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META-ANALYSIS

A Meta-Analysis on Teachers' Growth Mindset

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Abstract

The concept of growth mindset—an individual's beliefs that basic characteristics such as intelligence are malleable—has gained immense popularity in research, the media, and educational practice. Even though it is assumed that teachers need a growth mindset and that both teachers and their students benefit when teachers adopt a growth mindset, systematic syntheses of the potential advantages of a growth mindset in teachers are lacking. Therefore, in this article, we present the first meta-analysis on teachers' growth mindset and its relationships with multiple outcomes (50 studies, 81 effect sizes; $N = 19{,}555$). Multilevel analyses showed a small effect across outcomes. Statistically significant small-to-typical positive associations between teachers' growth mindset and their motivation in terms of self-efficacy and mastery goals were observed in subgroup analyses. No statistically significant relationships were found with teachers' performance-approach goals, teachers' performance-avoidance goals, teachers' performance on achievement tests, or student achievement. Teachers' growth mindset was related to instructional practices in terms of mastery goal structures but unrelated to performance goal structures. Moderator analyses indicated that the dimensionality of the mindset measure (recoded from a fixed mindset to a growth mindset measure vs. assessed as a growth mindset), item referent and content of the mindset measure, publication status (published vs. unpublished), world region, educational level, and study quality influenced the strengths of some of the relationships. Overall, our findings extend knowledge about teachers' mindset and add to the evidence base on teacher characteristics and their links to relevant outcomes.

Keywords Teacher · Growth mindset · Implicit theory · Achievement · Meta-analysis

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Mindsets or implicit theories capture individuals' beliefs about the nature of basic qualities, such as intelligence and abilities. A *growth mindset* (or *incremental theory*), located at one end of the mindset spectrum, implies the beliefs that these qualities can be changed and improved. By contrast, a *fixed mindset* (or *entity theory*), placed at the other end of the spectrum, refers to the beliefs that these qualities are largely unchangeable (e.g., Dweck, 2000; Dweck & Leggett, 1988). The study of mindsets and their consequences has become tremendously popular in research on students. Adopting a growth mindset (vs. a fixed mindset) should come with benefits for students, for example, because a growth mindset motivates students to take on more rigorous learning experiences and persist in the face of difficulties, thus also improving their performance (e.g., Yeager et al., 2019). Some studies with students have supported this premise, as indicated by relationships with achievement and other relevant educational outcomes, such as motivation (e.g., Claro et al., 2016; De Castella & Byrnes, 2015; Dweck & Master, 2009; Smiley et al., 2016; Yeager et al., 2019). The results of other studies with students, including meta-analyses with correlational and intervention data, have been less promising when they looked at average effects (e.g., weak effects on achievement for both correlational studies and mindset interventions in the meta-analysis by Sisk et al., 2018; see also Macnamara & Burgoyne, 2023). At the same time, mindset interventions have yielded benefits for specific groups of students (e.g., at-risk students), thus highlighting the importance of heterogeneous effects (see the meta-analysis by Burnette et al., 2023; see also Tipton et al., 2023).

Many publicly available sources (e.g., blog posts or web-based journals for teachers) advocate that educators need a growth mindset too (e.g., McKibben, 2019). Theoretically, teachers' mindsets have been proposed to play a substantial role in determining their expectations and teaching practices, and subsequently, student outcomes (e.g., Seaton, 2017; Trzesniewski et al., 2021). For example, when adopting a growth mindset, teachers should be "more likely to see the worth in promoting individual student gains and promote greater equitable access to instructional support and encouragement in their classrooms" (Shim et al., 2013, p. 88). Moreover, according to the basic assumptions of Dweck's mindset theory, leaning toward a growth (vs. a fixed) mindset instills positive motivational patterns in the teachers themselves because it orients them toward learning and improving (mastery goals; e.g., Elliott & Dweck, 1988; see Aldahdouh et al., 2018; Bråten & Strømsø, 2004; Dresel et al., 2013 for empirical studies) and positively affects their judgments of their own effectiveness (self-efficacy; e.g., Bandura, 1997; see Bathgate et al., 2019; Lin et al., 2022; Thadani et al., 2015 for empirical studies). Nonetheless, a systematic evaluation of research on teachers' mindset is currently lacking.

Therefore, in this meta-analysis, we synthesized the available findings on the relationships between teachers' mindset—specifically, teachers' growth mindset—and three strands of outcomes: teacher outcomes (teachers' motivation in terms of self-efficacy and achievement goals, teachers' performance on achievement tests, mainly knowledge-based tests), teachers' instructional practices (classroom goal structures), and student outcomes. By examining teacher outcomes in addition to student outcomes (achievement) and teaching aspects (instructional practices), we acknowledge the current trend in teacher-focused research to focus on not only student outcomes

and teachers' classroom behavior but also key teacher outcomes (e.g., Keller et al., 2016). To gain a deeper understanding of growth mindset, we also tested potential moderators in terms of measurement characteristics (e.g., referent of the mindset measure) and study and sample characteristics (e.g., world region in which a study was conducted, educational level teachers taught in). Taken together, by presenting what is, to the best of our knowledge, the first meta-analysis on teachers' mindset and various outcomes, we aimed to add a piece to the puzzle of potentially relevant personal characteristics of teachers and offer specific insights for mindset scholars by delving into teachers' mindset.

Relationships Between Teachers' Mindset and the Considered Outcomes

The following sections are devoted to a brief review of the conceptual underpinnings of the relationships between teachers' mindset and the three types of outcomes (teacher outcomes, instructional practices, student outcomes) and prior research on each of the respective associations. The selection of outcomes for our meta-analysis was guided by (a) conceptual ties between mindset and specific variables previously established in mindset research (e.g., variables that belong to the "meaning system" that mindsets create, such as goals, Dweck & Yeager, 2019; see also Yan & Schuetze, 2023), (b) the relevance of certain outcomes (i.e., student achievement) to research on teacher characteristics in general, further substantiated by recent increases in interest in teacher mindset and its role in promoting student achievement (e.g., Yeager et al., 2022), and (c) the consideration of instructional practices as critical outcomes on their own, also potentially serving as (behavioral) factors of transmission from teacher mindset to student outcomes (see also Blackwell et al., 2007; Lam & Zhou, 2020; Yan & Schuetze, 2023, for the importance of studying behaviors in mindset research).

Figure 1 displays a conceptual model with all hypothesized relationships. Solid lines symbolize associations that will be examined in the present meta-analysis. Dashed lines indicate potential underlying mechanisms, with instructional practices mediating the relation between teacher mindset and student achievement and self-efficacy mediating the relation between teacher mindset and teachers' own test performance, that will not be tested. Inter-relations among constructs (e.g., self-efficacy and achievement goals) as well as potential reciprocal effects are not shown due to parsimony.

Teacher Outcomes

We considered two types of motivational beliefs as mindset outcomes in our meta-analysis, namely, self-efficacy and achievement goals. First, mindsets may affect how information gets processed cognitively, thereby influencing judgments of personal *self-efficacy* (Chen & Usher, 2013). Aligned with this idea, participants in an experiment who were told that task performance on a motor task reflected an inherent

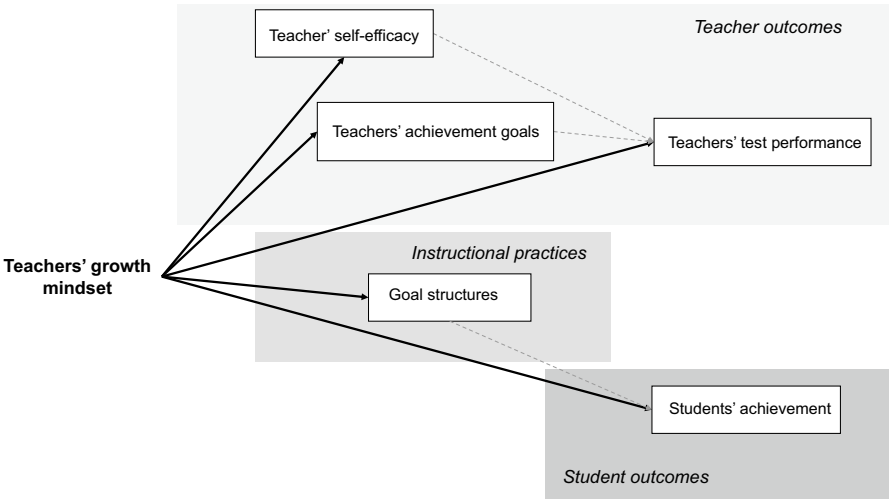

Fig. 1 Conceptual model of the relationships between teachers' growth mindset and the considered outcomes

aptitude displayed no growth in self-efficacy. Those who were told that they could improve their abilities showed an increase in self-efficacy (Jourden et al., 1991). Similarly, another study showed that students who held a growth mindset regarding their abilities reported higher levels of self-efficacy in the face of challenges (Davis et al., 2011). Some studies in the teacher domain have found that teachers' growth mindset was positively associated with self-efficacy (e.g., Leroy et al., 2007). Yet others did not reveal such a connection (e.g., zero effects; Aus et al., 2017), warranting more research to reach reliable conclusions.

