle school. Next, I investigate if this relationship differs for low- and high-performing students. Average marginal effects at representative values (Williams, 2012) can be used to investigate how a one-unit change in mindset may vary across representative values of GPA from middle school. In Figure 7, I explore the average marginal effect of growth mindset at representative values of GPA from middle school (still based on model 2 in Table 3). The figure shows that a one unit increase in growth mindset positively and significantly predicts completion for students at all specified grade levels except the two highest (55 to 60 grade points). The magnitude of the marginal effect is highest for students with 25 grade points from middle school. For these students, a one-unit change in the mindset variable is associated with around a 2-percentage point-higher predicted

completion rate (as seen in the figure). Based on this, the difference in predicted completion rates between students who hold value 1 and 6 (five units change) will be 9 to 10 percentage points.[4]

The average marginal effect of growth mindset is not significantly different for boys and girls. For students with a GPA from middle school higher than 25, the marginal effect of growth mindset is higher in academic track than in vocational track. There are no significant differences between boys and girls in the marginal effects of growth mindset at representative values of GPA.

These results suggest that for students who achieved a low GPA in middle school, it matters more for predicted completion rates whether they hold a high or a low level of growth mindset when they enter high school than it does for higher performing students.

Figure 7: Average marginal effects of growth mindset

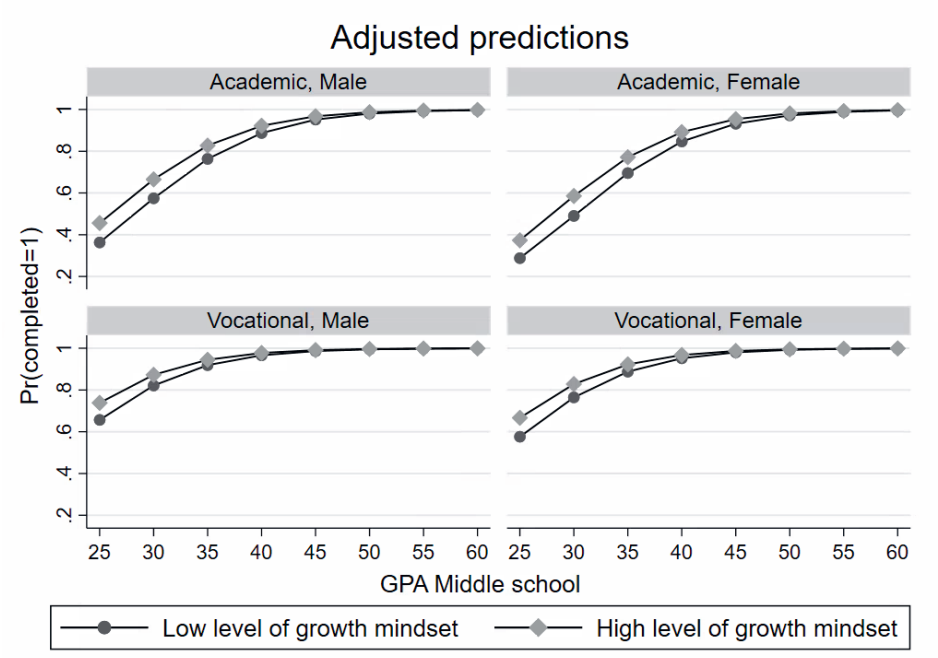


Notes: Average marginal effects of growth mindset on predicted completion after first year of high school at representative values for GPA middle school for boys and girls in vocational and academic track

[4] Predicted completion rate for boys with a GPA of 25 and value 1 and 6 for growth mindset: 76 percent versus 67 in vocational track, 35 versus 45 in academic track. For girls: 68 versus 58 in vocational track and 27 versus 36 in academic track. (Predict: boys: 74 versus 66 in vocational and 46 versus 36 in academic, for girls 37 versus 29 in academic and 67 versus 58 in vocational

So, do low-performing students who hold a growth mindset complete at the same levels as their higher-performing peers? To answer this question, I studied the predicted completion rates at a given grade level according to a high and a low mindset. This is shown in Figure 8. A low level of growth mindset is plotted at value 1 and a high level is value 6. The figure shows a strong relationship between GPA from middle school and completion of high school. Among the students who were high performing in middle school, the predicted completion rate is close to 1 regardless of mindset, gender, and which track the students are in. Lower-performing students have a higher predicted completion rate in vocational than in academic track. This has also been found in other studies and is interpreted as being due to differing evaluation regimes (Grøgaard and Arnesen, 2016). Within both tracks, low-performing girls have a lower predicted completion rate than similarly performing boys with the same level of growth mindset. Holding more of a growth mindset increases the predicted completion rate among low-performing students, as also shown in Figure 7, but holding more of a growth mindset does not fully outweigh the predictive effect of GPA from middle school on completion.

Figure 8: Predicted completion rates for similar performing students with low and high level of growth mindset



Note: Predicted completion rates for boys and girls at representative values of GPA from middle school (25 to 60 grade points) and low and high level of growth mindset in academic and vocational track (value 1 and 6). Based on model 2 in Table 3

Discussion

The aim of this article was to examine the relationship between performance in middle school and level of growth mindset when students enter high school and to investigate how these factors are predictive of completion of the first year in high school.

First, I examined the relationship between level of growth mindset and GPA from middle school. Consistent with the previous literature (Blackwell et al., 2007; Bettinger et al., 2018), I found that students with a higher GPA on average hold a higher level of growth mindset. Moreover, boys and girls with similar achievements from middle school express similar levels of growth mindset when they enter high school. Like Macnamara and Rupani (2017), I find no sign of higher levels of fixed mindset among high-achieving girls. Second, I examined how mindset and GPA from middle school predict high school completion. Holding a higher level of growth mindset significantly predicts completion after the first year of high school. Since there is a relationship between mindset and GPA from middle school, the difference according to mindset is smaller when we compare students who were similar performing in middle school. Furthermore, the results show that the marginal effect of holding a more growth mindset is larger for the students who were low-performing in middle school. While many low-performing students hold low levels of growth mindset when they enter high school, the ones who express more of a growth mindset are predicted to complete the first year to a higher extent than low-performing students with a fixed mindset. The difference in predicted completion rates for low-performing students at the highest and lowest value of the mindset measure is around 10 percentage points for boys as well as girls in both vocational and academic track.

What do these results tell us? First, they show that there is a positive relationship between higher performance in middle school and level of growth mindset, a socioemotional skill which is considered important for persistence in the education sector. Next, they show that low-performing students who do hold more of this skill have a higher predicted probability of completion.

This descriptive study cannot explain why we find a positive association between a higher GPA from middle school and a higher level of growth mindset; this will have to be explored in other studies. One explanation could be that students have a higher GPA at the end of middle school because they have had a higher level of growth mindset throughout compulsory education and that this has positively affected their achievement level. This would be a likely interpretation according to the mindset theory. On the other hand, it could also be that students have adjusted their mindset according to messages from parents and teachers responding to their performance in middle school. Further, they may have adjusted their mindset as a result of GPA (signals) during compulsory education, as suggested by more rational choice-oriented researchers (Holm et al., 2019; Gambetta, 1987). Finally, it could be that GPA from middle school to some extent reveals both academic and socioemotional skills, as proposed by Bowen et al. (2009). The origin of the

association between mindset and prior performance might also be different for different types of students, depending on the context they have been in and how they have encountered struggles.

Nonetheless, the correlation between GPA from middle school and level of growth mindset presented in the empirical approach section is 0.23. While the association between mindset and achievement is positive, it is far from linear. Some students with low achievement from middle school enter high school with a high level of growth mindset, and some students who were high performing in middle school enter high school with more of a fixed mindset.

I find that the magnitude of a one-unit change in the level of growth mindset on predicted completion is larger for the students who were low-performing in middle school. Blackwell et al. (2007) found emerging achievement patterns between students with a fixed and a growth mindset during the transition to junior high school. These authors argue that when students encounter the challenges of middle school, those with a fixed mindset are less equipped to surmount them. In the current article, I investigated the transition to high school, but the same mechanism could be in play. It may be that low-performing students with a higher level of growth mindset are more equipped to overcome the academic challenges they face in high school due to lower basic skills manifested by GPA, and hence have a higher predicted completion rate. Such a difference according to mindset is not found among the high-achieving students, but they may also be less exposed to educational struggles due to higher academic skills when they enter high school.

Girls have a lower predicted completion rate than similarly performing boys. This has also been found for completion according to normative length of study (Falch et al., 2016). The difference is found among students who were low-performing in middle school, and we know that fewer girls than boys are low-performing. Hence, low-performing girls is a more selected group than boys at the same grade level. This study does not reveal why girls have, on average, a higher GPA from middle school and, on average, express higher levels of growth mindset, but the fact that boys with similar GPA from middle school express the same levels of growth mindset as girls suggests that these relationships should be further examined.

I find that level of growth mindset predicts completion of high school similarly for boys and girls with a given grade level from middle school. As noted by DiPrete and Jennings (2012), the literature documenting differences in socioemotional skills has remained separate from the literature documenting academic performance differences between boys and girls. Future research could investigate these relationships in longitudinal designs throughout compulsory education, to possibly reveal more about the emergence of the gender achievement gap and examine the development of socioemotional skills and academic competencies among both boys and girls, especially among those who dropped behind their peers. Further investigations could also reveal if more focus upon teaching socioemotional skills and mindsets in schools could reduce the gender achievement gap.

One limitation of this study is that growth mindset was only measured after the first few weeks of high school. Hence, the study did not identify socioemotional learning in high school and its

relation to completion. Jackson et al. (2020) describe how self-reported socioemotional learning during high school more than doubled the explained variance of schools' added value compared to using only school test-score value added. I find differences in the magnitude of the marginal effect of mindset for higher values of GPA from middle school between vocational and academic track, and this could be due to more socioemotional learning during the first year in vocational track. Further research could investigate socioemotional learning in Norwegian high schools.

Overall, the study suggests that students who were low-performing in middle school may take less advantage of learning opportunities in high school since low-performing students on average express low levels of growth mindset. Also, low-performing students with more of a growth mindset have a higher completion rate than low-performing students with a fixed mindset. In the US debate, Steinberg (2014) has pointed to the fact that while the current knowledge curriculum may be essential, it remains incomplete without a parallel stream of "character education", focusing on self-regulation and especially how to deal with obstacles. In Norway, a study has shown that the national curriculum does not align with the international knowledge base emphasizing social and emotional skills that are clearly defined and whose development is as important as that of basic skills (Restad and Mølstad, 2020). These authors argue that Norwegian policymakers have a narrow understanding of social and emotional skills and underestimate the noncognitive aspects of students' learning. Would the nationwide initiatives on strengthening basic skills in the transition between middle and high school presented in the introduction section have yielded better results if they also targeted socioemotional skills as an area to strengthen along with basic skills? We don't know, but we know that growth mindset interventions have proven to increase learning more among low-performing students in the US context (Yeager et al., 2019).

By investigating the beliefs that youth hold about the nature of intelligence, as well as other socioemotional variables in future studies, we may be able to understand more about how these factors shape students' beliefs concerning their opportunities to learn and their approach to learning in high school. By focusing more upon the development of socioemotional skills in further studies, we can learn what the school context can do to teach all students, but especially the low-performing students, strategies that can increase their belief in their own learning opportunities and possibly increase completion rates in high school.

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Appendix 3: Long-Term Classroom Effects on Academic Choices

Long-Term Classroom Effects on Academic Choices*

By Elin Svensen[†,§] and Maximiliaan W. P. Thijssen[†]

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Abstract

Despite evidence linking classrooms to test scores, our understanding of how classrooms promote social and emotional skills remains limited. One skill that may be particularly relevant is the "growth mindset," that is, the belief that human abilities can be developed over time. Using quasi-random assignment to classrooms in Norwegian middle schools, we examine how classroom effects on growth mindset in middle school affect academic choices in high school. Our study reveals variation among classrooms in their ability to cultivate a growth mindset. A positive, albeit modest, correlation exists between classrooms that foster growth mindsets and those that impact test scores. Classroom effects on growth mindset affect academic track choices and enrollment in advanced math courses. The effect on track choice is particularly salient for girls as compared to boys. Lastly, students categorized as having "low" rather than "high" socioeconomic status experience a decreased likelihood of high school dropout due to classroom effects on students' growth mindset. Our findings imply that teacher training and classroom quality may be enhanced through practices that change students' beliefs about learning.

