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A mixed-methods study on the effects of a growth mindset program in Finnish elementary schools

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ABSTRACT

The aim of the present study was to explore the effects of a growth mindset intervention program called *I can learn* among Finnish elementary school students. Altogether, 116 third-grade students participated in this study, which used both quantitative and qualitative evidence to measure the effects of the intervention program. Even though the quantitative data showed no clear effect for the intervention on students' mindsets and effort beliefs, the qualitative data revealed that students in the intervention group reported more emotional control strategies and effort self-talk as well as less ability self-talk in challenging learning situations compared to the control groups. Nonetheless, these differences between the experimental groups were short-lived, with no differences observed eighteen months after the intervention.

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Finnish students; mindset; effort beliefs; mixed method; intervention; growth mindset pedagogy

In recent decades, implicit theories – beliefs about the malleability of personal characteristics (i.e., mindsets) – and their links to educational outcomes have received much attention from researchers, policymakers, and educators (Yeager & Dweck, 2020). The term fixed mindset (*entity theory)* denotes a belief that human qualities are unchangeable, whereas the notion of a growth mindset (*incremental theory*) refers to the tendency to regard these attributes as malleable and improvable (Dweck, 2006; Dweck & Yeager, 2019). Mindsets form a meaning system that shapes how individuals interpret their experiences and plan future behavior (Hong et al., 1999). They are especially relevant in situations involving challenges and setbacks, as they influence *attribution styles* – whether difficulties are attributed to fixed traits or processual and contextual factors (Burnette et al., 2013; Yeager & Dweck, 2012, 2020). Furthermore, a growth mindset is associated with a belief in the importance of effort in enhancing abilities (*positive effort beliefs*), whereas a fixed mindset leads to effort being viewed as futile and an indicator of lack of ability (*negative effort beliefs*). In addition, growth-oriented individuals typically endorse *mastery goals* (increasing ability) over *performance goals* (demonstrating and documenting ability; Blackwell et al., 2007; Yeager & Dweck, 2020).

Attribution style, effort beliefs, and goal orientations mediate the effect of mindsets on academic achievement and challenge seeking (Blackwell et al., 2007; Yeager & Dweck, 2020). Growth mindsets have also been consistently associated with persistence in the face of challenges, enjoyment of

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difficult tasks, resilience, and higher school grades and test scores (e.g., Aronson et al., 2002; Blackwell et al., 2007; Gouëdard, 2021; Yeager et al., 2016, 2019; Yeager & Dweck, 2020), whereas fixed mindsets are linked to maladaptive responses, avoiding challenges, and failing to fulfil one's own potential (Mueller & Dweck, 1998; Yeager & Dweck, 2020).

Although mindsets seem to become increasingly stable as children mature (Kim & Park, 2021), both longer in-person workshop interventions (e.g., Blackwell et al., 2007; Orosz et al., 2017) and shorter online interventions for larger populations (Yeager et al., 2019) have succeeded in influencing mindsets and academic achievement, challenge-seeking, and enrollment in advanced courses (Rege et al., 2020; Yeager et al., 2019). However, the results of mindset interventions have been somewhat contradictory, and not all studies have been able to repeat the results with sufficiently high effect sizes (e.g., Burgoyne et al., 2020; Gandhi et al., 2020; Li & Bates, 2019). Such inconsistencies might be explained by differences in student characteristics, subject areas, and the cultural and educational context (Sarrasin et al., 2018; for a discussion on the contradictory results, see Yeager & Dweck, 2020). Successful interventions have meticulously matched their approaches to target populations (Dweck & Yeager, 2019). Typically, moreover, interventions have not impacted all students equally; rather, they have been found to be more effective in terms of achievement among "high-risk" students (Broda et al., 2018; Paunesku et al., 2015). Students who experience academic difficulties might benefit from mindset interventions the most as mindset influences one's behavior especially when facing difficulties and challenges (Yeager & Dweck, 2012; 2020). Nevertheless, more research in different educational and cultural contexts is called for (Yeager & Dweck, 2020), and there is a need for more knowledge about the best means of supporting the development of a growth mindset, the influence of context on the effectiveness of mindset interventions, and the way to help schools, among others, embed growth mindsets into their culture (Dweck & Yeager, 2019, p. 482).

This paper presents the results of an intervention study in which we tested a 6-lesson (6×45 min) intervention program called *I can learn,* developed for elementary students in the context of the Finnish education system. The intervention program is based on the growth-mindset literature (Boaler, 2013; Dweck, 2006), the growth-mindset pedagogy literature (e.g., Rissanen et al., 2019), and earlier research on mindsets and mindset interventions (e.g., Aronson et al., 2002; Blackwell et al., 2007; Good et al., 2003). The aim of the *I can learn* program is to develop and strengthen students' growth mindset thinking and behavior by teaching them about the brain and neuroplasticity, normalizing mistakes and failure, supporting their belief in the utility of effort for enhancing their abilities, introducing strategies for confronting challenges in learning, and practicing positive (effort) self-talk. There is an evident lack of qualitative approaches in mindset interventions research. In the present study, we explore the effects of the *I can learn* program with both quantitative and qualitative data.

Mindset interventions in elementary schools

The majority of experimental studies on mindset intervention programs have been conducted among middle and high school students (Blackwell et al., 2007; Yeager et al., 2019), with only a limited number of experimental studies focusing on elementary school students (for a review, see Savvides & Bond, 2021). However, students' implicit conceptions of intelligence (Kinlaw & Kurtz-Costes, 2003; Laine et al., 2024) and giftedness (Laine et al., 2024) are most growth-oriented during elementary school, when mindsets as meaning systems are still developing (Kinlaw & Kurtz-Costes, 2007). Moreover, elementary school students' motivational frameworks (including mindsets and learning goals) develop in reciprocal relationships with their academic skills. Furthermore, in the context of mathematics, holding a fixed mindset and performance goals about ability in that subject during elementary years has been found to promote the development of math anxiety (Gunderson et al., 2018). Considering the growing cognitive demands and difficulty of different school subjects in the second half of elementary school (e.g., math: Tsang et al., 2015) and the relevance of mindsets when facing challenges (e.g., Blackwell et al., 2007; Moser et al., 2011), experimental research on the

effectiveness of mindset interventions in the elementary school context is surprisingly scarce (for a review, see Savvides & Bond, 2021). Moreover, in Finland, where the present study was conducted, it is during elementary and middle school that students' negative attitudes increase towards certain school subjects, such as math (Tuohilampi & Hannula, 2013).