Second, mindsets are believed to orient individuals toward different kinds of *achievement goals* (e.g., Dweck & Yeager, 2019; Dweck & Leggett, 1988; Hong et al., 1999). When individuals hold a growth mindset, they tend to pursue mastery goals, a motivational construct conceptually close to the growth mindset, given that mastery goals also center on growth by focusing on increasing competencies and learning (e.g., Bostwick et al., 2020). Specifically, Dweck and colleagues (e.g., Dweck, 1986; Elliot & Dweck, 1988; Blackwell et al., 2007) asserted that individuals with a growth mindset believe that attributes (e.g., intelligence and performance) can be altered through invested effort, and therefore, they adopt mastery goals. A fixed mindset, by contrast, should direct individuals toward adopting performance goals concerned with gaining favorable judgments of one's own attributes (performance-approach goals) and avoiding negative judgments (performance-avoidance goals): When abilities or other valuable attributes are seen as fixed, individuals strive to demonstrate that they have a sufficient amount of these qualities and avoid demonstrating deficiencies (Dweck & Leggett, 1988; Dweck & Yeager, 2019; Hong et al., 1999).

A non-teacher-focused meta-analysis on the nomological network of achievement goals (Payne et al., 2007) included fixed mindset as one of the antecedents and

found that fixed mindset had average small correlations with mastery goals (r = -.12) and performance-approach goals (r = .10). Furthermore, a weak positive relationship with performance-avoidance goals was found (r = .09), but this effect was based on only two studies (Payne et al., 2007). Another meta-analysis revealed larger effects, with growth mindset statistically significantly predicting mastery goals (r = .19) and performance goals (r = -.15; Burnette et al., 2013).[1] Nonetheless, it remains an open question whether a similar pattern can be obtained in samples of teachers.

Furthermore, aligned with theoretical premises in research on students and studies relying on adults working in different professions, one might assume that teachers' growth mindset should be linked to higher *achievement test performance.* This relationship could potentially be mediated by self-regulatory patterns (e.g., Burnette et al., 2013) or other features, such as self-efficacy (e.g., Macakova & Wood, 2020), even though direct effects of mindsets on achievement have been reported too (see, e.g., Cury et al., 2008). Although there are no achievement tests that (practicing) teachers routinely take, some empirical studies relying on samples of inservice or preservice teachers have employed achievement tests, mainly knowledge-based tests, and linked scores on these tests with other variables—such as teachers' growth mindset (e.g., content knowledge for teaching mathematics, Park et al., 2016; a knowledge survey of basic language constructs, Harrold, 2019; a knowledge test about behavioral genetics, Crosswaite & Asbury, 2019). In our meta-analysis, we took advantage of the existence of such studies and examined the relationships between teachers' mindset and their achievement test performance.

Instructional Practices

Among the different approaches for studying instructional practices, *goal structures* are arguably most proximal to mindsets because they represent the contextual reflection of achievement goals. Goal structures can be defined as teachers' policies and practices that make different achievement goals salient in a learning environment, as well as the goal-related messages teachers explicitly communicate to the students, and the more general goal-related climate in a learning environment (Bardach et al., 2020, see also, e.g. & Ames, 1992; Urdan, 2010). Referring to the mindsets teachers hold with regard to students (i.e., whether students can change their abilities or not), Shim et al. (2013) outlined that a strong growth mindset should make teachers understand the value of promoting each individual student's progress. Consequently, a growth mindset may prompt teachers to structure a class in accordance with a mastery goal structure (i.e., one that fosters learning and improvement). On the other hand, teachers with a fixed mindset who feel that students' ability is predetermined may be more inclined to think that their efforts and teaching are not likely to influence their students (Patterson et al., 2016; Rissanen et al., 2018). Hence, these teachers may direct their instructional resources toward identifying and supporting those

[1] No overlap exists between the studies synthesized in our meta-analysis and the meta-analysis by Payne et al. (2007), and only one study was included in both our work and that of Burnette et al. (2013).

individuals with high ability and may tend to foster competition among students (performance goal structure).

Student Achievement

Lastly, a key question in research on mindset—and any other personal teacher characteristics—concerns links to student outcomes. Theoretically, teachers with a growth mindset should, for instance, believe in every student's capacity for growth and should employ beneficial instructional practices (e.g., Shim et al., 2013), which may, in turn, promote adaptive student outcomes (e.g., achievement). By contrast, instructors with a fixed mindset, for example, have been found to comfort struggling students instead of motivating them to engage with the subject matter because these teachers believe that these students cannot improve anyway (Rattan et al., 2012). However, relationships between teachers' growth mindset and student achievement have only rarely been addressed, yielding mixed findings (e.g., Canning et al., 2019; Park et al., 2016). Hence, another aim of our work was to quantitatively summarize the association between teachers' mindset and their students' achievement (i.e., performance on achievement tests, grades).

Potential Moderators

In the present meta-analysis, we focused on three moderators related to the measurement of mindsets, considering that in any study or meta-analysis, the way constructs are translated into measures can largely affect the findings. Furthermore, measurement aspects might be particularly important to address in the mindset domain, due to several unresolved issues surrounding the assessment and definition of the construct (e.g., Limeri et al., 2020; Lüftenegger & Chen, 2017; Yan & Schuetze, 2023).

First, there are two basic assumptions about the *dimensionality* of the construct of mindset. Mindset can be assessed in terms of two independent dimensions (fixed and growth), by relying on two distinct scales (or just one scale if researchers are interested in only fixed or only growth mindset effects; e.g., Hong et al., 1999; Lou et al., 2017). Other researchers have viewed and measured mindset as a unipolar construct, with growth mindset and fixed mindset as the two endpoints of one continuous dimension (e.g., De Castella & Byrne, 2015; DeLuca et al., 2019; Roose et al., 2019). According to the second premise, the recoded values on a scale gauging a fixed (growth) mindset thus reflect a growth (fixed) mindset. The implications of these assumptions and measurement strategies are not yet well understood but could hold far-reaching implications for research on mindsets. Specifically, if the strengths of relationships to outcomes differ between recoded and nonrecoded measures, it might be necessary to handle fixed and growth mindset items separately and to view them as separate constructs (see also Yan & Schuetze, 2023). In the present meta-analysis, we therefore tested whether dimensionality, and relatedly, recoded versus nonrecoded mindset measures affect the strength of relationships between teachers' mindset and the outcomes. Because we focused on growth mindset in our meta-analysis, and therefore recoded the coefficients from studies that used fixed

mindset measures (e.g., Sisk et al., 2018), recoding was done either in the primary study or for the meta-analysis when a study relied on a measure that included nonrecoded fixed mindset items.

Second, mindsets can be assessed, for example, in reference to oneself or people in general, or, specific to studies on teachers, in reference to teachers or students (e.g., Patterson et al., 2016). Importantly, a previous study showed not only that individuals differ in their perceptions of the malleability of their own and others' intelligence, but that self-focused mindsets also yield different and stronger effects on outcomes (De Castella & Byrne, 2015).

Furthermore, a large number of mindset studies use items specifically referring to "you" (e.g., "You have a certain amount of intelligence and you can't really do much to change it"; Dweck, 1999), which may be interpreted ambiguously (Yan & Schuetze, 2023). Given that systematic investigations of the referent of mindset measures applying meta-analytic techniques are still lacking, we investigated whether the *referent of the mindset measure* had an impact on the relationships between a growth mindset and the outcomes. In line with the small amount of prior research, it may be the case that self-focused mindset measures show the strongest relationships to the outcomes in general (De Castella & Byrne, 2015). In addition to providing insights into the effects of critical conceptual and measurement characteristics, referent effects could also offer information for educational practice (e.g., it may be more promising to focus on teachers' mindsets regarding themselves, teachers in general, etc.).

Third, from the beginning of research on mindsets, it has been stressed that these beliefs can allude to *different domains*. In this meta-analysis, we restricted our focus to the cognitive domain (intelligence; e.g., Matteucci et al., 2017) and the ability-related domain (competencies in specific areas; e.g., Cutumisu, 2019a) and thus did not include features such as personality or morality as further mindset domains. Still, we tested whether the specific content of the mindset measure (e.g., intelligence or ability) influenced the findings. Deriving hypotheses on differences in the strength of these associations is difficult. As summarized in Yan and Schuetze (2023), these issues are complicated by the fact that people can define "intelligence" in vastly different ways that are not necessarily in line with scientific definitions of the constructs (see also Limeri et al., 2020, for an empirical study). Hence, the moderator analyses for mindset content are meant to shed some light on an unresolved issue in the mindset literature but without outlining a priori hypotheses. However, any differences in the effects found for scales phrased in terms of intelligence versus ability (or the lack thereof) will be informative for future mindset research and the formulation of items. Furthermore, we included three sample and study characteristics that are relevant for mindset research and that are also commonly considered in meta-analyses in (educational) research. Specifically, we tested whether the *world region* in which the study was conducted moderated the mindset effects. Most mindset research has been carried out in "western" and mostly American samples. At the same time, there is evidence of cultural differences in the interpretation of mindsets and related beliefs (e.g., Sun et al., 2021). Also, the popularity of growth mindset among educators, especially in the US, may prompt respondents to reply in more

socially desirable ways, which could attenuate correlations between mindset and outcomes in U.S. samples in comparison with samples from other world regions.