Automation and emerging new tasks continuously reshape the workplace (see, e.g., Acemoglu and Restrepo 2019). Such changes underscore the value of social and emotional skills— which are harder to automate (Beaudry, Green, and Sand 2016; Castex and Dechter 2014; Deming 2017, 2022; Edin et al. 2022) —that promote resilience and adaptability.[1] The effects of the COVID-19 pandemic on the labor market (see, e.g., Albanesi and Kim 2021) further highlights the importance of skills that enhance resilience and adaptability to new tasks and challenges. Consequently, it appears that individuals can accrue benefits from skills that transcend specific job roles or tasks (OECD 2021).

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1. Social and emotional (or socio-emotional) skills are sometimes also referred to as noncognitive or "soft" skills.

Recent evidence suggests that classroom processes may be conducive to shaping students' social and emotional skills (Blazar and Kraft 2017; Jackson 2018; Jennings and DiPrete 2010; Kraft 2019; Ladd and Sorensen 2017; Ruzek et al. 2015; Thijssen, Rege, and Solheim 2022). Among these skills, a "growth mindset"— the belief that human capacities are *not* fixed but can be developed over time (Dweck 2006) —may be particularly important.[2] In fact, not only do decades of research show that holding a growth mindset affects resilience and challenge-seeking behavior positively (Dweck and Leggett 1988; Hong et al. 1999; Mangels et al. 2006; Moser et al. 2011; Nussbaum and Dweck 2008), but recent evidence shows that classroom processes can shape a growth mindset (Kraft 2019). However, even if the classroom affects students' growth mindset, we do not know if these effects have long-term benefits and thus warrant deliberate intervention to promote them.[3]

This paper investigates how classroom effects on growth mindset in middle school affect long-term, consequential choices in high school using data collected by the U-Say Project (Rege et al. 2021). We start by replicating Kraft (2019). Key to this replication is the identifying assumption of as-good-as-random assignment to classrooms in Norwegian schools. By law, school administrators in Norway should not assign students to classes based on gender, religion, ethnicity, or ability (Kunnskapdepartementet 2017). In line with this legal requirement, our analysis shows a pattern of mean differences in student and family characteristics between classes (within schools) that is consistent with as-good-as-random assignment. Following Kraft (2019), we then estimate classroom effects on students' performance in national exams and on their growth mindset, as well as the correlation between the two. Lastly, we investigate how the impact of middle school classrooms on growth mindset affects consequential (academic) choices and performance during students' high school years.

The Norwegian high school system is ideal for investigating long-term academic choice behavior. Students entering this system initially face a critical decision between pursuing an academic track or a vocational track. The academic track, spanning three years, leads to higher education, while the vocational track involves two years of school-based learning followed by two years spent as an apprentice.[4] Students must also make a crucial choice

2. The idea of a growth mindset has received significant attention from policymakers and educators (Kraft 2019; Rege et al. 2021; Yeager et al. 2013).

3. See Bailey et al. (2017), Bailey et al. (2020), and Rothstein (2010) on the importance of persistence in educational research.

4. Opting for a rigorous academic year following two years in a vocational study track or

regarding the level of rigor of their math syllabus. This decision has implications for future endeavors since selecting a less demanding math course can limit opportunities to pursue STEM (science, technology, engineering, and math) degrees in higher education. To our knowledge, our study represents a novel effort to assess the effects of middle school classrooms on these choices. In this context, it is important to note that (academic) challenge-seeking in the form of choosing the academic track or advanced math may be a suboptimal strategy if it results in delayed graduation or dropout. For this reason, we also study on-time graduation and dropout rates.

We find classroom effects on students' growth mindset and national exam grades during middle school, even after adjusting for student and parental background variables. Interestingly, we observe that classrooms excelling in enhancing national exam performance might not necessarily wield the greatest influence on growth mindset (Pearson's $r = .13$), echoing the findings of Kraft (2019) in elementary school settings. These findings suggest that classrooms that excel in fostering academic achievement might possess attributes or strategies that contribute favorably, albeit modestly, to growth mindset cultivation. Conversely, a classroom prioritizing a growth mindset might only marginally impact exam score improvement. About 28% of classrooms in our sample exhibit above-average effects on both national exam scores and the nurturing of growth mindsets.

Shifting our focus to long-term academic choices, we find substantial effects of classroom beliefs about learning on the likelihood of students opting for the academic track over the vocational track. Specifically, an increase of one standard deviation in classroom effects on students' growth mindset corresponds to an increase of approximately .05 in the probability of choosing the academic track. Additionally, we observe that an increase of one standard deviation in classroom effects on students' mindset leads to an increase of approximately .11 in the probability of selecting advanced math courses. It is worth noting that classroom effects on national exam grades do not drive these effects. In essence, the effects of the classroom on growth mindset and national exam grades do not stem from the same mix of skills, which indicates that they possess distinct predictive power when it comes to long-term outcomes. This finding is consistent with Jackson (2018).

Finally, we investigate differential effects by gender and socioeconomic status (we categorize students as having "high" socioeconomic status if their mother had completed a university degree). When the effect of the classroom

completion of the vocational track opens up the possibility of qualifying for higher education.

on growth mindset increases by one standard deviation, we find that boys have an increased probability of .04 to choose the academic track and girls have an increased probability of .11. The difference is statistically significant at the 5% (p = .01). When the effect of the classroom on growth mindset increases by one standard deviation, we find that students categorized as having "low" socioeconomic status have a decreased probability of .04 of dropping out of high school. We find a null effect for students categorized as having "high" socioeconomic status. The difference is statistically significant at the 5% (p = .01). This finding is important because it suggests that middle school classrooms may compensate for less stimulating home environments, acting as a substitute (Bailey et al. 2020; Skinner et al. 2022).

To sum up, our findings imply that classroom environments focusing solely on traditional academic competencies may not necessarily cultivate a positive and inclusive learning environment that enhances students' ability to embrace new challenges. This cultivation, in turn, appears to encourage students to pursue challenging academic paths and expand their range of opportunities. Our study thus underscores the significance of a supportive environment for developing academic competencies as well as fostering students' personal growth, resilience, and challenge-seeking behavior.

Our study relates to an extensive literature on classroom effects. Many studies in this literature report that students assigned to "effective" classrooms, and teachers exhibit higher levels of achievement on standardized tests (Aaronson, Barrow, and Sander 2007; Araujo et al. 2016; Hanushek 1971; Jacob and Lefgren 2008; Kane, Rockoff, and Staiger 2008; Kane and Staiger 2008; Koedel and Betts 2011; Nye, Konstantopoulos, and Hedges 2004; Rivkin, Hanushek, and Kain 2005; Rockoff 2004; Rothstein 2010; Rowen, Correnti, and Miller 2002). Moreover, this positive impact extends beyond immediate academic gains, it benefits students' future classmates (Opper 2019), and it even persists into adulthood (Chetty, Friedman, and Rockoff 2014; Jackson 2018). In a similar manner, classroom processes play a crucial role in shaping students' social and emotional skills (Blazar and Kraft 2017; Jackson 2018; Jennings and DiPrete 2010; Kraft 2019; Ladd and Sorensen 2017; Ruzek et al. 2015).

We contribute novel evidence regarding classroom effects on beliefs about learning as we explore how these effects impact long-term choices. Prior studies used two distinct approaches to study the relationship between classroom effects and social and emotional skills. One approach focuses on long-term outcomes and behavioral proxies (e.g., absenteeism, on-time grade progression, suspensions) to assess social and emotional skills (see, e.g., Jackson 2018; Ladd and Sorensen 2017). While especially valuable for

examining social and emotional skills in the absence of dedicated measurement tools, this approach does not provide insights into the specific skills requiring attention. These behavioral proxies may encompass a range of social and emotional skills, thereby failing to provide a precise delineation.[5] The other approach taken involves studying short-term outcomes and specific social and emotional skills (see, e.g., Blazar and Kraft 2017; Jennings and DiPrete 2010; Kraft 2019; Ruzek et al. 2015; Thijssen, Rege, and Solheim 2022). By documenting such short-term effects, prior research using this approach has provided evidence supporting the importance of social and emotional skills, thus preparing the ground for the present study. By adding long-term outcomes, we can address questions about the sustainability and continued relevance of classroom effects, thereby gaining insight into whether effects endure over time or warrant targeted interventions (see Bailey et al. 2020; Bailey et al. 2017; Rothstein 2010).[6] In other words, to enhance our understanding of the link between classroom effects and social and emotional skills, we must broaden our scope by going beyond behavioral proxies and considering their long-term sustainability. This focus will yield the knowledge—based on verifiable, observable indicators—that we need to more effectively prioritize specific skills for intervention.[7]

Hypotheses Development

For the development of our hypotheses, we conceptualize the "classroom" as encompassing peers and classroom-specific components such as the teacher (see also Skinner et al. 2022). We draw insights from the psychology and education literature to expound on the potential mechanisms. Further, we also draw upon the human capital literature to explain long-term effects on academic choices (e.g., Heckman and Mosso 2014). However, before we introduce our hypotheses, we discuss what is meant by "growth mindset."

5. For example, school dropout is likely a function of many other factors (see, e.g., Battin-Pearson et al. 2000), this is a limitation acknowledged by Jackson (2018).

6. To take a case in point, Rothstein (2010) finds that teachers' long-term impacts are only weakly proxied by their immediate impacts.

7. Another important question that arises is the identification of the specific practices that influence these social and emotional skills (Hamre et al. 2010).

What Is a Growth Mindset?

The concepts of *growth mindset* and *fixed mindset* are directly related to what is known as implicit theories of intelligence (Dweck 2006). Holding a growth mindset means believing that human capacities are not fixed but can be developed. Students who hold a growth mindset believe that their skills are something they can cultivate through effort, good strategies, and help from others. In contrast, students with a fixed mindset believe that their intelligence is an innate quality that is not likely to change. These beliefs are formed, in part, by socialization experiences, such as praise from parents and teachers (Gunderson et al. 2013; Pomerantz and Kempner 2013), as well as reactions to the child's failures (Dweck 2006; Haimovitz and Dweck 2016). In turn, these beliefs—which derive from basic human needs—are thought to affect goals, motivation, and personality (Dweck 2017a).

When students hold a growth mindset, they aspire to cultivate their competence, embrace challenges, and exhibit higher persistence in the face of setbacks. Students with a fixed mindset, by contrast, tend to gravitate toward objectives that validate their "fixed" competence, to avoid challenge-seeking, and to display reduced persistence when facing setbacks (Dweck and Leggett 1988; Hong et al. 1999; Mangels et al. 2006; Moser et al. 2011; Nussbaum and Dweck 2008). A higher level of growth mindset has also been found to correlate with students' grades (Bettinger et al. 2018; Blackwell, Trzesniewski, and Dweck 2007; Yeager et al. 2019), with the use of mastery-oriented strategies such as seeking help from teachers, and with lower levels of psychological distress (Burnette et al. 2020).

How Can Classrooms Form Students' Beliefs About Learning?

Several studies have been considered important for conceptualizing the role of classroom processes in student development. Here, we draw on literature suggesting that teacher effectiveness, peers, and relationships with the teacher and peers are all important factors shaping classroom effects, as is classroom organization.

First, teachers play an important role in developing students' social and emotional skills (Blazar and Kraft 2017; Jackson 2018; Jennings and DiPrete 2010; Kraft 2019; Ladd and Sorensen 2017; Ruzek et al. 2015; Thijssen, Rege, and Solheim 2022). They do this by teaching and socializing students to act in accordance with the standards in school (Jennings and DiPrete 2010). Teachers may differ in their ability to teach social and emotional skills to students, and their professional beliefs regarding the

malleability and importance of such skills may also generate differences in how much effort they devote to teaching them (Jennings and DiPrete 2010).

Second, peers will also play a role in creating the learning environment that develops in a given classroom. In mindset theory, motivation can emerge from the interaction between individuals within the social context of the classroom and school (Urdan and Schoenfelder 2006). Sheffler and Cheung (2020) suggest that since the growth mindset point of view emphasizes persistence and mastery goals, a higher level of growth mindset among peers may convey optimism and encouragement without denouncing the students' own potential for equal competence. Yeager et al. (2019) found that a growth mindset intervention changed grades when peer norms were well in line with the messages conveyed as part of the intervention.