Students' self-regulated learning strategies and self-talk in challenging learning situations

A growth mindset is associated with more adaptive self-regulatory processes in challenging learning situations (Burnette et al., 2013). Self-regulated learning involves cognitive, metacognitive, behavioral, motivational, and emotional aspects of the learning process (e.g., Panadero, 2017). This study focuses particularly on students' self-regulated learning strategies and self-talk when they face challenges in learning due to the three reasons. First, in our earlier pilot study with elementary school teachers and students, teachers regarded challenges in *emotion regulation* as the most significant barriers to learning and considered the primary value of growth mindset pedagogy to be its capacity to overcome such obstacles (Rissanen et al., 2021). Emotion regulation or emotional control strategies are part of motivational strategies in learning (also referred to as affective learning strategies, Vermunt, 1996). They are activities that students intentionally engage in when they are required to initiate, maintain, or increase their willingness to start, persist at, or complete a specific learning task or activity – or when they need to regulate their emotional experience. Examples of such strategies include taking deep breaths, counting to 10, and positive self-talk (Wolters, 2003).

Second, in addition to emotional control strategies, the intervention targeted other parts of students' *self-regulated learning strategies*, such as help-seeking behavior and trying again. Help-seeking plays an important role in learning by affecting students' achievement (see Martín-Arbós et al., 2021 for a review). Based on earlier research, a growth mindset has been associated with greater help-seeking (Shively & Ryan, 2013) and lower help-seeking avoidance (Smalley & Hopkins, 2020). Trying again after a failure or mistake relates to persistence in the face of challenges. Growth mindsets have been linked to greater task persistence when challenges arise (Burnette et al., 2013).

Finally, inner speech (hereafter, self-talk) plays an important role in the self-regulation of both cognition and behavior and in childhood and adulthood (Alderson-Day & Fernyhough, 2015). Self-talk can be positive or negative. *Positive self-talk* serves as self-validation or self-encouragement, while *negative self-talk* emphasizes incompetence, failure, or personal harm (Thomaes et al., 2020). *Ability self-talk* (such as "I'm very good at this" or "I can do this") is one form of positive self-talk that endorses children's competence or efficacy in a task. Nevertheless, such concentration on the importance of inherent ability might cause fear of failure or underachievement (e.g., Mueller & Dweck, 1998; Paunesku et al., 2015). Another type of positive self-talk, *effort self-talk* (such as "I'll do my best" or "I'll try hard"), encourages children to try their best and work hard, and it is seen as a helpful alternative to ability self-talk. Effort self-talk might be especially beneficial for students with negative competence beliefs by helping them become more concerned about their strategies than about their abilities. Effort self-talk has been shown to improve children's performance in mathematics, while ability self-talk has not been found to offer similar benefits (Thomaes et al., 2020). The *I can learn* lessons aim to influence students' self-regulated learning strategies and self-talk and, especially, to increase students' use of emotional control strategies and effort self-talk when facing difficulties and challenges in learning through the reappraisal of such learning situations based on the growth mindset framework.

Finnish educational context

This research was conducted in Finnish elementary schools. Students (aged 7–12) study in elementary schools from 1st to 6th grade and are taught by classroom teachers who are highly educated, holding at least a master's degree in education (Tirri, 2014). Elementary-level teachers are responsible for teaching all school subjects except foreign languages.

Finnish education is intended to foster the holistic growth of students, including cognitive, affective, and social domains (Tirri, 2011). The national core curriculum (Finnish National Board of Education, 2014) forms the basis of teachers' work. The value base of the national core curriculum addresses students' uniqueness as learners and their right to quality basic education. In turn, the key learning concept underlines students' active participation and the acknowledgement and valuing of students' own interests, learning styles, emotions, and experiences. Students' self-image and feelings of competence guide their learning process and motivation, and thus students should receive guidance and teaching that strengthens their confidence in their own potential (Finnish National Board of Education, 2014). Furthermore, equality and inclusiveness are central values in educational policy (Arnesen et al., 2007); students are educated in inclusive classrooms, and differentiated teaching is emphasized as a core pedagogical principle. Furthermore, stress in placed on formative assessment, assessment of progress, and students' goal setting and self-assessment (Finnish National Board of Education, 2014).

Consequently, the Finnish education system clearly aligns in many ways with the principles of growth mindset pedagogy (GMP; Rissanen et al., 2019, 2021). Moreover, Finnish teachers mostly hold a growth mindset toward intelligence (Makkonen et al., 2019; Zhang et al., 2020) and giftedness (Laine et al., 2016). Furthermore, most students also exhibit growth mindsets, although younger students display a greater tendency towards fixed mindsets (Kuusisto et al., 2017; Laine et al., 2024). In addition, recent PISA-results (Gouëdard, 2021) have revealed that, in Finland, girls and students from socio-economically advantaged backgrounds are more likely than boys and disadvantaged students to hold growth mindsets.

Present study

This study is part of a larger research project called CoPErNicus – Connecting Psychological, Educational and Neuroscientific Evidence. The aim of the project is to investigate the views of students, teachers, and parents on learning. The project utilizes a multidisciplinary approach based on psychological, educational, and neuroscientific data. This study is related to our aim to develop a growth mindset intervention program that is suitable for teachers to use with their elementary school students in the wider context of growth mindset pedagogy (see Rissanen et al., 2019, 2021). As most growth mindset interventions have been conducted among older students, it was necessary to plan our own intervention program that acknowledges both prior understandings of growth mindsets, neuroplasticity, and growth mindset interventions and is applicable for teachers to use with students of a young age (elementary school level).

The present study examines the self-reported mindsets and effort beliefs of Finnish elementary school students from two different schools and inspects the effects of the *I can learn* program on the mindsets and effort beliefs of these students. We piloted the *I can learn* program with teachers as co-developers and implementors of the intervention. Our previous observations indicated an increase in students' growth mindsets and a decrease in students' negative effort beliefs after such intervention lessons, but control groups were not used (Rissanen et al., 2021). The present study adopts an experimental mixed methods approach to explore the effects of the *I can learn* program on Finnish elementary school students' mindsets and effort beliefs. Additionally, by using qualitative methods, we examine how the self-regulated learning strategies and self-talk when faced challenges in learning differ between students who participated in the *I can learn* lessons and those who did not participate in the lessons. Our research questions and hypotheses are:

(RQ1) What are the effects of the *I can learn* intervention program on students' mindsets and effort beliefs as well as on their self-regulated learning strategies?