Next, we considered *educational level* (e.g., whether the teachers taught in primary or secondary education institutions or whether the sample consisted of preservice teachers) as an additional moderator and key characteristic of the samples we studied. To the best of our knowledge, prior research has not tested whether relationships between teachers' mindset and the outcomes investigated herein vary across educational levels, and studies comparing different groups (e.g., preservice vs. inservice teachers) have not revealed differences in the extents to which mindsets were endorsed (Jones et al., 2012; Patterson et al., 2016). Nonetheless, finding that mindset associations generalize across teacher subgroups would contribute to the current understanding. Similarly, although we did not have strong assumptions about potential differences, detecting significantly stronger effects in a certain group could indicate the groups for which a growth mindset would potentially be most powerful and would thereby contribute to theorizing on teachers' mindsets.

We also considered publication year as a moderator variable, which allowed us to test for the *decline effect*. According to the decline effect, effects published in the literature often diminish with time (e.g., Schooler, 2011). Including publication year in moderator analyses also allowed us to investigate concerns expressed by mindset scholars. Specifically, because the idea of growth mindset has become more popular in education, researchers have cautioned that it may have become socially undesirable to admit to having a fixed mindset (Trzesniewski et al., 2021), and such rating tendencies may also affect the extent to which valid conclusions can be drawn from the respective research findings and the sizes of the effects that were found (i.e., decreasing with increasing publication years).

We included *publication status* (i.e., published vs. unpublished work, such as dissertations or conference presentations) to test for publication bias by comparing effect sizes from published studies with effect sizes from unpublished work. Lastly, we considered *study quality* (e.g., the representativeness of the sample, the sample size, how nonrespondents were handled) as a moderator to account for potentially effect-distorting influences of study quality on effect size estimations.

Goals of the Meta-Analysis and Research Questions

The goal of this meta-analysis was to conduct the first (to our knowledge) formal quantitative research synthesis of the relationships between teachers' growth mindset and multiple academic outcomes. Therefore, the major question guiding our work was: What are the strengths of the relationships between teachers' growth mindset and teacher characteristics (self-efficacy, achievement goals, teachers' own test performance), instructional strategies (goal structures), and student outcomes (student achievement)? To achieve a more differentiated understanding, we followed up on this question by additionally posing the question: Do measurement characteristics (dimensionality, referent, mindset domain) and study and sample characteristics (world region, education level, publication year, publication status, study quality) moderate these relationships?

Method

Literature Search

The literature search was conducted between March 11 and 15, 2024 in the three databases PsycINFO, Web of Science, and ProQuest Dissertations. We used the following search terms: (teacher* OR educator* OR instructor* OR lecturer* OR "university scholar*" OR "university facult*" OR professor*) AND ("implicit theor*" OR "implicit belief*" OR "entity theor*" OR "entity belief*" OR "incremental theor*" OR "incremental belief*" OR "mindset*" OR "mind-set*" OR "fixed mindset*" OR "growth mindset*" OR "malleable mindset*" OR "theor* of intelligence" OR "belief* about intelligence" OR "theor* of abilit*" OR "belief* about abilit*") AND ("self-efficacy" OR "teach* efficacy" OR "teach* self-efficacy" OR "teach* sense of self-efficacy" OR "achievement goal*" OR "personal goal*" OR "achievement goal orientation*" OR "goal structure*" OR "classroom goal structure*" OR "classroom structure*" OR "student* achievement" OR "student* performance" OR "student* test performance" OR "teacher* achievement" OR "teacher* performance" OR "teacher* test performance" OR achievement OR performance). More specific details about the search in each data base are reported in Online Supplement S1.

A total of 1,759 articles were retrieved (850 from Web of Science, 715 from PsycINFO, 194 from ProQuest Dissertations; see Fig. 2 for the flowchart), of which 1,495 remained after duplicates were removed). In a first step, we screened the Titles and Abstracts and included only studies (a) that focused on mindset in accordance with Dweck (e.g., Dweck & Leggett, 1988; Dweck & Master, 2009) and measured the outcomes we considered (self-efficacy, achievement goals, teachers' test performance, goal structures, student achievement), (b) that relied on samples of teachers, student teachers, or university staff involved in teaching, (c) that employed quantitative research methods to investigate the relationships between teachers' mindset and other factors, meaning that theoretical papers and qualitative studies were not included, and (e) for which full texts were available. When the Abstract did not unequivocally provide sufficient information to screen for eligibility, we checked the main text of the article. A subsample of the studies (35.45%) was screened independently by both the first author and a trained research assistant by applying the inclusion criteria outlined above. The results were then compared. Interrater agreement for study inclusion was high (96.04% rater agreement), and disagreements were discussed until a consensus was reached. The remaining studies were screened by the first author. After screening the hits, a total of 62 potentially eligible studies remained.

Of this initial pool of potentially eligible studies, we then had to exclude 28 studies because these studies (a) did not report zero-order correlation coefficients or their corresponding authors did not send the correlations upon request to the first author of this meta-analysis (6 studies); note that intervention studies and experiments were excluded if there were either no pretest/preintervention correlations between the mindset measure and our outcomes, or no correlations based

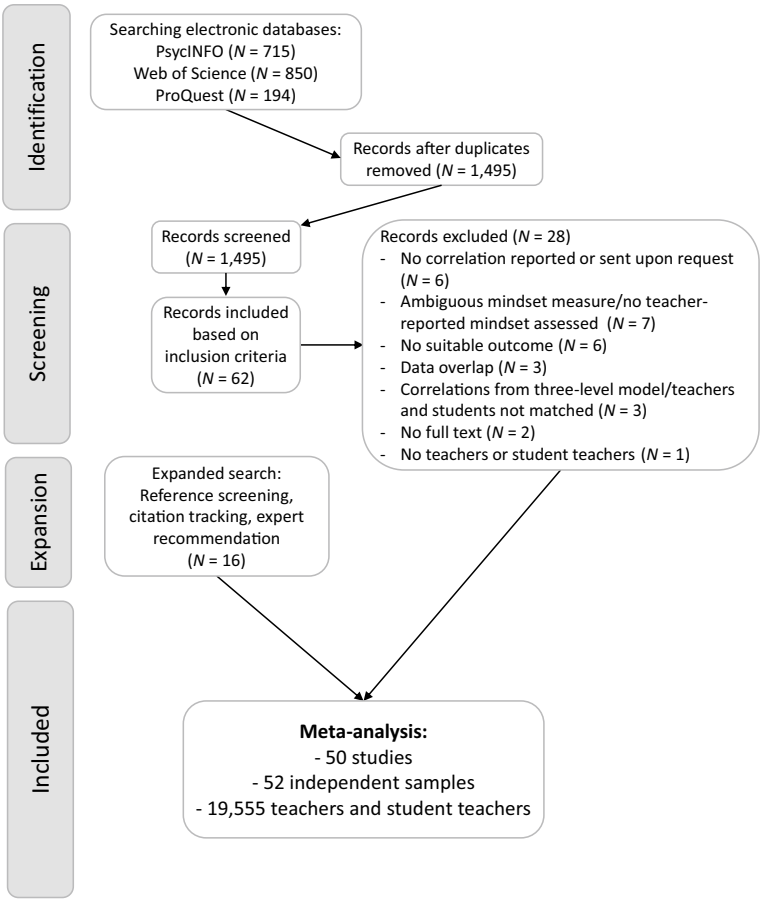

Fig. 2 Flowchart for study inclusion

on only the control group were available (or sent upon request). We furthermore excluded studies that (b) used ambiguous mindset measures (e.g., mindset scale mixed with other scales; 7 studies); (c) did not include outcomes we focused on (or assessed the outcome variables we focused on in a longitudinal study before measuring teacher mindset; 6 studies); (d) used data sets that were the same as or overlapped with data sets from other included studies (3 studies), or (e) did not provide a full text. With respect to student achievement analyses, we excluded studies that (f) did not report correlations at the teacher/class level (i.e., correlations between teachers' mindset and student achievement aggregated to the teacher/class level; 3 studies). We expanded the search by asking experts to recommend relevant literature, screening the references of included studies from the data base search, and performing citation tracking to find additional studies that the data base search might have missed. The expanded search resulted in 16 additional studies.