Third, the students' relationships with the teacher and with their peers can shape a positive classroom climate. Attachment theory (Bowlby 1969) and self-determination theory (Deci 1985; Deci and Ryan 2000) suggest that students who experience positive relationships can become more self-reliant, feel more secure, and be more motivated to learn when adults support their need for competence, relatedness, and autonomy. A classroom can fulfill these needs through emotional support and classroom organization, as well as instructional support (Pianta and Hamre 2009). For example, teachers may do so by engaging in respectful interactions, providing regular feedback, and being clear about what their expectations are and what the consequences of various actions will be. Indeed, a large meta-analysis (see Roorda et al. 2011) provided evidence of the importance of teacher-student relationships for students' engagement and achievement in school; associations with students' engagement were stronger than those with achievement and associations were stronger for adolescents than for younger students.

The classroom climate is generally viewed as an important factor in allowing students and teachers to make errors and develop as learners and in providing an invitation to learn (Hattie 2009). In mindset theory, teachers' reactions to students' successes and failures are a key factor for transmitting a growth or a fixed mindset to the students (Haimovitz and Dweck 2017). For instance, if a teacher responds to mistakes as opportunities to learn, cares about deeper understanding, and works with students to achieve this, students will be stimulated students to believe that their abilities can be developed (Dweck 2017b). Teachers who focus on the learning process and not on students' abilities create a culture of growth for the students in their classroom (Haimovitz and Dweck 2017). Further, Kraft (2019) found a positive correlation between teacher effects on growth mindset and the domain of "Establishing a culture of learning" in aggregate classroom-observation

scores. This can be seen as a direct link between teacher behavior and students' mindset. In addition, teachers can also influence the mindset prevailing in their classroom through their class policies, such as their formal grading practice and the opportunities they provide for students to act on a growth mindset. It is interesting to note that these aspects reinforce each other. Hecht et al. (2023) demonstrated a stronger link between students' growth mindset beliefs and their learning-oriented choices when the teachers conveyed that they supported a growth mindset not only through their messages but also through their class policies.

Fourth, well-organized classrooms will contribute to children's self-regulatory skills, promote active participation in classroom activities, foster better behavior, and improve the management of classroom time (Pianta and Hamre 2009).

We build on the literature discussed above from the fields of education and psychology, as well as empirical evidence that classroom processes play a crucial role in shaping students' social and emotional skills, to formulate the first of eight hypotheses:

Hypothesis 1: There are within-school differences in classroom effects on growth mindset.

Cultivating a Growth Mindset and Academic Skills: Amplification or Trade-off?

Importantly, while it is often assumed that a classroom environment that increases academic achievement will increase social and emotional skills as well, it is also possible that only one of these dimensions is cultivated. Researchers have investigated the consistency between academic achievement and socioemotional outcomes (Reynolds et al. 2014). A negative correlation might indicate the presence of a trade-off where one competency is fostered at the expense of the other. A positive correlation, by contrast, would support that they can both be stimulated simultaneously (Wal and Waslander 2007). However, the research findings remain inconclusive, suggesting that both a trade-off and amplification may occur, depending on specific school conditions (Wal and Waslander 2007). This issue has previously been studied in terms of teacher effects by Kraft (2019), who found a substantial degree of variation in individual teacher effects on state math tests and growth mindset. While a positive correlation was found between mindset and achievement, the author interprets these findings as an illustration of how some teachers teach core academic subjects in ways that also develop

the students' socioemotional competencies while others do not. Like Kraft (2019), we expect to find a positive correlation between classroom effects on growth mindset and classroom effects on achievement.

The second hypothesis we investigate is:

Hypothesis 2: Classroom effects on growth mindset are positively correlated with classroom effects on academic test scores.

How Can Classroom Effects on Mindset Impact Long-Term Choices?

The human-capital literature (e.g., Heckman and Mosso 2014) argues that skills are "capacities to act" and shape expectations, constraints, and information, enlarging individuals' choice sets. There is a growing literature in economics, epidemiology, and psychology on how attributes shaped in childhood determine adult outcomes. In this literature, both theory and evidence suggest that personality and character skills remain more malleable into adolescence and that students can benefit from school programs that improve their use of capacities (Heckman and Mosso 2014).

Chetty, Friedman, and Rockoff (2014) investigated long-term effects for students assigned to teachers with high value-added in terms of students' academic skills. They found that such students are more likely to attend college, attend higher-ranked colleges, earn higher salaries, live in neighborhoods with higher socioeconomic status, and save more for their retirement.

Mindset theory proposes that students with different mindsets will pursue differing goals and hence show dissimilar patterns of action (Dweck 2017a). Students with a fixed mindset will view failure as an indicator that they lack inherent ability, and they will manifest avoidance behaviors when faced with challenges. By contrast, students with a growth mindset will view challenges as an opportunity to learn, approach them positively, and show higher perseverance in learning (Dweck 2017b). Willingness to face challenges shapes educational choices (regarding electives, tracks, programs, etc.) (e.g., Yeager et al. 2019).

The classroom environments that students come from and, for instance, their previous teachers' assessment practices are likely to have shaped their challenge-seeking behavior. Experiments have shown that students who were praised for hard work and good strategies (process praise) showed a higher desire for intellectual challenge than students who were praised for intelligence or ability (person praise) (Mueller and Dweck 1998). Further, classroom effects on mindset will also be expected to increase perseverance among the students, suggesting that they will be more likely to graduate on

time and less likely drop out of high school education. It seems reasonable that beliefs about learning shaped in students' former classrooms may affect their educational choices, but to our knowledge, no studies have examined this relationship.

Hence, the third and the fourth hypotheses that we investigate are the following:

Hypothesis 3: Classroom effects on students' mindset in middle school increase the probability of making more challenging choices in high school.

Hypothesis 4: Classroom effects on students' mindset in middle school increase their completion in high school.

Do Classrooms Substitute or Complement Existing Disparities?

Finally, we investigate whether we find differential effects. Support from a teacher or some other social partner in school might protect students' academic development from the negative impact of poor relationships with other social partners (Skinner et al. 2022, p. 93). This would constitute substitutive or buffering classroom effects where the context compensates for low levels of a growth mindset among students by cultivating their skills more when they are in a resource-rich context.

However, classroom effects might also increase existing disparities if a student's relationship with one social partner magnifies the corresponding positive or negative effect of other social partners (Skinner et al. 2022). Such an effect of context on growth mindset would imply complementarity; that the classroom exerts a more positive effect on students who are already high on growth mindset.

It may be particularly important for students who are considered at-risk to be in an environment that cultivates a growth mindset. In one study, at-risk students placed in classrooms offering strong instructional and emotional support were found to have achievement scores and student-teacher relationships in line with those of their low-risk peers (Hamre and Pianta 2005). In this case, the classroom had a substitutive effect. Messages from teachers and peers that foster a growth mindset may be more important for students who do not receive such messages at home.

The final four hypotheses that we investigate aim to explore differential effects in terms of gender and socioeconomic background. On average, boys and students categorized as "low" socioeconomic status express lower levels of growth mindset and have a lower level of academic achievement in

middle school (Gouëdard 2021). Growth mindset interventions have been found to affect low- and high-performing students differently. The effects on academic outcomes are higher for students with low grades prior to the intervention. Among high achieving students, the effects are larger for factors like challenge seeking (Dweck and Yeager 2019). For this reason, we expect the classroom environment to be more important for completion rates among boys and students from households with "low" socioeconomic status. We expect the classroom effects to be more predictive of challenge-seeking choices for girls and students from high socioeconomic backgrounds. The hypotheses that we investigate are the following:

Hypothesis 5: Classroom effects on students' growth mindset increase the probability of choosing the academic track in high school more for students categorized as "high" socioeconomic status than for students categorized as "low" socioeconomic status.

Hypothesis 6: Classroom effects on students' growth mindset increase the probability of on-time graduation and decrease the probability of dropout in high school more for students categorized as "low" socioeconomic status than for students categorized as "high" socioeconomic status.

Hypothesis 7: Classroom effects on students' growth mindset increase the probability of choosing the academic track in high school more for girls than for boys.

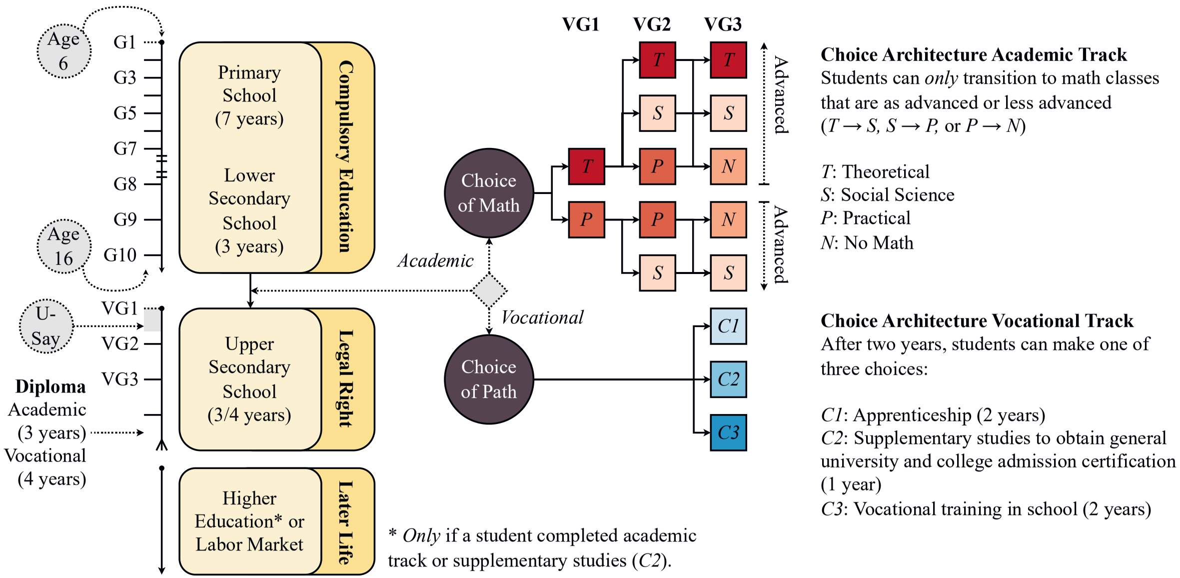
Hypothesis 8: Classroom effects on students' growth mindset increase the probability of on-time graduation and decrease the probability of dropout in high school more for boys than for girls.

The Norwegian School System

Figure 1 visualizes the Norwegian Education System. Children in Norway start compulsory education in the fall of the calendar year, during which they turn six years. This compulsory education covers ten years. During the last three years of compulsory education (ages 13 through 16), students attend middle school (also referred to as lower secondary school). Most students attend public schools, which are run by municipalities: only 4.6% of the compulsory-school students attended a private school in 2021/2022.

The Norwegian Education Act provides that the admission process for middle schools be structured to ensure that students residing in a given

Figure 1. The Norwegian Education System



Note.—This figure visualizes the Norwegian education system. Note that students on the vocational track also have access to theoretical math classes. The difference is that, in the vocational track, the theoretical math studied is more strongly related to the student's chosen program.

municipality are granted admission to the school nearest to their place of residence. Alternatively, they may be assigned to a school within the designated school district as defined by the municipality. The Education Act also lays down that students must not be sorted into classes based on gender, religion, ethnicity, or ability (Kunnskapdepartementet 2017).

Students who have fulfilled the requirements of compulsory education are legally entitled to pursue education in high school (also referred to as upper-secondary school). Despite the absence of a compulsory mandate, 98% of middle-school graduates decide to continue their academic journey. High schools, which are run by counties, offer students two distinct tracks to choose from: an academic track, encompassing five education programs, and a vocational track, encompassing ten programs.[8] Studies on the academic track consist of three years in school and lead to a university-admission qualification. Vocational education and training normally lasts for four years, of which the first two years are school-based and the last two are work-based in the form of an apprenticeship.[9]

The process for admission to high schools is a politically governed affair, overseen by the county councils, and operates under either of two primary regimes: the neighborhood-catchment regime and the school-choice regime (Fidjeland 2023). In the neighborhood-catchment regime, students are admitted to the nearest high school that offers their preferred education program. The school-choice regime instead lets students apply to any high school within their county, allowing them to apply for the same program across multiple schools or opt for several different programs within the same school. When the number of applicants exceeds a high school's capacity, the ranking of students is based on their compulsory-school GPA. The counties analyzed in this study adhere to the latter regime of admission, which is primarily based on students' grades.