(H1) In comparison to the control groups, the intervention group is expected to report a higher growth mindset and positive effort beliefs (quantitative data; e.g., Blackwell et al., 2007), as well as to express more emotional control strategies after the intervention (qualitative data).

(RQ2) What kind of long-lasting effects can be found 6 or 18 months after the intervention?

(H2) We expect that the effects of the intervention will remain evident 6 and 18 months after the intervention (quantitative and qualitative data; e.g., Blackwell et al., 2007; Paunesku et al., 2015).

(RQ3) What kind of self-talk do students express when faced with challenges in learning and are there any differences in self-talk between the experimental groups?

(H3) We expect students to express both ability and effort self-talk (Thomaes et al., 2020). We further expect that following the intervention, the experimental groups differ in self-talk due to the specifics of the intervention content.

Methods

Participating students and schools

This study was carried out in two comprehensive schools, representing different residential areas, in the capital city of Finland, Helsinki. School A was a teacher training school located in a middle-class district, whereas school B was situated in a lower socioeconomic area (Vilkama et al., 2014). Furthermore, in School A, special education services were offered to 5.5 percent of the students in elementary school (grades 1–6) and to two percent of lower secondary school students (grades 7–9), while in School B special education services were offered to 16 percent of students (Laine et al., 2024). From both schools all third-grade classes participated in the study.

A total of 116 Finnish third-grade students from seven classrooms ($n_{\text{School A}} = 66$; $n_{\text{School B}} = 50$), participated in the quasi-experimental study (see Table 1). The native language of most participants was Finnish ($n = 93$; $n_{\text{School A}} = 53$; $n_{\text{School B}} = 40$), with 2 students not indicating their mother tongue.

Participation in this study was voluntary, and written consent from the students' parents was obtained. The children and their parents were informed about the study procedures and their right to withdraw their participation at any moment of the study. The research project for the study was reviewed and approved beforehand by the Ethical Review Board of the University of Helsinki.

Procedure

A combination of strategic and random assignment was utilized to allocate the participating classrooms to the intervention, control 1, and control 2 conditions, ensuring that each school had one class in each condition. The participants in the intervention group received the *I can learn* intervention, while control group 1 participated in a program of the same length, concentrating on learning and health (nutrition, sport, and sleep), but without growth-mindset-oriented information. Control group 2 followed their normal school routines, without any additional training. The intervention and control intervention lessons were organized separately for students from both schools and were carried out by the same two researchers, one with wide teaching experience in the field of elementary education. All the lessons were video recorded. The six lessons were held within three weeks, two lessons (2 × 45 min) per week at the beginning of the 2020 spring semester during the students' normal school hours. The classes' own teachers were present during the lessons.

Table 1. Participants.

	Intervention ($n = 39$)		Control 1 ($n = 27$)		Control 2 ($n = 50$)		Total
	School A $n = 22$	School B $n = 17$	School A $n = 18$	School B $n = 9$	School A $n = 26$	School B $n = 24$	$N = 116$
Female	8	10	9	4	12	16	59
Male	14	4	9	4	14	7	52
Gender: other/not reported	–	3	–	1	–	1	5
Baseline age in years, M (SD)	8.9 (0.7)	8.9 (0.4)	8.9 (0.2)	9.0 (0.0)	8.9(0.3)	9.0 (0.3)	8.9 (0.4)

During the lessons, students completed learning diaries, the contents of which differed partly for those in the intervention group and control group 1. These learning diaries represent the main source of the qualitative data in this research. Additionally, we measured students' mindsets and effort beliefs before the intervention in autumn 2019 (pre-intervention 1, $n = 116$), within two months after the spring 2020 intervention (post-intervention, $n = 85$) and six months after the intervention (follow-up 1, $n = 112$). Eighteen months after the intervention (follow-up 2), students answered the qualitative learning diary questions for a follow-up regarding the qualitative data (see Figure 1).

Description of the intervention lessons

The intervention program included a total of 6*45 min lessons. The duration of the intervention is in line with earlier in-person mindset interventions such as 5*45 min in Orosz et al. (2017) study and 8*25 min in Blackwell et al. (2007) study. The intervention lessons are summarized in Table 2 (see also Rissanen et al., 2021). The key topics in the intervention program were neuroplasticity, effort beliefs, normalizing mistakes and failures in learning, and positive effort self-talk. These topics were present in all the lessons, but every lesson also contained its own specific main topic.

Measures and data analysis

Quantitative measures and analysis of mindsets and effort beliefs

Students' *mindsets* were assessed with four items (e.g., "You have a certain amount of intelligence, and you cannot really do much to change it.") from the Implicit Theories of Intelligence Scale (Dweck, 2000). *Effort beliefs* were measured using five negatively phrased statements (e.g., "If you have to work hard on some problems, you're probably not very good at them.") from the Effort Beliefs Scale (Blackwell et al., 2007). Participants indicated how much they agreed with each statement from these scales by marking one of six circles that varied in size ranging from "not at all" to "really a lot," which mapped to a 6-point scale. Averaged scores for each instrument at each assessment point were used, with higher scores indicating a greater endorsement of a growth mindset and a stronger belief in the utility of effort in increasing ability. The internal consistencies of the instruments were on an acceptable level and are presented in Table 4.

The missingness of the data was examined with the Little's (1988) MCAR test, which indicated that data were not missing completely at random (MCAR), $\chi^2(15) = 31.43$, $p = 0.008$. This result was

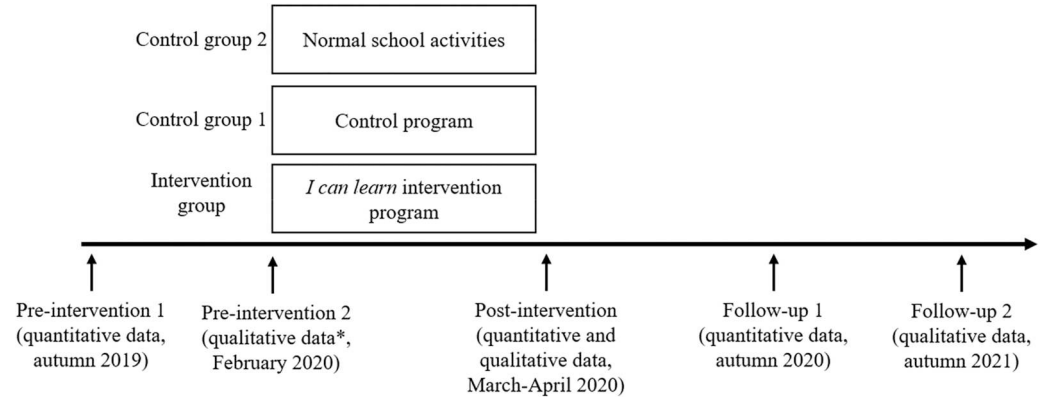

Figure 1. Timeline of the intervention and assessment points for qualitative and quantitative data.