The 50 studies (including 52 independent samples) yielded 81 effect sizes and a total sample size of 19,555 teachers and preservice teachers. The majority of the included samples came from the US or Canada (67.3%, $k = 35$), 25% ($k = 13$) from Europe, 5.8% ($k = 3$) from Asia, and 1.9% ($k = 1$) from Australia. Samples comprised teachers who taught at the primary ($k = 10$), secondary ($k = 16$), and tertiary educational levels ($k = 4$); $k = 10$ samples were from a mixed educational level, and $k = 9$ were preservice teachers. A total of 27 samples were from published studies, and 25 were from unpublished studies. The most used scales to assess self-efficacy were (adapted versions of) the Tschannen-Moran and Woolfolk Hoy's (2001) Teacher Self Efficacy Scale (TSES), followed by (adapted versions of) Gibson and Dembo's (1984) Teacher Efficacy Scale (TES), self-created scales, and Midgley and colleagues' Teacher Self-Efficacy scale from the Patterns of Adaptive Learning Survey (PALS, Midgley et al., 2000). Achievement goals were assessed with a variety of different (adapted) scales (e.g., Achievement Goal Orientations for Teaching Scales, Butler, 2007; Butler & Shibaz, 2008, Achievement Goal Orientation Scales, Midgley et al., 2000), and none of the achievement goal scales was used in more than one study. Most studies assessing goal structures used scales from the PALS (Midgley et al., 2000). While the majority of studies assessing teachers' achievement employed knowledge tests, a few studies focused on performance on specific tasks (the quality of a self-created poster). The largest proportion of included studies that assessed student achievement used achievement tests (mostly mathematics tests), and only two studies used school grades. Table S1 in the Online Supplement provides information on the coding for the moderator categories. Table S2 includes the coding file used for our analyses with all effect sizes.

Coding

The first author (all studies) as well as either the fourth or fifth author independently coded the correlation coefficients between growth mindset and each outcome (93.7% rater agreement). Any discrepancies in coding were resolved through discussions until an agreement was reached. When authors employed a mindset measure where higher scores were indicative of a fixed mindset, we reversed the sign of the correlation coefficient before analyzing the data. This approach is in accordance with previous meta-analyses on mindsets (see also, e.g., Sisk et al., 2018) and allowed us to synthesize a larger number of studies for each relationship. When studies measured mindsets with regard to intelligence, ability, or other factors (e.g., personality or morality), we coded only the correlation for the intelligence or ability measure. Some studies had assessed several domains of self-efficacy (e.g., self-efficacy for classroom management, self-efficacy for student support) in the same sample, and no relationship between mindset and a self-efficacy composite was reported. In such cases, the correlation coefficients were Fisher-z-transformed, averaged, and then back-transformed, yielding a composite self-efficacy score. When a study included different self-efficacy scales (self-efficacy referring to teachers, self-efficacy referring to oneself), we used the correlations for the self-efficacy measure focusing on oneself.

The first author (all moderators) and either the fourth or the fifth author independently coded all moderators (92.4% rater agreement). The third and fourth authors independently coded all study quality criteria (86.27% rater agreement). Disagreements were discussed until a consensus was reached, and when disagreements occurred, we thoroughly checked the original study to clarify ambiguities. For the moderator dimensionality, the following categories were coded: We documented whether the correlation was recoded (i.e., because the scale assessed a fixed mindset) or not (i.e., only growth mindset items were employed, with larger values indicating greater agreement with the growth mindset statements). The recoding could have taken place in the primary study or for the meta-analysis: Due to our focus on teachers' growth mindset, we recoded correlation coefficients obtained in studies that assessed only a fixed mindset (see also, e.g., Sisk et al., 2018).

In terms of the moderator referent of the mindset measure, we coded whether the mindset measure referred to teachers in general (e.g., "teachers have/teachers are …"), the students whom the teachers taught (e.g., "Students can …."), the self (e.g., "I can …"), "you" (e.g., "You can…."), or whether a study's scale mixed different item referents or referred to referents other than the previously listed item referents (e.g., "people"). We distinguished between three categories for the moderator content of mindset, namely, (a) intelligence, (b) ability, and (c) intelligence or ability mixed with other content, as well as other aspects in the academic domain, such as talent in mathematics. Whenever an article did not report all the items that were used in a study, we relied on the authors' description of the scale and the sample items that were provided to code for content and item referent. For moderator analyses regarding the study and participant characteristics, we coded the following categories: Educational level was divided into the categories primary education, secondary education, tertiary education (i.e., teaching at the university/college level), prospective teachers (i.e., preservice teachers), and mixed educational levels. We used the category mixed educational levels when, for example, some teachers in the study taught at the elementary-school level, whereas others taught at the secondary-school level, but not when the sample included both inservice teachers and preservice teachers (the latter was not coded). As broad categories for the origin of the sample, we relied on the following world regions: US and Canada, Europe, Asia, Africa, South America, and Australia. The quality of the included primary studies was assessed by two independent raters using an adapted version of the Newcastle Ottawa Scale (Wells et al., 2000) as used in the study by Dürlinger and Pietschnig (2022). The studies were evaluated on a set of criteria, encompassing the representativeness of the sample, the sample size, how nonrespondents were handled, the extent of the response rate, and the measurement tools. Such ratings yield an index of study quality, which can range from 0 to 5 points, with higher values indicating higher study quality (Dürlinger & Pietschnig, 2022). More information on the quality ratings is provided in Online Supplement S2.

Statistical Analyses

Instead of results from nominal null hypothesis testing, we focused on effect size indicators for the summary effects, interpreting correlations of .10, .20, and .30

as small, typical, and relatively large (Gignac & Szodorai, 2016). In addition, we considered prior meta-analytical work on growth mindset and motivation as benchmarks for evaluating the respective effects in our meta-analysis. Specifically, Burnette et al. (2013) and Payne et al. (2007) obtained correlations ranging from 0.09 to 0.19 between mindset and achievement goals in their meta-analyses, which did not focus on teachers. Lastly, with respect to the association between teacher mindset and student achievement, we acknowledge the importance of a multitude of factors, including individual differences between students, family background characteristics, and prior educational experiences that influence student achievement. In accordance with prior work on relationships between teacher characteristics and student outcomes that have, for the most part, found very small effects at best (see Bardach et al., 2022, for an integrative review), we therefore expected the relationship between teachers' growth mindset and student achievement to be very small at best (i.e., not likely to be above $r = .10$). Also, considering that students' own growth mindset correlates with their academic performance at approximately $r = .10$ (Sisk et al., 2018), it is unrealistic to expect larger relationships with teachers' mindset, which is much less proximal to student achievement than their own mindset.

Prior to all syntheses, the signs of the effect sizes were recoded to represent identical directions of effects (i.e., positive effects indicate that larger growth mindset values are typically observed in the presence of larger mastery-approach goals but lower performance-approach goals). We used two approaches to synthesize the effect sizes. First, we used three-level modeling to estimate an overall effect across all growth mindset correlations while accounting for effect size dependencies within studies. This technique is useful because many of the primary studies provided more than one effect size from the same sample for an outcome of interest. However, dependent effects cannot be included in conventional two-level models, thus often necessitating the selection of single effect sizes from the available data, a process that can lead to attrition of valuable information and conceivably misleading results. Multilevel modeling allows all reported relevant effect sizes to be included by accounting for data dependencies (e.g., Cheung, 2019). In multilevel meta-analyses, nonindependent (e.g., due to sample overlap or the reporting of more than a single indicator) effect sizes are assumed to be nested within studies, thus creating a third level in the two-level structure of conventional (two-level) meta-analyses. In our three-level model, heterogeneity was modeled between participants (i.e., on Level 1), within studies (Level 2), and between studies (Level 3; corresponding to between-study heterogeneity in conventional two-level meta-analyses). Both Level 2 and Level 3 heterogeneity were consequently modeled in the synthesis of effects. We used maximum likelihood estimation to calculate precision-weighted (i.e., where inverse sampling variances with more accurate estimates are assigned larger weights) summary effects by means of random-effects models. Subsequently, we used two-level approaches to calculate precision-weighted random-effects meta-analyses of independent effect sizes within subgroups. This approach was reasonable because there were no within-subset effect-size dependencies. We used *I*-squared values in accordance with the well-established thresholds by Higgins and colleagues (2003) to interpret between-study heterogeneity as trivial (< 0.25), small ($< 50\%$), modest ($< 75\%$), or large ($75 + \%$).

To assess influences of potential moderating variables, we first ran a series of single precision-weighted three-level mixed-effects meta-regressions across all growth mindset correlations using maximum likelihood estimation. Polytomous nominal-scaled variables were dummy coded prior to the calculations. Subsequently, we repeated this procedure using two-level regressions of independent effect sizes within subgroups (i.e., running analyses for each of the outcomes).