Within each admission regime, students have a right to be admitted to one of their top three preferred programs. Students make their decision in the final year of middle school by ranking the programs within their

8. When the students included in this study entered high school, they could choose among eight vocational education programs. The number of programs was increased to ten in 2020.

9. Approximately 50% of all students choose a vocational study program as their preferred educational pathway in high school. However, it is worth noting that many of these students eventually acquire a general university-admission qualification. Specifically, about 21% of students on vocational programs transition to Supplementary Studies after two years on the vocational track. After completing their apprenticeship and passing their Trade or Journeyman's examination, students can pursue a one-year course of supplemental studies.

applications.[10] While their choice is primarily driven by personal interests, students' decisions are also informed by career guidance provided during middle school and by advice from parents, teachers, or peers. Students both on the academic track and on the vocational one choose between practical or theoretical math in their first year in high school—but only if their school offers both types of courses. Besides math, most first-year courses are common to all students in the same education program. In the second year, students apply for program areas depending on their education program, and they can also choose among subjects within the program area.

Empirical Strategy

We first provide a narrative description of the data-generating mechanism. An extensive description of our empirical strategy is given in Appendix A. An observation can be broken down into three distinct components, each playing a crucial role: (1) the school component, (2) the classroom component, and (3) the student component. The school component arises from decisions made by families regarding their residential location and whether they opt for public or private schools.[11] The classroom component emerges from the collective environment shaped by the teacher, classmates, and various classroom resources assigned by the school principal (see, e.g., Centra and Potter 1980). Lastly, the student component is the result of individual choices, such as effort levels and unique experiences.

Formally, we can thus view the growth mindset of a student (denoted as m_{ics} for student i) in classroom c at school s as resulting from a sequential sampling process, with an overall mean value of $\mathrm{E}(m_{ics}) = \alpha$.[12] In the first stage, school-specific effectiveness is represented by a random constant, θ_s, drawn from a distribution with mean 0. This constant reflects the school's ability to foster students' beliefs about learning. The combination of the overall mean and the school-specific constant yields a mean measurement for school s: $\mathrm{E}(m_{ics}|\theta_s) = \alpha + \theta_s$. In the second stage, we introduce another random constant, θ_{cs}, drawn for each classroom c within school s from the same distribution with mean 0, contributing to the mean measurement for

10. The percentage of students admitted to their first-choice education program at the start of high school is higher for academic programs (89% in 2020) than for vocational ones (84% in 2020).

11. Note that this school component also captures neighborhood effects. Since we are not interested in such effects in this paper, we group them with the school effects.

12. $\mathrm{E}(\cdot)$ denotes the expectation operator.

school s and classroom c: $\mathrm{E}(m_{ics}|\theta_s,\theta_{cs}) = \alpha + \theta_s + \theta_{cs}$. In the final stage, a random constant, θ_{ics}, is drawn for each student i in classroom c at school s from the same distribution with mean 0. This constant forms the mean measurement $\mathrm{E}(m_{ics}|\theta_s,\theta_{cs},\theta_{ics}) = \alpha + \theta_s + \theta_{cs} + \theta_{ics}$. Thus, deviations from the overall mean can be attributed to variations at the level of the school, classroom, and student components.

At the start of middle school (grade 8), school administrators should (as-good-as) randomly assign students to classes.[13] At the end of middle school (grade 10), that assignment process will have affected many outcomes (e.g., critical thinking, communication skills, beliefs about learning), the cumulative effect of which we may observe at that point. As a result, for a middle school comprising two classes "Class A" and "Class B" at the end of middle school, the classroom component of "Class A" attributed to beliefs about learning is what a student assigned to "Class B" could have been exposed to if assigned to "Class A." Consequently, we can compare classrooms in the same middle school and investigate how they affect students' choices under the following identifying assumption:

Identifying Assumption (Random Assignment): Students are (as-good-as) randomly assigned to classrooms within schools such that any systematic differences between classes will occur only at the school level.

Given our identifying assumption, we have $\mathrm{E}(\theta_{cs}\theta_{ics}|\theta_s) = 0$ (see Appendix A for details) such that the classroom components capture the variability between classes within schools and the student components capture the variability between students within classes (and within schools). In the next section, we will investigate if students really are (as-good-as) randomly assigned in our data.

To estimate the impact of classroom effects on students' mindset and on their choices in high school, we can then use a linear probability model,

$$y^*_{ics} = \tau + \beta\theta_{cs} + \delta\theta_s + \xi_{ics}, \tag{1}$$

where y^*_{ics} represents the propensity to make a particular choice in high school and $\xi_{ics} \equiv \kappa\theta_{ics} + \eta_{ics}$ is the error term. What we are interested in is

13. With the exception of a few elective subjects, students will spend most classroom time throughout middle school with the members of their assigned class. Of the 2,622 classroom hours students spend in middle school, 222 are allocated to foreign language subjects and 171 to electives. Hence, students spend 2,229 hours in the same class (about 85 percent of the time) with the same group of peers.

the middle school classroom effect, β, on choices made in high school. Our identifying assumption and the inclusion of the middle-school component, θ_s, together ensure that β has a causal interpretation: the extent to which a student's middle-school classroom affects that student's choices compared with other classrooms to which that student could have been assigned in middle school.

Note that we are silent on how the classroom effects arise. A well-known *reflection problem* (Manski 1993) arises when we seek to infer whether the classroom environment influences the behavior of the students who belong to the classroom in question. That is to say, the correlation between students i and i', if $i \neq i'$, in classroom c may not be due only to the shared environment. The classroom effect may be due to *contextual effects* and *endogenous effects* (Manski 1993), where the former may arise when a student forms beliefs about learning because the classroom environment is more favorable with regard to certain predetermined characteristics whereas the latter may arise when a student forms beliefs about learning because classmates are forming them. In Appendix A, we formally describe contextual and endogenous effects. We do not attempt to separate these types of effects.

Data

We use data from a high-quality research project named U-Say, which was conducted in two large Norwegian counties: Rogaland and Akershus.[14] All public high schools in Rogaland and Akershus were invited to participate, and all but one agreed to do so. Subsequently, consent was obtained from 90% of the students concerned (Rege et al. 2021).

The U-Say project started in 2017 and aims to evaluate the effect of an online program that teaches students about research in neuroscience, demonstrating the brain's potential to grow (i.e., conveying a growth mindset message). Drawing inspiration from the mindset intervention proposed by Yeager et al. (2016) and Paunesku et al. (2015), the intervention's content and visual presentation were adapted to suit the Norwegian language, culture, and context. This involved enlisting the expertise of a professional translator and conducting interviews with several focus groups comprising Norwegian high school students. The resulting material ensures cultural

14. Rogaland and Akershus are relatively representative of Norway, but they are key urban and industrial counties, and hence have higher levels of education and earnings than many other counties.

relevance and enhances the program's efficacy within the Norwegian context.

Students were assessed online at the start of high school (August 2017) and after the intervention a couple of months into the same academic year. During these online assessments, students engaged with a carefully designed set of questions intended to gauge their inclination toward a growth mindset. For the purposes of this study, we only use data from the baseline assessment performed at the start of high school. We posit that the growth mindset measured at the start of high school essentially reflects the students' growth mindset at the end of middle school.

Utilizing unique identifiers for students, classrooms, and schools, the U-Say project effectively links survey data with relevant family-background characteristics sourced from Statistics Norway and with data on schooling outcomes sourced from county-level records. A comprehensive description of all variables is provided below. However, it is essential to acknowledge that each of the three data sources contains some missing observations. In Appendix B, we describe our approach to handling the missing observations in the data.

The sample consisted of 11,068 students. However, after implementing our selection criteria for the analytical sample, the total was reduced to 9,203 students.[15] The selection process involved the exclusion of certain groups to ensure a more focused and refined dataset. Specifically, we omitted 419 students who were not categorized as "regular" at the start of high school,[16] as well as 953 students who did not graduate from middle school in 2017. Additionally, we removed classes with fewer than ten students, resulting in the exclusion of 446 students. Lastly, one class composed solely of non-Western immigrants was dropped (16 students).

Description of Variables

Growth Mindset in Middle School

The assessment of students' growth mindset centers on their responses to three carefully selected survey questions. Extensively validated in prior research (e.g., Burnette et al. 2013; Yeager et al. 2016), these items have

15. We also dropped ten students for whom we did not observe a middle school class or school identifier and 24 students for whom we do not observe a math course code.

16. This includes students who enter a vocational program where the end competence is a university admissions qualification.

shown the ability to predict academic performance and behavioral outcomes effectively. The three items are as follows: (1) "You have a certain amount of intelligence, and you really can't do much to change it," (2) "Your intelligence is something about you that you can't change very much," and (3) "Being a 'math person' or not is something that you really can't change. Some people are good at math, and other people aren't." See Table B1 in Appendix B for the item-specific response frequencies.

Students responded to these items using a six-point scale ranging from "strongly agree" to "strongly disagree." In line with Rege et al. (2021), we specifically include the third item to address math-specific fixed mindset-beliefs. For interpretability, we inverted the items so that higher values denote a stronger inclination toward a growth mindset, while lower values signify a more fixed mindset perspective. There are several ways in which one can combine these items into a single measure of students' growth mindset. We construct low-dimensional variables using a factor model to summarize the available measures that proxy students' beliefs about learning, an approach taken by an increasing number of studies in the human capital literature (Cunha, Nielsen, and Williams 2021) See Appendix A for more details.

Academic Achievement in Middle School

To assess the classroom's impact on students' academic achievement, we use scores on national exams in Norwegian, English, and math, each of which is scored on a scale from 1 to 6. Our preference for national-exam grades over teacher grades is grounded in the view that the former provide a more precise measure of academic achievement, whereas teacher grades may encompass additional in-class behavioral aspects, potentially confounding the assessment of academic achievement. This view is supported by empirical evidence, which reveals that the correlation between teacher grades and exam grades tends to be as low as approximately .5. (see, e.g., Frisbie 1988; Pedulla, Airasian, and Madaus 1980).

The random allocation of students to one of the three exams (Norwegian, English, or math) is a critical aspect of our analysis because it allows us to observe a diverse distribution of test scores across the various assessments. When evaluating classroom effects on grades, we use the test score of the randomly assigned test for each student within a given classroom. See Table B2 in Appendix B for the test scores corresponding to each of the three exams.

Academic Choices

This study investigates four distinct types of academic choices made by students. The first choice pertains to their decision to enroll in either an academic or a vocational education program. To quantify this choice, we define a binary variable taking the value of 1 if the student opts for an education program on the academic track and 0 otherwise.

Understanding the process of the allocation of students to education programs, particularly between the vocational and academic tracks, is relevant, given that middle school grades play a role in students' decision-making. That is, it is essential to ascertain whether this allocation is genuinely a choice or simply a consequence of the admission process. In the last year of middle school, students apply for their preferred education programs. However, certain programs may have fewer places than applicants, leading to cases where some students cannot attend their first-choice program and must instead enroll in another program (within their top three preferences).