Note. *In pre-intervention 2, in February 2020, only one qualitative question ("When I cannot solve the task, I want to act like this … ?") from the learning diaries was included in the qualitative data collection.

Table 2. Summary of the intervention lessons.

Lesson number	Main topic	Content and main activities during the lessons
Lesson 1 Week 1	Introduction	• Introduction of the researchers and the outline of the *I can learn* program. • Handing out learning diaries to students. • Pre-intervention 2 data collection (qualitative data). • Students learn the easiest version of the *I can learn* rhyme.
Lesson 2 Week 1	Neuroplasticity	• Introduction to the structure of the brain and the role of the various key areas. • Students use their fist to model the brain stem, limbic system, and the cerebral cortex. • Students use the fist to model the effect of a strong emotional reaction in a learning situation, and one's ability to calm oneself down in such a situation ("Lizard")[a]. • Introduction of neuroplasticity using the example of a small forest track turning into a highway. • Students bring examples of and reflect on the learning process of skills they have acquired during childhood. • Students reflect on these skills as examples of the idea that "we are all capable of learning" and that the "brain is like a muscle." • *I can learn* rhyme: repetition of the previously learned version at the beginning of the lesson and learning a slightly more complex version at the end of the lesson.
Lesson 3 Week 2	Effort beliefs	• Students learn about the utility of effort in enhancing ability and learning, that learning is not supposed to always feel easy, and when it feels challenging and uncomfortable, one is probably learning more. • Introduction of the idea of the learning pit. Students reflect on and bring examples of their experiences of the pit. • Introduction of strategies (emotional control and help-seeking strategies) to escape from the pit. Students reflect on the strategies. • *I can learn* rhyme: repetition of the previously learned version at the beginning of the lesson and learning a slightly more complex version at the end of the lesson.
Lesson 4 Week 2	Mistakes and failures	• Students listen to a story about a character who had made a mistake, consequently experienced negative emotions, but later reframed the mistake and learned from it. • Students reflect on the story and their own experiences of mistakes or failures and the accompanying feelings. • Students are told about mistakes and failures being a normal and critical part of effective learning. • Students are told about the growth mindset attitude: how difficulties are an indicator of being on the verge of learning something new, the need for scaffolding and help, more effort or a different strategy; how difficulties are not an indicator of fixed and limited ability. • *I will learn* rhyme: repetition of the previously learned version at the beginning of the lesson and learning a slightly more complex version at the end of the lesson.
Lesson 5 Week 3	Effort self-talk	• Students are told about the concept of self-talk. • Students receive descriptions of situations where a student has made a mistake or failed a test, and based on these situations students practice positive effort self-talk in pairs. • Students practice effort self-talk in similar situations through drama. • Students reflect on whether and when they engage in negative ability self-talk and practice changing it into effort self-talk. • *I will learn* rhyme: repetition of the previously learned version at the beginning of the lesson and learning a slightly more complex version at the end of the lesson.
Lesson 6 Week 3	Summary	• Students reflect on and bring examples of what they have learned during the intervention. Students go over the main content and ideas of the intervention. • Post-intervention data collection (qualitative data). • *I will learn* rhyme: repetition of the previously learned version at the beginning of the lesson and the most complex version at the end of the lesson, accompanied by a reflection on the step-by-step process of learning the final, most complicated version of the rhyme.

[a]The term "lizard" was used to simplify information so that it would be understandable for the students at this age. The concept of the "lizard brain," which is a neuromyth, was not taught or referred to.

driven by the pattern of missing data from the post-intervention assessment point as Little's MCAR test based on data from only the pre-intervention 1 and follow-up 1 assessment points indicated that data was MCAR, $\chi^2(2) = 0.91$, $p = 0.635$. The descriptive statistics for mindsets and effort beliefs at all assessment points were calculated and the data was visually inspected. For the analyses, R 4.3.3 with RStudio interface (v2024.04.1) was used (R Studio Team, 2024). Differences in students' baseline mindsets and effort beliefs between the schools and experimental groups were examined using a multivariate analysis of variance (MANOVA) with mindset and effort beliefs at pre-intervention 1 as the dependent variables and school (school A vs B) and experimental group (intervention vs control 1 vs control 2) as predictors. The package *stats* (v4.3.3; R Studio Team, 2024) was utilized. In case of significant effects, separate follow-up linear regressions with the dependent variable of mindset or effort beliefs were conducted. For the research question regarding the effects of the intervention program on students' mindset and effort beliefs (RQ1, RQ2), linear mixed models (LMM) with R package *lme4* (v1.1.35.3; Bates et al., 2015) were used and *p*-values were computed with the *lmerTest* package (v3.1.3; Kuznetsova et al., 2017) using Satterthwaite's method to estimate degrees of freedom. When statistically significant effects of fixed factors emerged in LMM, the *emmeans* package (v1.10.1; Lenth, 2024) was used to compute estimated marginal means, and post hoc comparisons with Bonferroni–Holm corrections. One model was constructed with mindset as the dependent variable, while effort beliefs were used as the dependent variable for the other model, with experimental group (intervention vs control 1 vs control 2) and school (school A vs. school B) included as between-subject fixed factors and timepoint (pre-intervention 1 vs. post-intervention vs. follow-up 1) as a within-subject fixed factor. A random intercept by participant was included to account for random effects resulting from repeated measures regarding the same participants. The models were inspected for potentially influential extreme values, normality of residuals, homoscedasticity, and multicollinearity, with no severe violations of the assumptions being found.

Qualitative and quantitative analysis of learning diaries

Before the intervention (pre-intervention 2), students in the intervention, control group 1, and control group 2 wrote responses to "When I cannot solve the task, I want to act like this … ?" During the lessons, students (both intervention and control group 1) completed learning diaries. At the end of all 6 lessons, students in the intervention group and control group 1 were asked the following questions:

(1) When I cannot solve the task, I want to act like this …
(2) What would I like to say to myself when things feel difficult or I make mistakes?