Finally, we used three approaches to investigate evidence of potential confounding dissemination bias in three-level meta-analyses. Although many methods have been developed for bias assessment, most of them are only appropriate to be used in conventional (two-level) meta-analyses because data dependency and sample overlap cannot be accounted for. Therefore, we used three methods that have been shown to be suitable for multilevel meta-analyses in targeted investigations (Rodgers & Pustejovsky, 2021). First, we used Egger's regression, which uses sandwich estimators with a robust variance estimator to account for dependent effect sizes (henceforth: Egger sandwich; Rodgers & Pustejovsky, 2021). Second, we used Egger's regression with sandwich estimators in a multilevel model. This second approach performs favorably in terms of the Type I error rate but has been demonstrated to possess comparatively little bias detection power (henceforth: Egger MLM; Van den Noortgate et al., 2013). Third, we used a three-parameter selection (3PSM) approach. This method specifies *p*-value functions that should be unrelated to effect strength in the absence of bias. Systematic associations of *p*-values with effect sizes can therefore be interpreted as evidence of bias. Past studies have reported good performance for this method in terms of bias detection, despite suboptimal Type I error rates (Rodgers & Pustejovsky, 2021). We interpreted *p*-values $< .10$ as indicative of bias, on the basis of current standards (Siegel et al., 2022). All analyses were computed in the open source software R (R Core Team, 2022).

Transparency and Openness: The coding file and all analysis scripts can be found at the Open Science Framework (OSF, https://osf.io/zyt4b/). The coding file is also included as Table S2 in the Online Supplement. This review project was not preregistered.

Results

Associations Between Teachers' Growth Mindset and the Outcomes

We observed a small positive effect when all effects of teachers' growth mindset were synthesized across all available outcomes ($r = .111$, $p < .001$). However, when we differentiated the effects by outcome, we observed numerically somewhat larger nontrivial effects for self-efficacy ($r = .180$, $p < .001$), mastery-approach goals ($r = .148$, $p < .001$), and mastery-approach goal structures ($r = .137$, $p = .001$). The relationships between teachers' growth mindset and performance-approach goals ($r = .033$, $p = .084$), performance-avoidance goals ($r = .077$, $p = .074$), performance-approach goal structures ($r = .014$, $p = .717$), teachers' achievement ($r = .013$, $p = .852$), and student achievement ($r = -.024$, $p = .309$) were trivial in strength and not statistically significant. Table 1 presents all meta-analytic correlations.

Table 1 Summary effects for correlations with teachers' growth mindset in the three-level model and the eight two-level models

	k	*N*	I^2	*r*	*p*	*LCI*	*UCI*
Three-level model	80 (52)	19,555	79.47	.111	< .001	.070	.153
Self-efficacy	29	6,779	62.51	.180	< .001	.135	.226
Mastery-approach goals	7	3,182	< 0.01	.148	< .001	.113	.183
Performance-approach goals	7	3,182	6.25	.033	.084	-.004	.070
Performance-avoidance goals	6	1,773	59.44	.077	.074	-.007	.160
Mastery goal structure	8	1,944	63.46	.137	.001	.054	.220
Performance goal structure	6	900	19.22	.014	.717	-.062	.090
Teachers' achievement	8	1,039	75.18	.013	.852	-.125	.151
Students' achievement	10	756	19.79	-.024	.309	-.111	.063

Parenthetical *k* entries represent counts from the three-level model; lines without parenthetical expressions indicate two-level models

Results of the Moderator Analyses

In our three-level regressions, the effect of the moderator publication year was statistically significant, with smaller effects in more recent years ($b = -0.008$, $p = .008$). We observed significantly smaller correlations between teachers' growth mindset and the overall outcomes in studies that had been conducted in Europe and Australia compared with studies conducted in the US or Canada (moderator: world region, $b = -0.085$, $p = .005$ and $b = -0.673$, $p < .001$, respectively). Unexpectedly, unpublished studies showed larger effects than published ones (moderator: publication status, $b = 0.130$, $p < .001$), indicating the presence of reverse publication bias. None of the other moderators yielded statistically significant influences on the correlations (see Table 2). Next, we ran moderator analyses for the relationships between teachers' growth mindset and the separate outcomes.

Teacher Outcomes

In the analyses involving self-efficacy, we once again observed lower correlations for European studies compared with studies conducted in the US or Canada ($b = -0.142$, $p = .005$) and larger values for unpublished studies ($b = 0.116$, $p = .006$). The other moderating effects were not statistically significant (see Table 3). For mastery-approach goals and performance-approach goals, no significant moderating effects were found (see Tables 4 and 5, respectively). In the analyses for performance-avoidance goals, significantly smaller correlations emerged when the referent of the mindset measures was mixed/other as opposed to "you" (moderator: referent of the mindset measure, $b = 0.180$, $p = .003$). For performance-avoidance goals, unpublished studies yielded significantly larger effects ($b = 0.199$, $p = .001$). Furthermore, for the moderator educational level, significantly smaller effects were obtained for tertiary education ($b = -0.195$, $p = .002$) and mixed educational levels ($b = -0.243$, $p = .006$) than for primary

Table 2 Single dummy-coded three-level regressions of moderating effects on correlations between teachers' mindset and the overall outcomes

	b	*SE*	*p*	*LCI*	*UCI*
Publication year ($k = 80$ [52])	-0.008	0.003	.008	-0.014	-0.002
Study Quality ($k = 78$ [51])	-0.025	0.029	.376	-0.082	0.031
Dimensionality[a] ($k = 79$ [51])					
Not recoded	-0.048	0.033	.152	-0.113	0.018
Referent[b] ($k = 73$ [45])					
Student	-0.255	0.165	.122	-0.579	0.069
Self	-0.309	0.185	.096	-0.672	0.054
You	-0.283	0.164	.084	-0.603	0.038
Mixed/other	-0.321	0.167	.054	-0.648	0.005
Content[c] ($k = 79$ [51])					
Ability	-0.024	0.057	.666	-0.135	0.086
Mixed/other	-0.028	0.060	.646	-0.091	0.146
Publication status[d] ($k = 80$ [52])					
Not published	0.130	0.031	< .001	0.069	0.190
World region[e] ($k = 80$ [52])					
Europe	-0.085	0.030	.005	-0.145	-0.026
Asia	-0.056	0.053	.295	-0.160	0.049
Australia	-0.673	0.142	< .001	-0.952	-0.394
Education[f] ($k = 77$ [49])					
Secondary education	-0.054	0.060	.367	-0.172	0.064
Tertiary education	-0.050	0.080	.533	-0.205	0.106
Student teachers	-0.002	0.070	.975	-0.138	0.134
Mixed educational levels	-0.078	0.069	.257	-0.212	0.057

Reference category: [a]recoded in study or meta-analysis; [b]teachers in general; [c]intelligence; [d]published; [e]US and Canada; [f]primary education; k = number of effect sizes [nested in number of studies]

education (see Table 6 for all the results of the moderator analyses for performance-avoidance goals). In the analyses for teachers' test performance, we found significantly larger effects for unpublished than for published studies ($b = 0.262$, $p = .022$) and statistically significantly smaller effects for studies conducted in Europe than for studies conducted in the US or Canada ($b = -0.335$, $p = .016$). Furthermore, study quality was a statistically significant moderator, with smaller effects for studies with higher study quality ($b = -0.130$, $p = .024$; see Table 7).

Instructional Practices

The associations between teachers' growth mindset and mastery goal structures were statistically significantly moderated by the dimensionality of the mindset measures. Nonrecoded mindset measures yielded statistically significantly smaller effects than recoded measures ($b = -0.247$, $p < .001$, see Table 8 for all results of the moderator

Table 3 Single dummy-coded two-level regressions of moderating effects on correlations between teachers' mindset and self-efficacy

	b	*SE*	*p*	*LCI*	*UCI*
Publication year ($k = 29$)	-0.005	0.003	.120	-0.010	0.001
Study Quality ($k = 28$)	-0.013	0.031	.687	-0.074	0.049
Dimensionality[a] ($k = 29$)					
Not recoded	-0.014	0.069	.836	-0.149	0.121
Referent[b] ($k = 27$)					
Student	-0.218	0.161	.174	-0.533	0.096
Self	-	-	-	-	-
You	-0.236	0.159	.139	-0.548	0.077
Mixed/other	-0.173	0.168	.304	-0.502	0.157
Content[c] ($k = 29$)					
Ability	-0.074	0.065	.257	-0.201	0.054
Mixed/other	0.082	0.065	.210	-0.046	0.210
Publication status[d] ($k = 29$)					
Not published	0.116	0.042	.006	0.033	0.199
World region[e] ($k = 29$)					
Europe	-0.142	0.051	.005	-0.241	-0.043
Asia	-0.097	0.073	.181	-0.240	0.045
Australia	-	-	-	-	-
Educational level[f] ($k = 27$)					
Secondary education	0.013	0.068	.848	-0.120	0.146
Tertiary education	-0.089	0.103	.391	-0.292	0.114
Student teachers	0.049	0.103	.658	-0.157	0.248
Mixed educational levels	-0.068	0.078	.381	-0.221	0.084

Reference category: [a]recoded in study or meta-analysis; [b]teachers in general; [c]intelligence; [d]published; [e]US and Canada; [f]primary education; k = number of effect sizes

analyses for mastery goal structures). Furthermore, the association with mastery goal structures was moderated by study quality, with larger effects in the presence of higher study quality ($b = 0.115$, $p = .011$).