To delve deeper into this matter, we conducted an analysis focused on one of the counties, specifically examining the applications and enrollment distribution for students who started high school in 2017—aligning with the year of data collection for the U-Say project. Our investigation revealed that only a few students ended up in the vocational track when their primary preference was an academic program, and vice versa. This finding aligns with existing research. For example, Jansen and Johnsen (2023) observed that applicants to (vocational) programs such as Electrical Engineering, Technology and Industry, and Construction who did not get a place on their first-choice program often secured admission to one of the other programs within the same group. These findings assure us that we can use the track enrollment as a choice variable.[17]

Students' second choice is whether to take advanced (i.e., theoretical) or practical math during the first year of high school. To characterize this decision, we introduce a binary variable that takes the value of 1 if students enroll in advanced math courses and 0 if they choose practical math. The third choice facing students is whether to drop out of high school. Here, we define dropout status using a binary variable, assigning the value of 1 if a student has left high school by the end of the third year and 0 if he

17. Note that students may have adjusted their choice of first-preference program based on their GPA at the time of decision-making. Such a strategic approach could have been taken to increase their chances of being admitted to a program that they are more likely to be accepted to.

or she remains enrolled. Dropout status is applicable when the student's completion status is given as "quit school" or contains missing completion information. The final choice pertains to whether the student graduates on time or not. For this choice, we define an on-time graduation variable, taking the value of 1 if a student successfully completes high school within the specified time frame and 0 if he or she does not meet the on-time graduation criteria after the third year. In the vocational track, on-time graduation is defined as being in an apprenticeship or having completed and passed all subjects in a level 3 course (supplementary studies or other vocational courses).

Family Background Characteristics

From Statistics Norway, we obtained data on relevant family background characteristics. We had access to data on student's gender, number of siblings and birth order as well as data on the parents' income from work, their marital status, their educational background, and whether they are non-Western immigrants. These family background characteristics serve two purposes in our study.

Firstly, we can investigate the extent to which school administrators assign students to classes in a manner akin to random allocation. Under the assumption of (as-good-as) random assignment, we would not expect to observe significant mean differences between classes. For instance, the ratio of boys to girls in one classroom should not statistically differ from that in another classroom within the same middle school under (as-good-as) random assignment.

Secondly, we leverage these family-background characteristics as control variables to enhance the precision of our estimates. This strategic inclusion is grounded in the predictive nature of these family-background variables in relation to the outcome variables. In our analysis, we specifically control for the student's gender, family income, and parental education as well as whether at least one parent is a non-Western immigrant.[18] By contrast, we do not control for the number of siblings, birth order, or parents' marital status. The exclusion of these variables is intended to simplify the already intricate estimation process (see Appendix A). Moreover, our choice of vari-

18. Regarding family income, we recode all values falling within the 99th percentile to the specific value denoting the boundary of the 99th percentile. Additionally, in relation to parental education, we simplify the initial nine categorical levels into more manageable four categories.

ables to be included is well in line with their common usage in the existing literature.

Table 1 presents summary statistics regarding the family-background variables and academic choices under examination. About 66.8% of middle-school students opt to pursue an education program on the academic track, and about 35.5% choose to enroll in more advanced math courses. Around 84.1% of students successfully graduate on time, while approximately 6.8% drop out of high school. Further, mothers have a higher average level of education, with approximately 50% possessing a bachelor's degree or higher, compared with about 40% of fathers. However, fathers tend to earn more, with an average earnings figure of NOK 706,800 compared with NOK 435,919 for mothers. Regarding marital status, approximately 68% of mothers and 70% of fathers are married. Finally, around 10% of both mothers and fathers are identified as non-Western immigrants.

Assignment of Students to Classes

Our key identifying assumption is that school administrators' classroom-assignment practice is (as-good-as) random in nature. While the Norwegian Education Act lays down that administrators must not sort students, prior empirical evidence from North Carolina shows that administrators may allocate better teachers to higher-performing students (Clotfelter, Ladd, and Vigdor 2006). If the school administrators in our sample systematically assigned higher-performing students to higher-quality teachers, the validity of our identifying assumption would be called into question and the the possibility of within-school student sorting would be introduced. To evaluate the plausibility of our assumption, we examine mean differences in family-background characteristics across classrooms within middle schools. This analysis aims to determine whether these differences significantly deviate from what one would expect under the assumption of (as-good-as) random assignment.

We adopt a methodology employed by Clotfelter, Ladd, and Vigdor (2006) and others. Specifically, we conduct a series of Pearson χ^2 tests of homogeneity for each middle school. In our set-up, a χ^2 test of homogeneity examines whether administrators distribute students, with particular characteristics, in an identical manner across classrooms. If the assignment is entirely random, the associated p-values should be uniformly spread. When there is a deliberate effort to balance student characteristics, the distribution of p-values will be right-skewed, and when there is sorting, the distribution of p-values will be left-skewed. Figure 2 illustrates the distribution of p-values

Table 1. Sample Descriptives

	(1) Obs.	(2) Mean	(3) SD
	Panel A. *Student Data*		
Female (%)	9,203	50.99	
Number of Siblings	9,020	1.82	1.12
Birth Order	9,025	1.85	.94
Middle School GPA (Teacher Graded)	9,132	42.49	7.60
Academic Track (%)	9,203	66.82	
Advanced Math Classes (%)	9,203	35.47	
On-Time Graduation (%)	9,203	84.08	
Dropout (%)	9,203	6.79	
	Panel B. *Mother Data*		
Income From Work (NOK)	8,946	435,919	310,504
Non-Western Immigrant (%)	9,027	9.65	
Married (%)	8,933	67.56	
Education (%)	8,782	100.00	
Less Than High School Degree (%)	1,701	19.37	
High School degree or other (%)	2,676	30.47	
Bachelor Degree (%)	3,396	38.67	
More than Bachelor Degree (%)	1,009	11.49	
	Panel C. *Father Data*		
Income From Work (NOK)	8,617	706,800	604,492
Non-Western Immigrant (%)	9,027	10.36	
Married (%)	8,622	69.73	
Education (%)	8,620	100.00	
Less Than High School Degree (%)	1,682	19.51	
High School degree or other (%)	3,402	39.47	
Bachelor Degree (%)	2,197	25.49	
More than Bachelor Degree (%)	1,339	15.53	

Note. This table reports sample descriptives for student and family data. "On-time graduation means that the student has the completion status "completed" at the end of the third year and has the level status of "vg3". "Dropout" means that the student has the completion status of "quit school" or has a missing completion status. "Advanced math classes" means that a student chose to take theoretical math instead of practical math in the first grade of high school. The education variable in the source data has been compressed from nine to four categories. We combined the first four categories into the category "less than a high school degree" and we combined the fifth and sixth categories into the category of "high school degree or other" (where "other" refers to other post-secondary education, not to higher education.

obtained from our analysis, it does not present any compelling evidence of sorting.

Our interview with middle school administrators in Rogaland County shed further light on their interpretation of the Education Act's provisions. They perceive the Education Act's stance against sorting students based on gender, religion, ethnicity, or ability as a directive to balance classes. Emphasizing the social aspect of classroom composition, the administrators prioritize creating cohesive and well-functioning groups.[19] As the school administrators lack detailed information about students' prior performance or beliefs about intelligence, we contend that these factors are unlikely to significantly influence the classroom assignment process in a manner that would compromise our identifying assumption.

Results

Classroom Effects on Beliefs About Learning

Our first hypothesis is that there are significant differences in growth mindset and grades between classes within schools. The null hypothesis assumes no variation between classrooms within schools. Conversely, the alternative hypothesis assumes the existence of variation. A fail to reject the null hypothesis, implies that classrooms do not differ in their impact on the outcome variable. To test this—assuming that regularity conditions hold—we we employ a likelihood ratio test and the Breusch and Pagan Lagrange multiplier score test (Breusch and Pagan 1980; Cox and Hinkley 1974).[20]

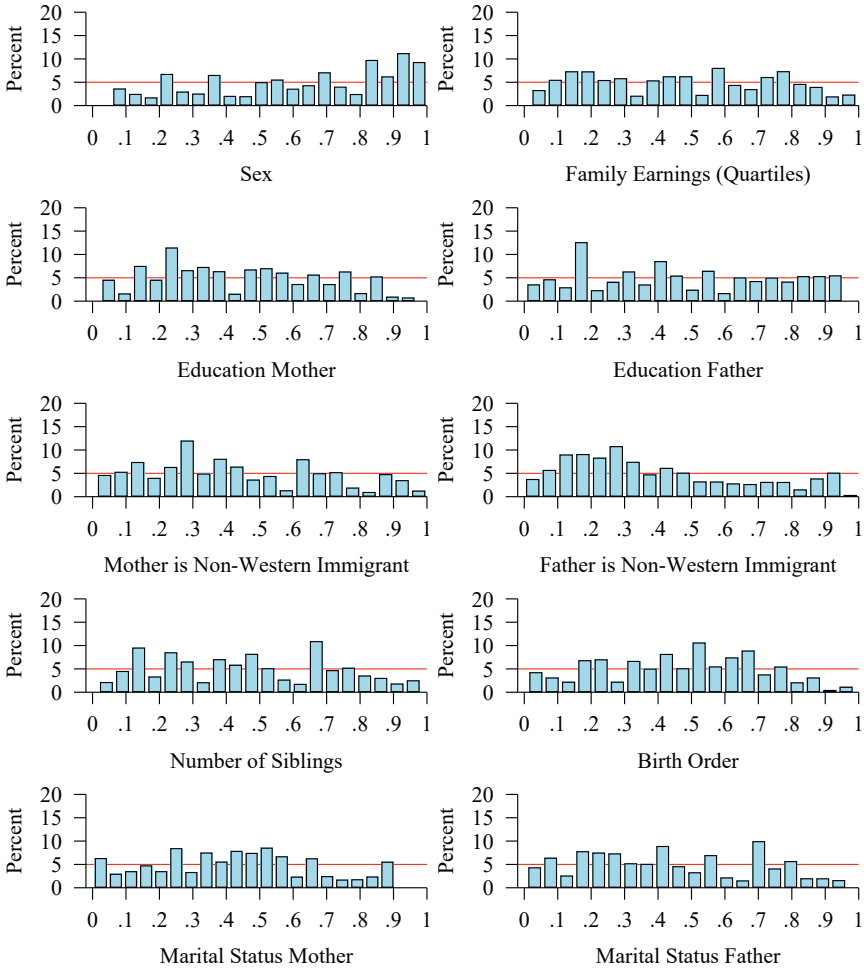
Table 2 presents the p-values associated with the test statistic of the likelihood ratio test and score test. In columns (1) and (3), we do not include control variables, but we do so in columns (2) and (4). There we also add classroom- and school-level averages for the control variables.[21] Therefore, we do not report the likelihood ratio test in columns (2) and (4), as the

19. Although grades are not officially given until students begin middle school, school administrators do consider performance levels and, as a result, place students with "special" education backgrounds into separate classes. We omitted students who were not categorized as "regular" at the start of high school.

20. The Wald statistic is an alternative approximation of the likelihood-ratio statistic. However, the Wald test is not invariant to nonlinear transformations of the parameter, and so does not perform well for variance parameters (Skrondal and Rabe-Hesketh 2004).

21. We test whether the *joint* effect of these classroom-level control variables is zero with a test of joint significance. Under the null hypothesis, the joint effect of these variables is null. For both mindset ($p = 0.6$) and grades ($p = 0.62$), we fail to reject the null of no effect.

Figure 2. χ^2 Tests of Homogeneity for Family Background Characteristics



Note.—This figure shows the distributions of p-values from the χ^2 tests of homogeneity for student and family background variables. The near uniform distribution of the p-values suggests that only a very small fraction of schools systematically sort students within schools. While we cannot prove that assignment is truly random in these schools, any within-school sorting of students would have to be uncorrelated with these student and family background variables, which are highly and significantly predictive of academic achievement, dropout, and on-time completion.

test would also capture the effect of these classroom-level control variables. The p-values reported in Table 2 are below conventional critical values, so we reject the null hypothesis in favor of the alternative one, meaning that there is significant variability between classrooms within schools in growth mindset and grades.