The same two questions were asked from students in control group 2 during the same period. In order to answer the research questions, deductive oriented content analysis (Elo & Kyngäs, 2008) was used to investigate the students' responses. The purpose was both to determine the effects of the intervention on students' self-regulated learning strategies and to explore the type of self-talk they use when faced with challenges in learning. For this, a coding framework was developed. Coding framework was built based on the previous studies and literature on strategies when facing challenges (e.g., Boaler, 2019; Shively & Ryan, 2013; Wolters, 2003) and self-talk (e.g., Mueller & Dweck, 1998; Paunesku et al., 2015; Thomaes et al., 2020). These were also presented in greater detail in the introduction. Furthermore, these strategies and positive self-talk were taught during the intervention lessons (See Table 2), but they did not form part of the lessons of control group 1. The categories included in the coding framework varied between the two questions and are presented in Table 3 together with representative example expressions. The coding framework for "strategies when facing challenges" included 5 categories: help-seeking, emotional control strategies, new try, give up and other. Whereas, for self-talk the coding framework entailed categories such as comforting, effort – self courage, effort – strategy, ability positive, ability negative and

other. For both questions, the student's entire answers for the questions were considered as a coding unit of analysis.

For question 1, students' responses consisted of lists of their possible strategies in a challenging learning situation. Thus, in the coding phase, all the coding categories were sought from every response to gain an overall picture of the practices used. In the following example, the original singular strategy expressions are marked in italics and coding categories within parenthesis:

> I'll first *calm down* (Category: Emotional control strategy). Then I can *try again* (Category: New try) and *ask help from my teacher or classmate* (Category: Help-seeking). (Girl, School B, intervention group)

For question 2, students' responses were short, singular self-talk phrases that they would like to utter to themselves when facing challenges in learning. Thus, students' phrases were coded under one coding category – the category that corresponded most strongly with their response. In the following example, the units of analysis are marked in italics and the category within parenthesis:

> *I can do this if I ask for help.* (Category: Effort – Strategy; Boy, School B, intervention group)

> *Calm down. I learn at my own pace.* (Category: Effort – Self-encourage; Girl, School A, control 1)

Furthermore, we used Chi-square tests to examine statistically significant differences in strategies between the three experimental groups at pre-intervention 2, post-intervention and follow-up 2. When the Chi-square tests indicated significant differences between the groups, we used adjusted residuals to inspect which groups differed from each other. In case of multiple comparisons, we used the Bonferroni correction to adjust the adjusted residual cutoff value indicating a significant difference (the absolute value of 1.96 for a single comparison) for the number of the cells in the analysis, as recommended by MacDonald and Gardner (2000).

The deductive coding was done in Excel using a coding template with coding categories in columns and students' responses in lines. We used 0 (not evident) and 1 (evident) to indicate whether the coding category was present in the particular response or not. The first author coded the entire dataset. Then, to increase reliability, the third author coded 20% of the data. The first author familiarized the third author to use the deductive coding framework and coding template in Excel. Both coders are experienced researchers and familiar with content analysis. Using Cohen's Kappa coefficient, intercoder reliability was calculated separately for every question and its categories (see Table 3). Cohen's Kappa-values were between .64 and 1.00, indicating good reliability and agreement between the coders (Cohen, 1960), and no further discussion about disagreements was required.

Table 3. Coding categories with example statements and Cohen's kappa-values.

Question	Coding categories and example statements	κ – value
Strategy when facing challenges	Help-seeking: "I'll ask the teacher to help me."	.95
1. When I cannot solve the task, I want to act like this … ?	Emotional control strategy: "I need to calm down my lizard."	1.00
	New try: "I'll try again."	1.00
	Give up: "I'll do some other task, or I won't do anything."	1.00
	Other: "Good and diligent."	.72
Self-talk when things feel difficult, or I do mistakes	Comforting: "It will be ok."	1.00
2. What would I like to say to myself when things feel difficult or I make mistakes?	Effort – Self-encourage: "I don't know it yet. But I'll learn!"	.78
	Effort – Strategy "I'll try again, and I won't give up!"	.83
	Ability – Positive: "I can do it!"	.84
	Ability – Negative: "Don't I know anything?"	.88
	Other: "Nothing"	.64

Table 4. Descriptive statistics and internal consistencies of mindset and effort beliefs at the three assessment points.

Variable	*n*	Cronbach's alpha	Intervention group *M* (*SD*)	Control group 1 *M* (*SD*)	Control group 2 *M* (*SD*)
Mindset T1	116	.73	3.44 (1.26)	3.64 (1.04)	3.70 (1.20)
Mindset T2	85	.82	3.96 (1.43)	3.74 (1.38)	4.43 (0.91)
Mindset T3	112	.82	3.94 (1.32)	3.73 (1.07)	4.02 (1.34)
Effort beliefs T1	116	.69	3.93 (1.12)	4.36 (1.09)	4.35 (0.94)
Effort beliefs T2	85	.66	4.30 (0.90)	4.03 (1.04)	4.57 (0.87)
Effort beliefs T3	112	.70	4.22 (0.94)	4.49 (0.67)	4.22 (1.06)

Note. T1 – pre-intervention 1; T2 – post-intervention; T3 – follow-up 1.

Results

Quantitative analysis of students' mindsets and effort beliefs and the effects of the intervention

Table 4 presents the number of the participants as well as the descriptive statistics and internal consistencies of the mindset and effort belief measures at the three assessment points for the quantitative data. Table 5 presents correlations between mindsets and effort beliefs from these three assessment points. Mindset and effort beliefs correlated positively with each other at all assessment points (Table 5). Additionally, both mindset and effort beliefs demonstrated positive within-construct correlations between assessment points, indicating weak to moderate stability of these beliefs (Table 5).

Students' mindsets and effort beliefs in the two schools and three experimental groups before the intervention

When examining potential differences between the participating schools and experimental groups in students' mindset and effort beliefs before the intervention, MANOVA demonstrated a significant effect of school (Pillai's Trace = 0.19, $F(2, 112) = 13.17$, $p < .001$) and a marginal effect of experimental group (Pillai's Trace = 0.05, $F(2, 112) = 2.89$, $p = .060$). Follow-up separate linear regressions indicated that, at pre-intervention 1, students in school A were more likely to endorse a growth mindset ($M = 3.81$, $SD = 1.24$, Min = 1.25, Max = 6.00) and exhibit positive effort beliefs ($M = 4.58$, $SD = 0.91$, Min = 2.00, Max = 6.00) than were students in school B (mindset: $M = 3.32$, $SD = 1.03$, Min = 1.00, Max = 5.50; effort beliefs: $M = 3.72$, $SD = 1.03$, Min = 2.00, Max = 5.80; mindset: $F(1, 112) = 5.23$, $p = .024$; effort beliefs: $F(1, 112) = 23.32$, $p < .001$). As to differences between the three experimental groups, the follow-up linear regressions indicated no significant differences in baseline mindset ($F(2, 112) = 0.57$, $p = .568$) or effort beliefs ($F(2, 112) = 2.53$, $p = .085$).