In the analyses for performance goal structures, smaller correlations emerged when the referent of the mindset measure was "you" as compared with mixed/other ($b = -0.358$, $p = .012$). We obtained a statistically significant moderating effect of the content of the mindset measure. Compared with measures focusing on intelligence, measures with mixed/other content yielded statistically significantly larger effects ($b = 0.333$, $p = .017$). The relationship between teachers' growth mindset and performance goal structures was also statistically significantly smaller in secondary education than in primary education ($b = -0.358$, $p = .012$). Table 9 presents all moderator effects for performance goal structures.

Table 4 Single dummy-coded two-level regressions of moderating effects on the correlations between teachers' mindset and mastery-approach goals

	b	*SE*	*p*	*LCI*	*UCI*
Publication year ($k=7$)	-0.004	0.006	.507	-0.014	0.007
Study Quality ($k=7$)	-0.020	0.033	.534	-0.084	0.044
Dimensionality[a] ($k=7$)					
Not recoded	-0.035	0.040	.379	-0.112	0.043
Referent[b] ($k=7$)					
Student	0.057	0.073	.436	-0.086	0.199
Self	-0.012	0.067	.854	-0.144	0.119
You	-0.029	0.043	.499	-0.113	0.055
Teachers in general	-	-	-	-	-
Content[c] ($k=7$)					
Ability	> -0.001	0.057	.994	-0.112	0.111
Mixed/other	-	-	-	-	-
Publication status[d] ($k=7$)					
Not published	0.015	0.058	.796	-0.098	0.128
World Region[e] ($k=7$)					
Europe	-0.028	0.052	.593	-0.129	0.074
Asia	-0.069	0.051	.176	-0.168	0.031
Australia	-	-	-	-	-
Education[f] ($k=7$)					
Secondary education	-0.021	0.162	.900	-0.338	0.297
Tertiary education	-0.004	0.062	.955	-0.126	0.119
Student teachers	-0.036	0.061	.558	-0.154	0.083
Mixed educational levels	0.073	0.089	.411	-0.101	0.246

Reference category: [a]recoded in study or meta-analysis; [b]mixed/other; [c]intelligence; [d]published; [e]US and Canada; [f]primary education; k = number of effect sizes

Student Achievement

In the analyses for student achievement, we obtained statistically significantly larger effects for mindset measures that were not recoded than for recoded mindset measures ($b=0.276$, $p=.021$). Table 10 presents all moderator effects for student achievement.

Additional Analyses

We supplemented our regression analyses with mixed-effects subgroup analyses to examine potential differences between categorical predictors other than compared with the respective reference category. One additional effect was identified ($Q=15.287$, $df=1$, $p<.001$), indicating significantly larger associations between teachers' growth mindset and teachers' test performance for studies

Table 5 Single dummy-coded two-level regressions of moderating effects on correlations between teachers' mindset and performance-approach goals

	b	*SE*	*p*	*LCI*	*UCI*
Publication year ($k=7$)	-0.001	0.006	.869	-0.012	0.010
Study Quality ($k=7$)	-0.041	0.033	.206	-0.105	0.023
Dimensionality[a] ($k=7$)					
Not recoded	-0.041	0.040	.306	-0.119	0.037
Referent[b] ($k=7$)					
Student	0.063	0.073	.384	-0.079	0.206
Self	0.016	0.067	.811	-0.115	0.147
You	-0.045	0.043	.296	-0.129	0.039
Teachers in general	-	-	-	-	-
Content[c] ($k=7$)					
Ability	0.032	0.058	.577	-0.082	0.147
Mixed/other	-	-	-	-	-
Publication status[d] ($k=7$)					
Not published	-0.024	0.064	.705	-0.149	0.100
Region[e] ($k=7$)					
Europe	-0.005	0.052	.923	-0.106	0.096
Asia	-0.059	0.051	.243	-0.158	0.040
Australia	-	-	-	-	-
Education[f] ($k=7$)					
Secondary education	0.015	0.162	.926	-0.303	0.333
Tertiary education	0.040	0.062	.526	-0.083	0.162
Student teachers	-0.012	0.061	.844	-0.130	0.107
Mixed educational levels	0.116	0.089	.191	-0.058	0.289

Reference category: [a]recoded in study or meta-analysis; [b]mixed/other; [c]intelligence; [d]published; [e]US and Canada; [f]primary education; k = number of effect sizes

relying on preservice teachers ($r=.115$, LCI = -.037, UCI = .268) compared with those from mixed/other educational levels ($r=-.259$, LCI = -.368, UCI = -.149).

Dissemination Bias

We did not observe any evidence of bias based on the three detection methods we used ($p=.316$, .259, and .930 for Egger MLM, Egger sandwich, and 3PSM, respectively).

Table 6 Single dummy-coded two- and three-level regressions of moderating effects on correlations between teachers' mindset and performance-avoidance goals

	b	*SE*	*p*	*LCI*	*UCI*
Publication year ($k=6$)	-0.006	0.009	.517	-0.023	0.012
Study Quality ($k=6$)	0.084	0.044	.056	-0.002	0.169
Dimensionality[a] ($k=6$)					
Not recoded	-0.034	0.097	.728	-0.225	0.157
Referent[b] ($k=6$)					
Student	-0.040	0.036	.582	-0.183	0.103
Self	0.029	0.073	.664	-0.102	0.160
You	0.180	0.067	.003	0.061	0.300
Teachers in general	-	-	-	-	-
Content[c] ($k=6$)					
Ability	-0.048	0.106	.648	-0.255	0.159
Mixed/other	-	-	-	-	-
Publication status[d] ($k=6$)					
Not published	0.199	0.061	.001	0.080	0.318
Region[e] ($k=6$)					
Europe	-0.075	0.088	.393	-0.248	0.097
Asia	-	-	-	-	-
Australia	-	-	-	-	-
Education[f] ($k=6$)					
Secondary education	-0.243	0.162	.133	-0.561	0.074
Tertiary education	-0.195	0.062	.002	-0.317	-0.073
Student teachers	-0.123	0.126	.332	-0.370	0.125
Mixed educational levels	-0.243	0.089	.006	-0.417	0.070

Reference category: [a]recoded in study or meta-analysis; [b]mixed/other; [c]intelligence; [d]published; [e]US and Canada; [f]primary education; k = number of effect sizes

Discussion

Dweck's theory of growth and fixed mindsets (e.g., Dweck, 2000) has amassed copious research over the past decades, has inspired multiple practical applications, and has gained popularity in both the academic domain and the media. Nonetheless, most of the work on mindsets in educational research, including existing syntheses, have focused on students. Far less is known about teachers as those who teach and support students, structure class, and are, just like students, characterized by specific motivational patterns that may be more (e.g., self-efficacy) or less adaptive (e.g., performance-avoidance goals) for their professional lives and well-being. In this article, we thus present a meta-analysis of teachers' growth mindset and its relationships with teachers' own motivation in the sense of self-efficacy and achievement goals, their achievement test performance, their instructional strategies, and their students' achievement.

Table 7 Single dummy-coded two-level regressions of moderating effects on correlations between teachers' mindset and teachers' test performance

	b	*SE*	*p*	*LCI*	*UCI*
Publication year ($k = 8$)	-0.004	0.030	.904	-0.063	0.056
Study Quality ($k = 8$)	-0.130	0.058	.024	-0.244	-0.017
Dimensionality[a] ($k = 7$)					
Not recoded	-0.076	0.124	.539	-0.320	0.167
Referent[b] ($k = 6$)					
Student	-	-	-	-	-
Self	-	-	-	-	-
You	0.265	0.181	.144	-0.090	0.619
Teachers in general	-	-	-	-	-
Content[c] ($k = 7$)					
Ability	0.031	0.209	.884	-0.378	0.439
Mixed/other	-0.036	0.233	.878	-0.492	0.420
Publication status[d] ($k = 8$)					
Not published	0.262	0.114	.022	0.038	0.485
World region[e] ($k = 8$)					
Europe	-0.335	0.139	.016	-0.607	-0.063
Asia	-	-	-	-	-
Australia	-	-	-	-	-
Education[f] ($k = 7$)					
Secondary education	-	-	-	-	-
Tertiary education	-	-	-	-	-
Student teachers	0.169	0.154	.273	-0.133	0.471
Mixed educational levels	-0.206	0.184	.262	-0.567	0.154

Reference category: [a]recoded in study or meta-analysis; [b]mixed/other; [c]intelligence; [d]published; [e]US and Canada; [f]primary education; k = number of effect sizes