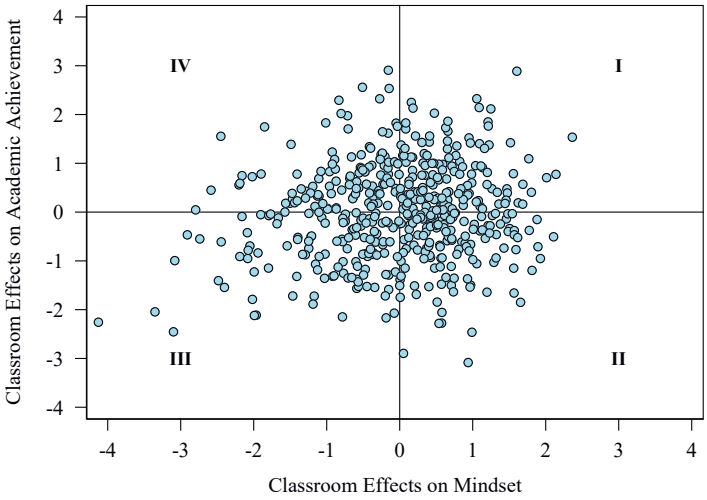
Table 2. Decomposing Variability

	Mindset		Grades	
	(1)	(2)	(3)	(4)
School	0.123	0.101	0.221	0.102
Classroom	0.106	0.095	0.255	0.250
Student	0.943	0.933	1.010	0.955
Control Variables	No	Yes	No	Yes
No. of Schools	147	147	145	145
No. of Classrooms	509	509	506	506
No. of Students	9,201	9,201	8,892	8,892
Log Likelihood	–42,610	–42,518	–12,995	–12,428
AIC	85,238	85,094	25,998	24,904
BIC	85,302	85,300	26,026	25,074
Likelihood Ratio Test	0.021	–	0.000	–
Test of Joint Significance	–	0.602	–	0.615
Score Test	0.000	0.000	0.000	0.000

Note.—This table reports a variance decomposition based on a variance component model. It shows the square roots of each variance components' estimated parameter value. We test hypothesis 1 using two approaches: (1) a likelihood-ratio test and (2) a score test (i.e., Lagrange multiplier statistic). The likelihood-ratio test statistic is $\mathscr{L} = 2(l_1 - l_0)$, where l_1 is the maximized log-likelihood with θ_{cs} included and l_0 is the maximized log-likelihood of the model without θ_{cs} (see Appendix A for details). The Breusch and Pagan Lagrange multiplier (Breusch and Pagan 1980) score test is based on a quadratic approximation of the likelihood at $\sigma(\theta_{cs}) = 0$. We also report an F-test of joint significance for the classroom-level control variables. Lastly, e report measures of model performance: AIC (Akaike 1987) and BIC (Schwarz 1978).

Our second hypothesis is that classrooms that positively affect growth mindset also positively affect test scores. To investigate this hypothesis, we use a three-step approach. In the first step, we re-estimate the models from columns (2) and (4) in Table 2. In the second step, we assign values to the latent classroom components affecting students' mindsets and test scores. We assign values to the latent classroom components using (parametric) empirical Bayes predictions (Morris 1983). In the last step, we calculate the Pearson correlation coefficient.

Figure 3. Correlation Between Classroom Effects on Mindset and Academic Achievement



Note.—This figure plots classroom effects on achievement versus those on mindset, both measured by parametric empirical Bayes predictions (Morris 1983). Empirical Bayes estimates are the Best Linear Unbiased Estimators of random effects from maximum likelihood models. The scales of both class effect estimates are measured in student-level standard deviation units for the respective outcomes. The Pearson correlation coefficient is .126.

The results are reported in Figure 3, which visualizes the relationship between classroom effects on mindset and classroom effects on academic achievement. The Pearson correlation coefficient is positive but modest (Pearson's $r = 0.13$). About 28% of classrooms in the sample have above-average effects on both outcomes (Quadrant I). About 24% of classrooms in the sample have below-average effects on both outcomes (Quadrant III). About 21% of classrooms have below-average effects on the academic outcome and above-average effects on the mindset outcome (Quadrant II). Finally, about 27% of classrooms have below-average effects on the mindset outcome and above-average effects on the academic outcome (Quadrant IV).

These findings illustrate that classrooms that positively affect students' growth mindset also positively affect test scores, albeit modestly, offering support for Hypothesis 2. However, the pattern is dispersed: classes are not simply effective or ineffective but have influences that may differ across multiple dimensions of effectiveness. Our findings about classroom effects

on mindset in middle school are consistent with the results of Kraft (2019) regarding elementary school.

Classroom Effects on Mindset and Long-Term Choices

Our third and fourth hypotheses state that classroom effects on students' mindset in middle school increase the probability of making challenging choices and the probability of completion in high school. Increased completion will imply a higher probability of on-time-graduation and a lower probability of dropout. In Table 3, we report these classroom effects (β in Equation 1). We report estimates with and without control variables for whether or not students opt for the academic track, take advanced math courses, graduate on time, and drop out of high school. Our preferred specification is the one with control variables. The estimates in Panel A refer to the classroom effect on students' mindset, and the estimates in Panel B refer to the classroom effect on their grades.

The estimates in Table 3 provide support for Hypothesis 3: Classroom effects on students' mindset in middle school affect the probability of making challenging choices in high school. An increase of one standard deviation in classroom effects on students' growth mindset increases the probability of choosing the academic track instead of the vocational one by about .053–.068. Further, an increase of one standard deviation in the classroom effect on students' mindset increases the probability of choosing advanced math courses by about .105–.124. In addition, for the students who may have been prompted by classroom effects to choose a track and courses that are academically more challenging, we do not find any tendency for delayed graduation or dropout. If anything, we find suggestive evidence that a one standard deviation increase in the classroom effect on students' mindset decreases the probability of dropout by about .018–.030, providing some support for Hypothesis 4.

Further, the estimates in Table 3 also suggest that classroom effects on grades are important for long-term choices. However, the effect sizes in Panel B are smaller in magnitude than those in Panel A. The results provide suggestive evidence that a one standard deviation increase in classroom effects on grades increases the probability of choosing the academic track by .013–.026. Also, there is a .041–.046 higher probability of choosing advanced math courses, a .017–.019 higher probability of on-time graduation, and .011–.014 lower probability of dropout, when students are exposed to a one standard deviation increase in classroom effects on grades.

The estimates reported in Table 3 are obtained from joint estimation;

Table 3. Classroom Mindset, Academic Achievement and Students' High School Outcomes

	Academic Track		Advanced Math		On-Time Graduation		Dropout	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A. *Beliefs About Learning*							
Class Effect	0.068	0.053	0.124	0.105	0.018	0.006	–0.030	–0.018
	(0.020)	(0.021)	(0.020)	(0.018)	(0.013)	(0.013)	(0.010)	(0.010)
No. of Students	9,203	9,203	9,203	9,203	9,203	9,203	9,203	9,203
Log Likelihood	–48,568	–48,071	–48,851	–48,522	–46,460	–46,282	–43,037	–42,886
	Panel B. *Academic Achievement*							
Class Effect	0.026	0.013	0.046	0.041	0.017	0.019	–0.014	–0.011
	(0.008)	(0.009)	(0.007)	(0.008)	(0.007)	(0.010)	(0.004)	(0.004)
No. of student	9,203	9,203	9,203	9,203	9,203	9,203	9,203	9,203
Log Likelihood	–18,866	–18,387	–19,499	–18,791	–16,765	–16,596	–13,342	–13,196
School Means	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes

Note. This table reports the estimates of a joint model, that is, the variance-component model and the outcome equation. The results represent the effect of class-level mindset on students' choice behavior (Panel A) and the effect of class-level academic achievement (in standard deviations) on students' choice behavior (Panel B). In columns (1) and (2), we report the effect on the decision to pursue an academic instead of a vocational track. In columns (3) and (4), we report the effect on the decision to pursue the advanced math class (i.e., theoretical math). In columns (5) and (6), we report the effect on on-time graduation, and in columns (7) and (8), the effect on dropout. Since the assignment mechanism is clustered, we cluster the standard errors (Abadie et al. 2023). We cluster the standard errors at the middle school and present them in parentheses.

we jointly estimate the factor (or measurement) model and the outcome model (see Appendix A for details). As a robustness check, we also conduct multi-step estimation. First, we estimate the factor model. Second, we assign values to the latent variables using empirical Bayes predictions (Morris 1983). Lastly, we estimate the outcome model (Equation 1). The results, which are reported in Table 4, are consistent with those reported in Table 3. Further, using the same multi-step estimation algorithm, we can rule out that the classroom effect on students' mindset and that on their exam grades stem from the same mix of skills—by estimating a model in which both effects are included. The results of this are also reported in Table 4. Overall, our results indicate that classroom effects on students' mindset and exam grades possess a distinct predictive power for long-term academic choices, which is consistent with Jackson (2018), and implies the existence of complementarities.

Differential Effects

To test our four final hypotheses, we investigate differential effects by socioeconomic status and gender. We categorize students as having "high" socioeconomic status if their mother has completed more than high school. The differential effects for socioeconomic status and gender are reported in Table 5 and Table 6, respectively. We also report the p-value associated with a Wald test, to investigate whether the effect for one group (say, boys) is larger or smaller than that for the other group (say, girls) when both are exposed to a one standard deviation increase in classroom effects. Note that we do not include the choice of taking advanced math classes. Boys and students from households with "low" socioeconomic status are more likely to choose the vocational track, in which taking advanced math courses is not so much a choice as it is the result of the program one decide to follow.

The estimates in Table 5 show the following. When exposed to a one standard deviation increase in classroom effects on students' mindset, students from households categorized as having "high" socioeconomic status have an increased probability of .045–.046 of choosing the academic track in high school. By contrast, students from households categorized as having "low" socioeconomic status have an increased probability of .037–.042 when exposed to the same increase. The latter effect is imprecisely estimated, however. The difference between students categorized as having "high" and "low" socioeconomic status is not statistically significant, as indicated by the p-value of a Wald test ($p = .706$). Thus, we do not find support for Hypothesis 5. The data does not seem to suggest that classroom effects on students'

Table 4. Classroom Mindset and Students' High School Outcomes using a Multi-step Estimation Strategy

	Academic Track		Advanced Math		On-Time Graduation		Dropout	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Class Effect Mindset	0.061	0.048	0.057	0.048	0.016	0.009	–0.015	–0.011
	(0.022)	(0.021)	(0.018)	(0.019)	(0.015)	(0.015)	(0.012)	(0.012)
Class Effect Achievement	0.033	0.024	0.048	0.039	0.021	0.017	–0.013	–0.010
	(0.009)	(0.008)	(0.007)	(0.007)	(0.005)	(0.005)	(0.004)	(0.004)
No. of Students	9,203	9,203	9,203	9,203	9,203	9,203	9,203	9,203
School Means	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes

Note. This table reports the estimates from the multi-step estimation strategy (i.e., the variance-component model and the outcome equation are estimated separately) conditional on the class effect on academic achievement. In the first step, we estimate the variance-component model. in the second step, we assign values to the latent variables using empirical Bayes prediction (Morris 1983). Empirical Bayes estimates are the Best Linear Unbiased Estimators of random effects from maximum likelihood models. In columns (1) and (2), we report the effect on the decision to pursue an academic instead of a vocational track. In columns (3) and (4), we report the effect on the decision to pursue the advanced math class (i.e., theoretical math). In columns (5) and (6), we report the effect on on-time graduation, and in columns (7) and (8), the effect on dropout. Since the assignment mechanism is clustered, we cluster the standard errors (Abadie et al. 2023) at the middle school level and present them in parentheses.

growth mindset will be more predictive of challenge seeking among students categorized as having "high" socioeconomic status.

We also find that students categorized as "low" socioeconomic status have a decreased probability of .044–.050 of becoming a high-school dropout when exposed to a one standard deviation increase in classroom effects on students' mindset. This effect is statistically different from the corresponding decreased probability of .004 found for students categorized as having "high" socioeconomic status and provides some support for Hypothesis 6. This finding holds significance as it suggests that middle school classrooms may compensate for home environments that are less beneficial to the development of human capital, thereby increasing the probability of dropout (this is an example of what is referred to as a substitutive effect by Bailey et al. (2020) and Skinner et al. (2022)).

Table 6 shows that girls have an increased probability of choosing the academic track of .105–.121 when exposed to a one standard increase in classroom effects on students' mindset. By contrast, boys have an increased probability of only .042–.067 when exposed to the same standard deviation increase. This difference is statistically significant ($p = .000$). Further, we find suggestive evidence that boys are more likely than girls to graduate on time from high school when they have been exposed to a one standard deviation increase in classroom effects on students' mindset. These findings provide evidence for Hypotheses 7 but not for Hypothesis 8 since the difference is not statistically significant.