RQ1 and RQ2: effects of the intervention on students' mindsets and effort beliefs

Based on LMM, the variance explained by the nestedness of the measurements in participants regarding the intercept of mindset was 0.34 ($SD = 0.58$), while for the intercept of effort beliefs it

Table 5. Bivariate correlations between dependent variables of mindset and effort beliefs at the three assessment points.

Variable	Mindset T1	Effort beliefs T1	Mindset_T2	Effort beliefs T2	Mindset_T3
Mindset T1					
Effort beliefs T1	.19*				
Mindset T2	.30**	.24*			
Effort beliefs T2	.12	.45***	.46***		
Mindset T3	.20*	.28**	.50***	.47***	
Effort beliefs T3	.11	.32***	.30**	.53***	.43***

Note. T1 – pre-intervention 1; T2 – post-intervention; T3 – follow-up 1. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 6. Results of linear mixed models of mindset and effort beliefs.

	$Model_{Mindset}$				$Model_{Effort\ beliefs}$			
Predictor	df_{Num}	df_{Den}	*F*	*p*	df_{Num}	df_{Den}	*F*	*p*
Experimental group	2	114.89	2.12	.125	2	111.81	1.37	.259
School	1	114.04	16.14	**<.001**	1	111.12	32.24	**<.001**
Time	2	206.13	3.91	**.022**	2	200.30	0.50	.606
Experimental group * Time	4	205.84	0.694	.597	4	200.09	1.95	.104
Observations	313				312			
AIC	1009.66				833.21			
BIC	1054.61				878.13			
Pseudo-R^2 (fixed effects)	.11				.16			
Pseudo-R^2 (total)	.33				.43			

Note. Significant *p*-values are marked in bold.

was 0.26 ($SD = 0.51$). For the experimental group, no effects on either mindset or effort beliefs emerged, but we did observe main effects for school and, in the model on mindset, also for time (Table 6). Subsequent post hoc analysis revealed that students in school A (averaged across the intervention and control groups) were more likely to hold growth mindsets and positive effort beliefs than were students in school B at all assessment points (pre-intervention 1, post-intervention and follow-up 1; mindset: $t\ (114) = 4.01$, $p < .001$; effort beliefs: $t\ (112) = 5.63$, $p < .001$). As to the main effect of time on mindset, post hoc analysis indicated that, compared to pre-intervention 1, the students held a significantly more growth mindset at post-intervention ($t(211) = -2.50$, $p = .039$) and a marginally more growth mindset at follow-up 1 ($t(198) = -2.23$, $p = .054$; Table 4).

Qualitative analysis of the effects of the intervention on students' self-talk and strategies

RQ1 and RQ2: strategies in the face of challenges

As illustrated in Table 7, for all groups, both before and after the intervention, the most typical strategies students reported for challenging learning situations were *help-seeking* and *trying again*. Only rarely did students mention that they would give up.

A Chi-square test failed to reveal any statistically significant differences in the reported strategies between the three groups before the intervention. However, whereas before the intervention none of the students mentioned emotional control strategies, about one fourth of the intervention group referred to such strategies immediately after the intervention (post-intervention). This difference between the intervention group and the two control groups was statistically significant ($\chi^2\ (2) = 17.800$; $p < 0.001$, intervention group adjusted residual 4.2, with the cutoff for six cells adjusted to ±2.64). Nonetheless, no significant differences between the experimental groups were found 18 months after the intervention (at follow-up 2).

RQ3: self-talk when encountering challenges and mistakes

Immediately after the intervention (post-intervention), a total of 95 of the 116 students described what they would like to say to themselves when learning felt difficult or they made mistakes. The purpose of this question was to examine the type of self-talk students wished to use in such situations. Further, we wanted to explore whether the students in the different experimental groups differ from each other.

As Table 8 demonstrates, based on the coding framework, all of the categories of students' self-talk were mentioned in students' responses. *Effort* self-talk ($n = 25$; 69%) dominated the responses of the intervention group students at the post-intervention phase. Such *effort* self-talk included both *self-encouragement* and *strategies*, as the following examples illustrate:

Table 7. Categories of students' self-reported strategies when facing challenges by experimental group status.

	Intervention						Control group 1						Control group 2					
	Pre-intervention 2 ($n = 37$)		Post-intervention ($n = 37$)		Follow-up 2 ($n = 32$)		Pre-intervention 2 ($n = 24$)		Post-intervention ($n = 22$)		Follow-up 2 ($n = 22$)		Pre-intervention 2 ($n = 39$)		Post-intervention ($n = 37$)		Follow-up 2 ($n = 36$)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*N*	%
Help-seeking	32	80	18	45	15	38	18	75	15	63	7	29	31	71	24	55	18	41
Emotional control	0	0	10*	25	0	0	0	0	0*	0	1	4	0	0	0*	0	0	0
Trying again	9	23	14	35	11	28	7	29	7	29	9	38	16	36	14	32	15	34
Giving up	3	8	2	5	2	5	0	0	1	4	3	13	4	9	3	7	6	14
Other	2	5	2	5	7	18	1	4	4	17	2	8	0	0	2	7	1	2

Note. * indicates that χ^{2-} test revealed a significant difference between experimental groups at that timepoint.

Table 8. Categories of students' self-talk when encountering challenges by intervention and control groups.

	Intervention				Control group 1				Control group 2				Total			
	Post-intervention ($n = 36$)		Follow up 2 ($n = 35$)		Post-intervention ($n = 21$)		Follow up 2 ($n = 22$)		Post-intervention ($n = 38$)		Follow up 2 ($n = 35$)		Post-intervention ($n = 95$)		Follow up 2 ($n = 92$)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Effort:	**25***	**69**	**20**	**57**	**8***	**38**	**14**	**64**	**12***	**32**	**22**	**63**	**45**	**47**	**56**	**61**
Self-encouragement	15*	42	5	14	2*	10	4	18	5*	13	2	6	22	23	11	12
Strategy	10	28	15	43	6	29	10	45	7	18	20	57	23	24	45	49
Ability:	**4***	**11**	**3**	**9**	**8***	**38**	**4**	**18**	**14***	**37**	**5**	**14**	**26**	**27**	**12**	**13**
Positive	2	6	2	6	5	24	0	0	6	16	3	9	13	14	5	5
Negative	2	8	1	3	3	14	4	18	8	21	2	6	13	14	7	8
Comforting	**4**	**11**	**3**	**9**	**5**	**24**	**3**	**14**	**7**	**18**	**3**	**9**	**16**	**17**	**9**	**10**
Other	**3**	**8**	**8**	**23**	**0**	**0**	**1**	**5**	**5**	**13**	**3**	**9**	**8**	**8**	**12**	**13**

Note: * indicates that χ^{2-} test revealed a significant difference between the intervention and control groups at that timepoint.