We obtained a small positive effect across outcomes, indicating that teachers' growth mindset is, to some extent, relevant to the considered outcomes. However, the separate analyses for the seven outcomes yielded more differentiated insights. With regard to self-efficacy and mastery goals, our results showed that both constructs are related to teachers' growth mindset in a conceptually meaningful way. The statistically significant positive effects are well-aligned with longstanding theoretical premises (e.g., Dweck & Leggett, 1988; Elliot & Dweck, 1988). As would be assumed on the basis of theory, both average correlations with performance goals pointed into the expected direction (i.e., higher levels of a growth mindset were associated with lower levels of performance goals); however, both were small-to-trivial and did not reach statistical significance in this meta-analysis. We know now that performance-approach goals can show different and sometimes even contrasting associations with further outcomes depending on their conceptualization (appearance focus; i.e., competence demonstration vs. normative focus, i.e., outperforming

Table 8 Single dummy-coded two-level regressions of moderating effects on correlations between teachers' mindset and mastery goal structures

	b	*SE*	*p*	*LCI*	*UCI*
Publication year ($k=8$)	-0.005	0.008	.511	-0.020	0.010
Study Quality ($k=7$)	0.115	0.045	.011	0.026	0.203
Dimensionality[a] ($k=8$)					
Not recoded	-0.247	0.057	< .001	-0.359	-0.136
Referent[b] ($k=8$)					
Student	-0.050	0.121	.682	-0.287	0.188
Self	-	-	-	-	-
You	-0.095	0.123	.441	-0.336	0.146
Teachers in general	-	-	-	-	-
Content[c] ($k=8$)					
Ability	0.027	0.105	.795	-0.179	0.233
Mixed/other	0.113	0.179	.528	-0.238	0.464
Publication status[d] ($k=8$)					
Not published	0.136	0.071	.057	-0.004	0.276
World Region[e] ($k=8$)					
Europe	-0.082	0.089	.356	-0.256	0.092
Asia	-	-	-	-	-
Australia	-	-	-	-	-
Education[f] ($k=8$)					
Secondary education	-0.115	0.181	.525	-0.471	0.240
Tertiary education	-	-	-	-	-
Student teachers	-	-	-	-	-
Mixed educational levels	-0.092	0.185	.619	-0.454	0.270

Reference category: [a]recoded in study or meta-analysis; [b]mixed/other; [c]intelligence; [d]published; [e]US and Canada; [f]primary education; k = number of effect sizes

peers, e.g., Hulleman et al., 2010; Senko & Dawson, 2017). The studies in our meta-analysis did not distinguish between different performance-approach goal facets, and thus, their findings may have been obscured. For example, some early work in the mindset domain (e.g., Dweck & Leggett, 1988; Hong et al., 1999) suggested that a fixed mindset should shift individuals toward adopting goals concerned with gaining favorable judgments of their attributes (i.e., a performance-approach goal with appearance focus). Therefore, it is possible that strictly appearance-oriented performance-approach goals—and possibly also performance-avoidance goals—may be more strongly correlated with teachers' mindset than the performance goal composites investigated in our meta-analysis.

However, beyond statistical significance and conceptual meaningfulness (alignment with mindset theory), researchers should also consider the extent to which teachers' growth mindset is practically meaningful to their adaptive motivation. The effects for self-efficacy and mastery-approach goals observed in the current study

Table 9 Single dummy-coded two-level regressions of moderating effects on correlations between teachers' mindset and performance goal structures

	b	*SE*	*p*	*LCI*	*UCI*
Publication year ($k=6$)	0.004	0.008	.576	-0.011	0.019
Study Quality ($k=6$)	0.014	0.039	.717	-0.062	0.090
Dimensionality[a] ($k=6$)					
Not recoded	-0.066	0.080	.412	-0.223	0.091
Referent[b] ($k=6$)					
Student	-0.258	0.147	.080	-0.546	0.030
Self	-	-	-	-	-
You	-0.358	0.142	.012	-0.635	-0.080
Teachers in general	-	-	-	-	-
Content[c] ($k=6$)					
Ability	0.104	0.116	.370	-0.123	0.331
Mixed/other	0.333	0.140	.017	0.059	0.607
Publication status[d] ($k=6$)					
Not published	-0.072	0.100	.469	-0.268	0.124
World region[e] ($k=6$)					
Europe	-0.066	0.080	.412	-0.223	0.091
Asia	-	-	-	-	-
Australia	-	-	-	-	-
Education[f] ($k=6$)					
Secondary education	-0.358	0.142	.012	-0.635	-0.080
Tertiary education	-	-	-	-	-
Student teachers	-	-	-	-	-
Mixed educational levels	-0.258	0.147	.080	-0.546	0.030

Reference category: [a]recoded in study or meta-analysis; [b]mixed/other; [c]intelligence; [d]published; [e]US and Canada; [f]primary education; k = number of effect sizes

($r=.180$, $r=.148$) were within the range of small to typical effects found in psychological research (Gignac & Szodorai, 2016). Moreover, the estimate of mastery goals in our meta-analysis is similar to effect sizes found in previous meta-analyses on mindset and achievement goals (Burnette et al., 2013; Payne et al., 2007) against which we evaluated our effects. The importance of reliable small effects has been highlighted (Abelson, 1985; Matz et al., 2017), and researchers may want to explore the potential benefits of teachers' growth mindset for adaptive motivation in more depth in future studies.

Next, we addressed the question of whether teachers with higher growth mindset scores do better on achievement tests. A potential link between growth mindset and higher performance has been discussed, for example, because individuals with a growth mindset typically show higher academic persistence, are better able to self-regulate their behavior to attain desired goals, and exhibit higher levels of self-efficacy (e.g., Burnette et al., 2013). However, our meta-analytic results revealed no

Table 10 Single dummy-coded two-level regressions of moderating effects on correlations between teachers' mindset and student achievement

	b	*SE*	*p*	*LCI*	*UCI*
Publication year ($k = 10$)	-0.028	0.018	.113	-0.062	0.007
Study Quality ($k = 10$)	-0.093	0.070	.184	-0.231	0.044
Dimensionality[a] ($k = 10$)					
Not recoded	0.276	0.120	.021	0.041	0.511
Referent[b] ($k = 7$)					
Student	-0.022	0.152	.884	-0.321	0.276
Self	-	-	-	-	-
You	0.143	0.133	.283	-0.118	0.405
Teachers in general	-	-	-	-	-
Content[c] ($k = 10$)					
Ability	-	-	-	-	-
Mixed/other	-0.066	0.095	.485	-0.253	0.120
Publication status[d] ($k = 10$)					
Not published	0.123	0.092	.181	-0.057	0.303
World region[e] ($k = 10$)					
Europe	-0.103	0.182	.572	-0.460	0.254
Asia	-	-	-	-	-
Australia	-0.049	0.160	.762	-0.362	0.265
Education[f] ($k = 7$)					
Secondary education	-0.106	0.093	.254	-0.287	0.076
Tertiary education	-	-	-	-	-
Student teachers	-	-	-	-	-
Mixed educational levels	-0.081	0.228	.724	-0.528	0.367

Reference category: [a]recoded in study or meta-analysis; [b]mixed/other; [c]intelligence; [d]published; [e]US and Canada; [f]primary education; k = number of effect sizes

significant relationship between teachers' growth mindset and their own test performance, although we did not test for potential indirect effects on test performance (see e.g., Macakova, & Wood, 2020). Still, the available evidence synthesized in our meta-analysis suggests that teachers' growth mindset is not likely to be a strong correlate of teachers' performance on achievement tests.

Furthermore, although no statistically significant relationships between teachers' growth mindset and instructional strategies in terms of performance goal structures were found, we observed a statistically significant small-sized positive relationship with mastery goal structures. Mastery goal structures as indicators of high-quality teaching represent important outcomes on their own and have been shown to be related to other relevant outcomes (e.g., mastery goal structures were found to be related to students' motivation; Bardach et al., 2020). Our finding for mastery goal structures mirrored the finding for mastery-approach goals; hence, teachers' growth mindset appears to be relevant for constructs focusing on mastery and growth, not

only on a personal level (mastery-approach goals) but also on a contextual level (mastery goal structures).

The results of our meta-analysis revealed no meaningful relationship between teachers' growth mindset and their students' achievement. It has proved challenging to identify factors beyond student characteristics, family background factors (e.g., socioeconomic status), and concrete teaching behaviors that strongly impact student achievement, with teachers' personal characteristics usually demonstrating small positive average relationships at best and often no relationships with student achievement at all (for self-efficacy, see, e.g., Klassen & Tze, 2014). In all, it seems that teachers' characteristics, at least in the way they are currently usually studied, only have limited effects on (or are, at most, only weakly related to) average student achievement. Our meta-analysis empirically supports the idea that there is no meaningful average association between teachers' characteristics and student achievement when the focus is on teachers' mindset.

Several noteworthy findings emerged from the moderator analyses. First, direct comparisons of published and unpublished studies indicated a reverse publication bias, with larger effects in unpublished than in published studies. These effects were largely significant, and, in terms of signs, this finding held across all outcomes as well as for teachers' self-efficacy, teachers' performance-avoidance goals, and teachers' test performance. We suggest two potential explanations. First, it may be the case that published and unpublished studies differed systematically in other study characteristics, which could have influenced the strength of effects. For example, unpublished studies may have been conducted more carefully and under more scrutiny, and therefore, their data might be more valid. Second, as concerns about and criticisms of growth mindset research have been voiced (e.g., Macnamara & Burgoyne, 2023; Sisk et al., 2018), researchers may be more reluctant to publish large effects of teacher mindset. However, formal publication bias assessment detection methods have failed to yield evidence of systematically confounding effects.