Conclusion

We explored the impact of classrooms on growth mindset development in middle school and the subsequent influence on consequential decisions made ahead of and during high school. Through our analysis, we discovered noteworthy classroom effects on both growth mindsets and performance in national exams during middle school. Our findings suggest that classrooms focusing on boosting academic achievement may be characterized by attributes or strategies that contribute modestly yet favorably to the cultivation of growth mindsets, this is in line with previous research. Further, we find that these classroom effects on students' mindsets significantly shape their decision-making processes in relation to high school, particularly as regards whether they should pursue an academic or vocational pathway and whether they should take advanced math courses. Notably, we also find distinct effects of gender and socioeconomic status.

In light of these findings, it is important to acknowledge the limitations

Table 5. Class Mindset and Students' High School Outcomes by Socioeconomic Status

	Academic Track		On-Time Graduation		Dropout	
	(1)	(2)	(3)	(4)	(5)	(6)
Class Effect High	0.045	0.046	0.018	0.018	–0.004	–0.004
	(0.013)	(0.014)	(0.011)	(0.011)	(0.007)	(0.007)
Intercept High	0.744	0.664	0.860	0.845	0.051	0.060
No. of Students	4,826	4,826	4,826	4,826	4,826	4,826
Class Effect Low	0.042	0.037	–0.014	–0.019	–0.050	–0.044
	(0.021)	(0.022)	(0.015)	(0.014)	(0.013)	(0.013)
Intercept Low	0.556	0.494	0.811	0.805	0.086	0.091
No. of Students	4,377	4,377	4,377	4,377	4,377	4,377
Wald Test	0.863	0.706	0.055	0.030	0.001	0.005
Log Likelihood	–48,530	–48,346	–46,617	–46,477	–43,198	–43,075
School Means	Yes	Yes	Yes	Yes	Yes	Yes
Control	No	Yes	No	Yes	No	Yes

Note.—This table reports the estimates of a joint model by students' socioeconomic status, that is, the variance-component model and outcome equation. The results represent the effect of class-level mindset for students born in high and low socioeconomic households and their choice behavior (in standard deviations). In columns (1) and (2), we report the effect on the decision to pursue an academic instead of a vocational track. In columns (3) and (4), we report the effect on on-time graduation, and in columns (5) and (6), the effect on dropout. Since the assignment mechanism is clustered, we cluster the standard errors (Abadie et al. 2023). We cluster the standard errors at the middle school level (and present them in parentheses). We report the p-value of a Wald test investigating whether the class effect varies for students from households with high and low socioeconomic status, respectively.

Table 6. Class Mindset and Students' High School Outcomes by Gender

	Academic Track		On-Time Graduation		Dropout	
	(1)	(2)	(3)	(4)	(5)	(6)
Class Effect Boys	0.067	0.042	–0.010	0.056	–0.035	–0.025
	(0.025)	(0.024)	(0.015)	(0.015)	(0.016)	(0.015)
Intercept Boys	0.598	0.424	0.822	0.773	0.077	0.110
No. of Students	4,510	4,510	4,510	4,510	4,510	4,510
Class Effect Girls	0.121	0.105	0.034	0.021	–0.019	–0.011
	(0.019)	(0.019)	(0.013)	(0.014)	(0.010)	(0.010)
Intercept Girls	0.693	0.526	0.850	0.810	0.059	0.092
No. of Students	4,693	4,693	4,693	4,693	4,693	4,693
Wald Test	0.037	0.010	0.039	0.095	0.378	0.428
Log Likelihood	–48,702	–48,269	–46,665	–46,503	–43,247	–43,100
School Means	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Note.—This table reports the estimates of a joint model by students' gender, that is, the variance-component model and outcome equation. The results represent the effect of class-level mindset for boys and girls on their choice behavior (in standard deviations). In columns (1) and (2), we report the effect on the decision to pursue an academic instead of a vocational track. In columns (3) and (4), we report the effect on on-time graduation, and in columns (5) and (6), the effect on dropout. Since the assignment mechanism is clustered, we cluster the standard errors (Abadie et al. 2023). We cluster the standard errors at the middle school level (and present them in parentheses). We report the p-value of a Wald test investigating whether the class effect varies for boys and girls, respectively.

of our study. First, the self-reports used to measure growth mindset may be prone to various biases such as student misinterpretation, lack of insight, reference bias, faking, and social desirability bias (Duckworth and Yeager 2015). Second, we cannot isolate teacher effects from peer influences and transitory shocks.[22] Third, owing to data limitations, we could not conduct any placebo testing (see Rothstein 2010). For example, school administrators assigning students to classrooms may consider factors not examined in our study.

In conclusion, we wish to underscore the multifaceted nature of classroom effects, and emphasize that this highlights the need to adopt a comprehensive measurement framework to assess both teacher and classroom quality (Kraft 2019). Notably, experts stress the importance of diversifying metrics to evaluate school performance beyond sole reliance on achievement tests (Heckman and Kautz 2012). This implies that— while curricula should not undermine traditional educational objectives (Scheerens, Werf, and Boer 2020) —there is merit in integrating a component of social and emotional learning that can foster abilities helpful for embracing novel challenges and, subsequently, broaden opportunities. Such endeavors are deserving of further exploration to create classroom environments conducive to holistic student development.

22. Most studies focusing on middle school or high school cannot separate teacher effects from, for example, classroom effects. Aaronson, Barrow, and Sander (2007) is a notable exception. Many within-school conditions may conflate interpretability (e.g., instructional organization, peer group influences, administrative organization, and ambiance: Centra and Potter 1980).

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A. Further Notes on the Empirical Strategy

To examine the impact of classroom effects on mindset within the same middle school and to explore how those effects influence students' choices, it is essential to address two key aspects: (1) isolating the variability that can be attributed to the classroom and (2) ensuring that unobserved factors are not driving the relationship between classroom effects on mindset and students' choices. We discuss each of these aspects formally below.

Isolating Variability Attributable to Classroom Effects

Consider a dependent variable, denoted m^g_{ics}, for student i in classroom c in school s in grade g. This dependent variable can, for example, represent students' beliefs about learning or a score on an achievement test. Applying the intuition discussed in the empirical strategy, we decompose the dependent variable into three components,

$$m^g_{ics} = \alpha + \theta_s + \theta_{cs} + \theta_{ics}, \tag{A1}$$

where α is an intercept and θ_s, θ_{cs}, and θ_{ics} denote the mean-zero school, classroom, and student components, respectively. These components have no g superscript because they represent the *total effects* up to and including grade g. For example, for a dependent variable observed at the end of grade 10, m^{10}_{ics}, the classroom component, θ_{cs}, captures the total effect of middle school (grades 8 through 10).

As discussed in the empirical strategy, the school component emerges endogenously as a result of family preferences and decisions regarding the residential location and type of schooling (such as public or private). For this reason, we exclusively focus on within-school variation. The challenge is to isolate the variability attributable to the classroom component, θ_{cs}. It is helpful to express the variance that is conditional on the school component:[23]

$$\mathrm{Var}\left(m^g_{ics}|\theta_s\right) = \underbrace{\mathrm{E}\left(\theta^2_{cs}|\theta_s\right)}_{\substack{\text{Classroom}\\ \text{Component}}} + \underbrace{\mathrm{E}\left(\theta^2_{ics}|\theta_s\right)}_{\substack{\text{Student}\\ \text{Component}}} + \underbrace{2\mathrm{E}\left(\theta_{cs}\theta_{ics}|\theta_s\right)}_{\substack{\text{Correlated}\\ \text{Effects}}}. \tag{A2}$$

It becomes evident that the conditional variance in the dependent variable cannot be attributed solely to the classroom and student components. In the spirit of Manski (1993), we identify an additional factor referred to as

23. $\mathrm{Var}(\cdot)$ denotes the variance operator.

correlated effects. These effects arise when students within the same group are subject to a common influence that is not modeled directly. for example, school administrators may intentionally assign advantaged students to more effective teachers (Clotfelter, Ladd, and Vigdor 2006). Such sorting may not be observable.

If students are assigned at random to classrooms, this is no longer a problem. Instead, sorting then occurs exclusively at the school level, which we can ignore because we focus on within-school variability. Thus, we can address the problem that arises from correlated effects under the following assumptions:

Identifying Assumption (Random Assignment): Students are as-good-as-randomly assigned to classrooms within schools such that any systematic differences between classes will occur at the school level.

Given this assumption, we have $\mathrm{E}(\theta_{cs}\theta_{ics}|\theta_s) = 0$ such that the classroom component captures variability between classrooms within the same school and the student component captures variability between students within the same classroom (and school).

Note that we are silent on how the classroom effects arise. A well-known *reflection problem* (Manski 1993) arises when we seek to infer whether a classroom environment influences the behavior of the students belonging to the classroom in question. That is to say, the correlation between student i and i', if $i \neq i'$, in classroom c may not be due only to the shared classroom environment. To illustrate this, it is helpful to express the covariance, conditioned on the school component:

$$\mathrm{Cov}\left(m^g_{ics}, m^g_{i'cs}|\theta_s\right) = \underbrace{\mathrm{E}\left(\theta^2_{cs}|\theta_s\right)}_{\substack{\text{Contextual}\\ \text{Effects}}} + \underbrace{\mathrm{E}\left(\theta_{ics}\theta_{i'cs}|\theta_s\right)}_{\substack{\text{Endogenous}\\ \text{Effects}}}. \tag{A3}$$

Equation A3 illustrates that the classroom effect may arise as a result of *contextual effects* and *endogenous effects* (Manski 1993). The former may arise when a student forms beliefs about learning because the classroom environment is more favorable regarding predetermined characteristics. The latter arises when a student forms beliefs about learning because classmates are forming them. We do not attempt to separate these effects.

Middle School Classroom Effects and Choices in High School

We know what assumption we need in order to isolate the variability attributable to middle school classroom effects. Next, we will describe how these effects relate to high school outcomes. Consider a dependent variable, y_{ics}, for student i in classroom c in high school s. For example, this dependent variable can represent students' decision to pursue the vocational track instead of the academic track. Underlying the observed (binary) dependent variable, y_{ics}, we assume a continuous latent response, y^*_{ics}, representing the propensity to make a particular choice in high school. This latent response is 1 if it is greater than 0 and 0 otherwise,

$$y_{ics} = \begin{cases} 1 \text{ if } y^*_{ics} > 0 \\ 0 \text{ otherwise} \end{cases}$$

We can then evaluate the effect of middle-school classroom c on academic choices in high school using a linear probability model,

$$y^*_{ics} = \tau + \beta\theta_{cs} + \delta\theta_s + \xi_{ics}, \tag{A4}$$

where $\xi_{ics} \equiv \kappa\theta_{ics} + \eta_{ics}$ denotes the regression error term. We are interested in the middle school classroom effect, β, on choices made in high school. Our identifying assumption and the inclusion of the middle school component, θ_s, together ensure that β has a causal interpretation.

Measuring Students' Beliefs About Learning

So far, we have assumed that a growth mindset (m^g_{ics} in Equation A1) is directly observable. In reality, it is not. Instead, we observe manifestations (e.g., responses to survey questions) assumed to be consistent with a particular level of growth mindset. One way of summarizing these manifestations is to use a simple unweighted average.[24] However, such "*measurement by fiat*" (Torgerson 1958, p. 22) is not ideal and hard to justify theoretically. First, each manifestation may vary in its informativeness concerning students' growth mindset, but simple averages use arbitrary weights.[25] Moreover, an average only accounts for measurement error through simple averaging. For these reasons, we employ a measurement strategy involving a factor

24. This approach is widely used in psychology. See the review in Borghans et al. (2008).
25. See, e.g. Cunha and Heckman (2008).

model, thus using an approach taken by an increasing number of studies in the human-capital literature.[26]

The measurement model we employ defines each measure (or manifest variable), denoted z_{lics} for manifest variable $l = 1,\ldots,L$, as a function of the unobserved growth mindset (or common factor), as well as other unobserved influences (or unique factors and errors of measurement). As is common in the psychometric literature, we assume a dedicated measurement model, one in which each manifest variable proxies only one common factor (Gorsuch 1983, 2003). We further assume that each manifest variable is additively separable in the common factor that it proxies, so that,

$$z_{lics} = \mu_l + \lambda_l m^g_{ics} + \epsilon_{lics} = \mu_l + \lambda_l(\alpha + \theta_s + \theta_{cs} + \theta_{ics}) + \epsilon_{lics}, \tag{A5}$$

where μ_l is an intercept, λ_l is a factor loading that measures the relationship between students' growth mindset and each manifestation, and ϵ_{lics} is an error term.