I need to calm down my lizard and try again. (Category: Effort_strategy; Boy, School A, Intervention)

It doesn't matter. Next time I will try as hard as I can. I will try my best. (Category: Effort_self-encouragement; Girl, School B, control 2)

The Chi-square test further indicated differences between the three groups regarding *effort* self-talk (χ^2 (2) = 11.562; $p < 0.01$) and *self-encouragement* talk (χ^2 (2) = 11.260; $p < 0.01$) at post-intervention. The adjusted residuals (cutoff for six cells adjusted to ±2.64) revealed that students in the intervention group used more effort-talk ($n = 25$, 69%, adjusted residual 3.4) and self-encouragement-talk ($n = 15$, 42%, adjusted residual 3.3) than did students in the control groups.

Students used also both positive and negative *ability* self-talk in challenging learning situations. *Positive* expressions primarily emphasized self-encouragement, endorsing competence, such as:

Do better, you will succeed. (Girl, School A, control 2) and

It doesn't matter because next time I will succeed. (Girl School B, control 2)

By contrast, the following examples, which illustrate students' expressions of incompetence, failure, or personal harm, were coded under *negative* self-talk:

I can't do anything. (Girl, School A, control 1)

I'm stupid. (Girl, School B, control 2)

Oh no! What did I do? (Boy, School A, control 2)

The Chi-square test and adjusted residuals (cutoff for six cells adjusted to ±2.64) further revealed that students in the intervention group used less *ability* self-talk (χ^2 (2) = 7.718; $p < 0.05$, adjusted residual −2.8) at the post-intervention phase than did students in the control groups. Furthermore, at the post-intervention phase control group students' mentions of effort self-talk and ability self-talk were evenly distributed.

Some students also used self-talk that was categorized under *comforting*, which is one type of positive self-talk. However, it does not include aspects of effort or ability. In this category, students used such expressions as:

It will be fine. (Boy, School A, intervention)

Everyone makes mistakes sometimes! (Girl, School A, control 1)

Poor you. It's okay. It might go better next time. (Girl, School B, control 2)

Some comforting self-talk included the idea of normalizing mistakes, which is also part of the *I can learn* lessons. The Chi-square test did not reveal any statistically significant differences between the different groups in this category.

Ninety-two students answered similar questions 18 months after the intervention (follow up 2). As Table 8 indicates, effort self-talk, especially referring to strategies, was the most typical in all groups. No statistically significant differences were found between the groups at follow-up 2. However, as the intervention group's effort self-talk remained similar between the two measures, the amount of effort self-talk had increased in the two control groups. That is, the control groups had caught up with the intervention groups in 18 months.

Discussion

The present study inspected the mindsets and effort beliefs of Finnish students from two elementary schools and aimed to explore the effects of the *I can learn* program among these students. Our results show that the students of the two schools differed regarding their mindsets and effort beliefs. As to the *I can learn* program, our findings indicate that the intervention affected students' self-

regulated learning strategies in challenging learning situations, but it exerted no significant effect on their self-reported mindset and effort beliefs. Furthermore, exploratory examination of students' self-talk when facing challenges and mistakes in learning showed that the students in the intervention group referred more to effort self-talk and less ability self-talk than students in control groups.

Students' mindsets and effort beliefs and the effects of the intervention

We found that students in school A were more likely than students in school B to endorse growth mindsets and hold positive effort beliefs. School A, where students reported stronger growth mindsets and more positive effort beliefs, was a teacher training school located in a middle-class district, whereas school B was situated in a lower socioeconomic area (Vilkama et al., 2014). Laine et al. (2024) found similar differences between a larger group of students from these two schools in their previous study as well. Moreover, other prior studies have also demonstrated that students from lower socioeconomic backgrounds are less likely to exhibit growth mindsets (Gouëdard, 2021). Additionally, we found that after the intervention students had a more growth mindset, independent of which experimental group they belonged to. This effect, though, was significant only right after the intervention – at the assessment point with the most missing data –, while being marginal at follow-up 1. As the data right after the intervention was not missing completely at random and the effect of time at the follow-up 1 was only approaching significance, the increase in the growth mindset should be interpreted with caution. Nonetheless, earlier cross-sectional studies among Finnish students have shown that younger students tend to hold a more fixed mindset than older students (Kuusisto et al., 2017; Laine et al., 2024).

By contrast, we observed no statistically significant effects for the intervention on students' self-reported mindsets and effort beliefs (RQ1, RQ2). This could be partly explained by the fact that the mindset and effort belief measures used in the present study were self-reports, which could be problematic for children of this age (Borgers et al., 2000). However, an alternative explanation could be the already relatively strong growth-mindset-oriented context of Finnish education and the prevalence of growth-minded teachers (Laine et al., 2016; Makkonen et al., 2019; Zhang et al., 2020). Nonetheless, despite this growth-mindset-oriented context, slightly more than half the participants were fixed-mindset-oriented at the beginning of third grade. This finding is in line with earlier research on Finnish students' mindsets, which has shown that younger students are more likely than their older peers to hold fixed mindsets (Kuusisto et al., 2017; Laine et al., 2024).