Second, when looking at the overall outcomes, we found that the strength of effects diminished over time. Explanations for the decline effect include, for example, inflated effects when a new topic is introduced due to selective reporting and underpowered and poorly designed initial studies (Protzko & Schooler, 2017). Moreover, mindset scholars have voiced the concern that the growing popularity of the growth mindset concept in education may make it increasingly unpopular to admit to having a fixed mindset (Trzesniewski et al., 2021). Such systematic rating tendencies related to social desirability could distort research findings and lead to decreasing effects by creating noise. These are interesting possibilities that should be more thoroughly examined; the current meta-analytic findings indicate the existence of declining effects, but they cannot tease apart different sources of the declining effects.

Third, stronger effects were obtained in studies from the US or Canada than in European studies across all outcomes as well as for teachers' self-efficacy and teachers' test performance. The mindset construct is even more popular and more systematically implemented in teacher education and professional development programs for practicing teachers in the US or Canada than in Europe (e.g., Yettick et al., 2016). It may be the case that teachers from the US or Canada tend to more strongly

integrate the concept of growth mindset into the self, prompting stronger connections with other teacher factors (e.g., self-efficacy). Furthermore, for the overall outcomes, stronger effects were found for studies from the US or Canada than for studies from Australia; however, caution is warranted when interpreting this finding due to the very small number of effect sizes from Australia.

Fourth, with respect to measurement characteristics, the referent of the mindset measures moderated some of the effects. For teachers' performance-avoidance goals, we observed larger correlations when the referent of the mindset measures was "you" as opposed to mixed/other. Participants may feel that measures using "you" are more relevant, and they may feel more closely connected to such measures than to measures that mix different referents, a phenomenon that might explain the larger effects for performance goals. On the other hand, for performance goal structures, the results revealed statistically significantly smaller effects for mindset measures that referred to "you" as opposed to mixed/other. As performance goal structures refer to instructional practices and not to the self (as performance goals), mindset scales that mix different referents and do not exclusively target the self and participants' beliefs (as scales referring to "you" likely do) may be more closely related to performance goal structures.

Fifth, the moderator analyses for the content of the mindset measures showed that for performance goal structures, studies with mindset measures that referred to mixed/other content yielded significantly larger effects than studies that used measures that focused on intelligence. We propose that broader mindset measures capturing different performance-focused content may be more relevant to performance goal structures, which typically include references to achievement (e.g., Bardach et al., 2020) and not to intelligence.

Sixth, for mastery goal structures, assessing teachers' growth mindset using nonrecoded mindset measures yielded significantly smaller effects, whereas for student achievement, nonrecoded measures produced larger effects. It has been proposed that recoded scales may be the better measures. Concretely, Carole Dweck described growth mindset items as highly compelling and explained that, therefore, individuals with a growth mindset and those with a fixed mindset both tend to agree with growth mindset statements, whereas only individuals with a fixed mindset endorse fixed mindset items. As such, only fixed mindset items should serve to discriminate between the two mindsets (Dweck et al., 1995; Hong et al., 1999). It is also possible that nonrecoded growth mindset measures and recoded measures tap into somewhat different constructs. The fact that the significant moderator effects were restricted to mastery goal structures and student achievement, with opposing directions of effects, raises the interesting possibility that these different constructs change their meaning depending on the respective mindset–outcome combination. However, more research systematically comparing mindset measures is needed before confident conclusions can be drawn.

Seventh, the strength of some of the relationships varied by educational level, with smaller effects in higher educational levels for specific performance-oriented types of motivation and instructional practices. As all coefficients for the meta-analysis were coded so that higher values indicated more positive effects, the associations between mindset and the performance measures became less positive (more

negative) at higher educational levels. Specifically, the association with performance-avoidance goals was smaller (i.e., more negative) in tertiary and in mixed educational levels than in primary education, and the association with performance goal structures was smaller (i.e., more negative) in secondary than in primary education. It has been suggested that, in comparison with primary school, in more advanced educational settings, such as in secondary school, the salience and, thus, the negative impact of performance-oriented messages increases (e.g., Meece et al., 2006). Our findings from the moderator analyses were somewhat aligned with this claim, while expanding the current evidence base due to our focus on teacher mindset. Moreover, the association between growth mindset and teachers' test performance was stronger in preservice teacher samples than in samples from mixed educational levels (e.g., samples including primary and secondary school teachers). Because preservice teachers complete tests on a regular basis as part of their study program, they likely have more opportunities to put their adaptive mindsets "into practice," which may have led to stronger effects for this group.

Eight, study quality moderated two associations. For teachers' test performance, we obtained smaller effects in the presence of higher study quality, whereas for mastery goal structures, larger effects were obtained in the presence of higher study quality. These findings indicate potentially effect-distorting influences of study quality on effect size estimations and should be kept in mind when the respective associations are interpreted.

Limitations and Future Research

Several limitations and directions for future research should be noted. For example, we could not explore heterogeneous effects, such as whether teachers' growth mindset may be beneficial for specific subgroups, such as disadvantaged students (e.g., Sisk et al., 2018; Yeager et al., 2019). In addition, all included studies relied on self-report measures of teacher variables and goal structures. Further studies and future research syntheses should examine the effects of other assessment practices and test whether the relationships converge with those found in our work. These other assessment practices could involve observations of teachers' behavior and recordings of teachers' talk in class (e.g., Boden et al., 2020), implicit association tests for teachers (e.g., Mascret et al., 2015), teachers' responses to vignette-based assessments, such as situational judgment tests (e.g., Bardach et al., 2021), or students' ratings of their teachers' mindset and other teacher characteristics (e.g., Muenks et al., 2020). All these assessment practices are less susceptible to social desirability and response bias on the part of teachers. Nonetheless, we argue that self-reports are still indispensable for gaining insights into teachers' mental states (e.g., Pekrun, 2020) and that different assessment practices should therefore be combined.

Regarding instructional practices, the recent literature on goal structures and their subtypes is far more nuanced than suggested by the mastery–performance dichotomy used in the studies included in our meta-analysis. Specifically, (a) performance goal structures have been divided into approach and avoidance components; (b) a four-dimensional goal structure model, which additionally incorporates

a mastery-avoidance goal structure, has been introduced; and (c) different performance-approach goal structure facets (i.e., normative vs. appearance) have been investigated (e.g., Bardach et al., 2022; Peng et al., 2018; Schwinger & Stiensmeier-Pelster, 2011). It is therefore possible that teachers' growth mindset has different and potentially larger relationships with specific goal structure subtypes. In addition, it remains a limitation that, for some outcomes, there were only a rather limited number of studies that could be included in the meta-analysis. Consequently, more research on teachers' mindset is clearly needed. Moreover, the moderator analyses in some subsets of data had comparatively low power due to the small numbers of effect sizes that were available from the literature. Therefore, we cannot rule out the possibility that particularly in data-subset-based analyses other than those on self-efficacy associations, some true effect differentiation may have remained undetected. As outlined in the introduction, there are theoretically sound reasons to believe that teachers' growth mindset could influence the outcome variables addressed in our work. However, our correlation-based meta-analysis cannot provide insights into causal effects. Hence, experiments and intervention studies that target teacher mindset and investigate effects on relevant outcome variables are required. To date, several theory-based intervention programs for student growth mindset are available (e.g., Porter et al., 2022; Yeager et al., 2019), and similar investments would need to be made to develop growth mindset interventions for teachers. Finally, to complement our work, meta-analyses examining outcomes that were not synthesized here are warranted, for instance, on students' motivation, students' and teachers' emotions, or teachers' help-seeking (e.g., Heyder et al., 2020; Nalipay et al., 2019).

Conclusions

Do teachers need a growth mindset? As shown in our meta-analysis, teachers' growth mindset may have potential benefits in terms of relationships with their own self-efficacy and mastery-approach goals, and with mastery goal structures. However, teachers' growth mindset was not statistically significantly related to teachers' performance-approach goals, teachers' performance-avoidance goals, performance goal structures, teachers' achievement test performance, or student achievement. Overall, our results do not offer a wholehearted endorsement of the salience of teachers' growth mindset for a range of outcomes. To derive strong recommendations for educational practice, further evidence is needed, and for several outcomes investigated herein, the establishment of larger effects is required. Nonetheless, for research purposes and theory-building, our results add to the understanding of different personal characteristics of teachers. Moreover, the effects we obtained for mastery constructs were largely in line with previously estimated associations in nonteacher samples (Burnette et al., 2013; Payne et al., 2007), and the effects for self-efficacy even exceeded these estimates. Hence, relationships with the motivational variables in terms of mastery constructs and self-efficacy can still be considered to be meaningful.

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