Since none of the right-hand variables in Equation A5 is observable, there is an identification problem (Anderson and Rubin 1956; Ben–Moshe 2018; Williams 2020). We first require some normalization to set a scale and location. We normalize the common factor variance to 1 to set the scale, $\text{Var}(m^g_{ics}) = 1$, and the common factor mean to 0 to set the location, $\text{E}(m^g_{ics}) = 0$. Further, we assume independence (1) between the common factor and unique factors, $\text{E}(m^g_{ics}\epsilon_{lics}) = 0$ for all l and (2) between the unique factors, conditional on the common factor, $\text{E}(\epsilon_{lics}\epsilon_{l'ics}|m^g_{ics}) = 0$ for all l, l' where $l \neq l'$. With a minimum of three measures, these normalizations and assumptions are sufficient to establish identification. We can identify factor loadings (up to a sign change) from the ratio of covariances. We then identify the factor distributions by applying Kotlarski's lemma (see Lemma 1, Remark 4, and Remark 5 in Kotlarski 1967, pp. 70-73).[27]

Estimation Strategy

We use a one-step maximum likelihood estimation procedure where the measurement model (Equation A5) and linear probability model (Equation A4) are estimated jointly. As there is clustering in the sampling and clustering in the assignment, we cluster the standard errors at the middle school

26. See the reviews in Heckman and Mosso (2014) and Cunha, Nielsen, and Williams (2021). Factor analysis is a statistical method that summarizes the covariability among observable manifestations (or measures) using lower-level dimensional latent variables.

27. We formally demonstrate identification in the supplementary material.

level (Abadie et al. 2023). To add robustness, we also perform a multi-step estimation procedure.[28] We first estimate the measurement model using maximum likelihood. Next, we calculate (parametric) empirical Bayes predictions for the latent variables (Morris 1983). Third, we estimate the linear probability model in Equation A4.

B. Further Notes on the Data

B.1. *Further Descriptive Statistics*

Table B1. Response Numbers and Frequencies: Mindset Items

	Item 1		Item 2		Item 3	
	(1)	(2)	(3)	(4)	(5)	(6)
Strongly Agree	148	1.6%	120	1.3%	397	4.3%
Agree	830	9.0%	665	7.2%	828	9.0%
Somewhat Agree	1,706	18.6%	1,274	13.9%	1,480	16.1%
Slightly Disagree	1,660	18.1%	1,903	20.7%	1,850	20.1%
Disagree	3,318	36.1%	3,699	40.3%	3,082	33.5%
Strongly disagree	1,525	16.6%	1,530	16.7%	1,561	17.0%
Total	9,187	100%	9,191	100%	9,198	100%

Note.—This table reports response numbers and frequencies for the three mindset items. These items are (1) "You have a certain amount of intelligence, and you really can't do much to change it," (2) "Your intelligence is something about you that you can't change very much," and (3) "Being a 'math person' or not is something that you really can't change. Some people are good at math and other people aren't." Students responded to these items on a six-point scale ranging from "strongly agree" to "strongly disagree."

B.2. *Missing Data*

We present missingness descriptives in Table B3. For our analyses, we assume the data are missing at random. That is, the probability that a data point is missing does not depend on the value of the missing data point but only on available information. We miss data in some of the variables provided by Statistics Norway. The likely reason is that these families in question are recent immigrants to Norway and that the government has

28. The multi-step estimation procedure is not statistically efficient, given that we do not impose cross-equation restrictions across the stages of the estimation.

Table B2. Exam Grades Math, Norwegian, and English

	Math		Norwegian		English	
	(1)	(2)	(3)	(4)	(5)	(6)
1	98	3.2%	5	0.2%	12	0.4%
2	478	15.4%	349	12.1%	181	6.1%
3	916	29.5%	1,118	38.7%	816	27.5%
4	863	27.8%	961	33.3%	1,095	36.9%
5	598	19.3%	377	13.1%	649	21.9%
6	124	4.0%	56	1.9%	206	6.9%
Exemption	4	0.1%	4	0.1%	4	0.1%
No Show	23	0.7%	17	0.6%	7	0.2%
Total	3,104	100%	2,887	100%	2,970	100%

Note. This table reports (relative) exam grade frequencies for math, Norwegian, and English in middle school. Exams are scored one (lowest) through six (highest) based on the number of correctly answered questions. Many missing observations occur because students are randomly assigned to these three exams. A student is only observed in math, Norwegian, or English, not in multiple.

therefore not yet collected all records. For many of the parents concerned, we know their country of birth. Consequently, conditional on the country of birth, and on other variables that we have on the family, we assume that the data provided by Statistics Norway misses at random. For control variables that are categorical, we add another category representing missingness. For control variables that are continuous, we impute using the mean and include an indicator variable if the value of the control variable was imputed, which is otherwise set to zero.

B.3. *Supplementary Tables*

Table B3. Missingness Descriptives

	Observed		Missing	
	(1)	(2)	(3)	(4)
Academic Track	9,203	100.0%	0	0.0%
On-Time Graduation	9,203	100.0%	0	0.0%
Dropout	9,203	100.0%	0	0.0%
Advanced Math Class	9,203	100.0%	0	0.0%
Student is Female	9,200	100.0%	0	0.0%
Mindset Item 3	9,198	99.9%	5	0.1%
Mindset Item 2	9,191	99.9%	12	0.1%
Mindset Item 1	9,187	99.8%	16	0.2%
Middle School GPA	9,132	99.2%	71	0.8%
Mother is Non-Western	9,027	98.1%	176	1.9%
Father is Non-Western	9,027	98.1%	176	1.9%
Birth Order	9,025	98.1%	178	1.9%
Number of Siblings	9,020	98.0%	183	2.0%
Earnings Mother	8,946	97.2%	257	2.8%
Education Mother	8,933	97.1%	270	2.9%
Mother is Married	8,782	95.4%	421	4.6%
Education Father	8,622	93.7%	581	6.3%
Father is Married	8,620	93.7%	583	6.3%
Earnings Father	8,617	93.6%	586	6.4%

Note. This table reports missingness descriptives. Before calculating the missingness descriptives, we made several sample restrictions. First, we dropped students who, at the start of high school, were not categorized as "regular" students (419 students). Second, we dropped students who did not graduate from middle school in 2017 (953 students). Third, we dropped 24 students for whom we did not observe an advanced math choice. Fourth, we dropped nine students for whom we missed a middle-school class identifier. Fifth, we dropped one student for whom we did not know the lower secondary school identifier. Sixth, we dropped middle-school classrooms with fewer than ten students (446 students). Lastly, we dropped one special middle-school class comprised exclusively of children of non-Western immigrants (16 students).

Table B4. Class Mindset and Students' Choice Behavior Using a Multi-Step Estimation Strategy

	Academic Track		Advanced Math		On-Time Graduation		Dropout	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A. *Beliefs About Learning*							
Class Effect	0.069	0.054	0.069	0.058	0.022	0.013	–0.019	–0.014
	(0.021)	(0.021)	(0.019)	(0.019)	(0.016)	(0.015)	(0.012)	(0.012)
No. of Students	9,203	9,203	9,203	9,203	9,203	9,203	9,203	9,203
	Panel B. *Academic Achievement*							
Class Effect	0.035	0.025	0.050	0.041	0.022	0.018	–0.013	–0.011
	(0.009)	(0.008)	(0.008)	(0.007)	(0.005)	(0.005)	(0.004)	(0.004)
No. of student	9,203	9,203	9,203	9,203	9,203	9,203	9,203	9,203
School Means	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes

Note. This table reports the estimates from a multi-step estimation strategy; the variance-component model and outcome equation are estimated separately. In the first step, we estimate the variance-component model. We assign values to the latent variables in the second step using empirical Bayes prediction (Morris 1983). Empirical Bayes estimates are the Best Linear Unbiased Estimators of random effects from maximum likelihood models. We estimate the outcome equation using the empirical Bayes prediction in the third step. The results represent the effect of class-level mindset (in standard deviations) on students' choice behavior (Panel A) and the effect of class-level academic achievement (in standard deviations) on students' choice behavior (Panel B). In columns (1) and (2), we report the effect on the decision to pursue an academic track instead of a vocational one. In columns (3) and (4), we report the effect on the decision to pursue the advanced math class (i.e., theoretical math). In columns (5) and (6), we report the effect on on-time graduation, and in columns (7) and (8), the effect on dropout. Since the assignment mechanism is clustered, we cluster the standard errors (Abadie et al. 2023). We cluster the standard errors at the middle school level (and present them in parentheses).

Table B5. Class Academic Achievement and Students' Choice Behavior by Gender

	Academic Track		On-Time Graduation		Dropout	
	(1)	(2)	(3)	(4)	(5)	(6)
Class Effect Boys	0.089	0.095	0.041	0.043	–0.037	–0.032
	(0.019)	(0.054)	(0.022)	(0.016)	(0.009)	(0.008)
Intercept Boys	0.355	0.535	0.835	0.784	0.072	0.106
	(0.015)	(0.018)	(0.008)	(0.013)	(0.004)	(0.009)
No. of Students	4,510	4,510	4,510	4,510	4,510	4,510
Class Effect Girls	0.066	0.054	0.035	0.031	–0.018	–0.015
	(0.010)	(0.013)	(0.008)	(0.008)	(0.005)	(0.005)
Intercept Girls	0.339	0.488	0.841	0.805	0.064	0.092
	(0.013)	(0.022)	(0.008)	(0.013)	(0.004)	(0.009)
No. of Students	4,693	4,693	4,693	4,693	4,693	4,693
Wald Test	0.278	0.402	0.783	0.484	0.059	0.076
Log Likelihood	–18,732	–18,331	–16,728	–16,568	–13,305	–13,169
School Means	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Note.—This table reports the estimates of a joint model by students' gender, that is, the variance-component model and outcome equation. The results represent the effect of class-level academic achievement for boys and girls on their choice behavior (in standard deviations). In columns (1) and (2), we report the effect on the decision to pursue an academic instead of a vocational track. In columns (3) and (4), we report the effect on on-time graduation, and in columns (5) and (6), the effect on dropout. Since the assignment mechanism is clustered, we cluster the standard errors (Abadie et al. 2023). We cluster the standard errors at the middle school level (and present them in parentheses). We report the p-value of a Wald test investigating whether the class effect varies for boys and girls, respectively

Table B6. Class Academic Achievement and Students' Choice Behavior by Socioeconomic Status

	Academic Track		On-Time Graduation		Dropout	
	(1)	(2)	(3)	(4)	(5)	(6)
Class Effect High	0.036	0.033	0.023	0.019	–0.009	–0.006
	(0.008)	(0.009)	(0.008)	(0.007)	(0.004)	(0.004)
Intercept High	0.302	0.376	0.850	0.842	0.055	0.060
	(0.016)	(0.021)	(0.021)	(0.013)	(0.004)	(0.005)
No. of Students	4,826	4,826	4,826	4,826	4,826	4,826
Class Effect Low	0.092	0.094	0.037	0.040	–0.039	–0.035
	(0.027)	(0.038)	(0.046)	(0.021)	(0.009)	(0.008)
Intercept Low	0.379	0.448	0.828	0.815	0.078	0.086
	(0.015)	(0.018)	(0.011)	(0.011)	(0.005)	(0.006)
No. of Students	4,377	4,377	4,377	4,377	4,377	4,377
Wald Test	0.046	0.113	0.754	0.339	0.003	0.001
Log Likelihood	–18,465	–18,289	–16,591	–16,457	–13,167	–13,048
School Means	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Note.—This table reports the estimates of a joint model by students' socioeconomic status, that is, the variance-component model and outcome equation. The results represent the effect of class-level academic achievement for students born in high and low socioeconomic households and their choice behavior (in standard deviations). In columns (1) and (2), we report the effect on the decision to pursue an academic instead of a vocational track. In columns (3) and (4), we report the effect on on-time graduation, and in columns (5) and (6), the effect on dropout. Since the assignment mechanism is clustered, we cluster the standard errors (Abadie et al. 2023). We cluster the standard errors at the middle school level (and present them in parentheses). We report the p-value of a Wald test investigating whether the class effect varies for students from households with high and low socioeconomic status, respectively.