Effects of the intervention on students' self-regulated learning strategies

As to students' strategies when facing challenges, overall, we found that students most typically reported seeking help and trying again when faced with a challenging learning situation. Regarding the effects of the *I can learn* program, we found that immediately after the intervention students in the intervention group were more likely to report the use of emotional control strategies, such as finding ways to calm themselves, than were students in the other groups (RQ1). Importantly, no differences between the groups were found before the intervention, which indicates that this increased preference for emotional control strategies is plausibly the result of the intervention program. Indeed, one lesson in the *I can learn* program was completely dedicated to introducing the potential and use of simple emotional control strategies when encountering challenges in learning. Moreover, the entire intervention program and all the lessons reflected the idea that with effort and the use of effective strategies, anyone can further develop their skills and abilities. Additionally, the lessons emphasized that meaningful learning is supposed to feel challenging and occasionally frustrating. Therefore, through these lessons and by normalizing such feelings of frustration, the intervention provided a framework for reappraising challenging learning situations as positive rather than negative occurrences, possibly leading students to consider engaging in emotional control strategies a worthwhile activity throughout the learning process. Nevertheless, 18 months after

the intervention, the intervention group no longer reported the will to engage in emotional control strategies in challenging situations (RQ2). In other words, the effects of the intervention on students' emotional control strategies were short-lived. This result adds to the findings of mindset intervention studies that have reported a lack of sustained long-term effects for mindset interventions (e.g., Donohoe et al., 2012; Orosz et al., 2017). Such findings have led to a wider discussion on the role of the students' everyday learning environments in fostering a growth mindset (e.g., Dweck & Yeager, 2019).

Students' self-talk when facing challenges in learning

All the categories of self-talk – effort self-talk, ability self-talk and comforting – were used by the participating students. In accordance with our hypothesis, the results from the qualitative and quantitative analysis of students' learning diaries indicated that, immediately after the intervention, the students in the intervention group were more likely to use effort self-talk, especially self-encouragement talk, and less ability self-talk than were the students in the two control groups (RQ3). Furthermore, the use of effort self-talk dominated among the intervention group students, whereas the use of effort versus ability self-talk was distributed more evenly in the two control groups.

As to long-term impact of the study, while the intervention group had sustained their effort self-talk 18 months after the intervention, by that time students from the other groups also reported using a similar amount of such self-talk (RQ3). In other words, the other groups had increased in their willingness to use effort self-talk, catching up with the intervention group. It is possible that as the Finnish education system is aligned in many ways with the principles of growth mindset pedagogy (GMP; Rissanen et al., 2019, 2021) and Finnish teachers mostly hold a growth mindset (Laine et al., 2016; Makkonen et al., 2019; Zhang et al., 2020), the more school experience students of this age acquire, the better they understand the importance of effort in successful learning. Research findings indicating that older Finnish students are more likely than their younger peers to hold growth mindsets could reflect such a process (Kuusisto et al., 2017; Laine et al., 2024). Such an understanding of the importance of effort could therefore be reflected in the students' reported self-talk. It is possible that by highlighting the role of effort the intervention simply helped the participating students develop a more positive view of the role of effort sooner, which was reflected in their self-talk. Nevertheless, our results on students' self-reported effort beliefs show neither such a general developmental trend towards more adaptive beliefs about the utility of effort nor the effect of the intervention on these beliefs. Therefore, it is also possible that the participating students simply learned the expressions used in the intervention lessons without a deeper understanding of or reflection on the meaning of such self-talk. It is also important to note that we did not assess students' self-talk before the intervention, so we cannot exclude the possibility that the intervention group already differed from the control groups in their self-talk before the intervention. Nevertheless, as the effects of the intervention also emerged in students' reported strategies when faced with challenges (compared to other groups as well as the pre-intervention assessment), it is plausible that this difference immediately after the intervention does indeed reflect the effect of the *I can learn* lessons.

Trustworthiness and limitations

We have described the *I can learn* intervention program and analysis process in as much detail as possible to increase the trustworthiness and reliability of our research. In the qualitative parts, we have included direct quotes to provide examples of the nature of the data. Furthermore, we used interrater reliability to increase the reliability of our categorization.

Although the results of the present study indicate that students who participated in the intervention program learned the effort self-talk and emotional control strategies taught in the intervention lessons, our findings are limited. First, it should be noted that as the present results are based on

students' written answers to questions regarding how they would behave, the results do not inform us about whether the students actually used these strategies and effort self-talk when faced with real challenging learning situations. It is possible that the students from the intervention group simply learned the language and expressions taught in the intervention lessons without any deeper reflection on and understanding of the meaning of such self-talk and strategies. Additionally, as we did not assess students' self-talk before the intervention, it cannot be inferred that post-intervention differences in self-talk were a result of the intervention.

Second, students' mindset and effort beliefs were assessed using self-report measures, which could be problematic for participants as young as those in the present sample. Namely, young children can struggle both to understanding the questions in such measures and to produce the level of self-reflection required to answer them (Borgers et al., 2000). To address these challenges, we used different sized circles mapping onto a 6-point scale to help students report their agreement with the items. Additionally, we used example statements to facilitate their understanding of how to indicate their agreement with the survey statements. Moreover, at pre-assessment, the questions were read out by the researcher one by one. Nevertheless, it is possible that participants struggled to produce the level of self-reflection necessary to answer the questionnaire, and therefore, partly due to this, we were unable to observe any effects of the intervention on these measures. Mindsets and effort beliefs are by nature implicit; thus, using teacher reports of students' beliefs is not a credible approach. Nonetheless, teacher reports of other theoretically relevant constructs, such as students' task persistent behavior, could be used in the future.

Third, there are several issues that may pose a threat to internal validity of the study. Namely, the number of participants is small, which leads to low power regarding the detection of the effects of the intervention program. A sensitivity analysis using a repeated measures MANOVA design (3 groups, 3 time points) with a sample size of 116, α error probability of .05, power of .80, and a correlation of .40 between repeated measures indicated a minimum required effect size of $f = .23$ (G*Power; Faul et al., 2007), which could be considered a small-to-moderate effect. Most effects observed in previous mindset intervention studies have been small. As the effect size of $f = .23$ is very close to .25, which is considered a benchmark for a moderate effect, it is possible that, in the present study, we were not able to detect effects on students' mindsets and effort beliefs if these were small. Moreover, classrooms and not individuals were assigned to experimental conditions, with the combination of strategic and random assignment was used to allocate classrooms to experimental conditions. As such, the present study does not fulfill the conditions of a randomized control trial and, in the future when assigning experimental conditions to clusters (here: classrooms) instead of individuals, the suggested practices for cluster randomized trial should be followed (Hemming & Taljaard, 2023). This aspect should also be taken into account when considering the sensitivity analysis concerning the smallest detectable effect size. Importantly, a clustered design inflates the smallest detectable effect size and, therefore, although we controlled for pre-intervention measures, which helps to mitigate this problem, the sample size and design of the present study would enable detecting only moderate to large effects (in the case of negligible to small intraclass-correlations of outcome variables, respectively; Rutterford et al., 2015). In addition, the clustered study design does not enable us to control for, for example, group differences in maturational processes.

Fourth, as only two schools participated in the study, the generalizability of the results to other schools is limited. It is likely that school characteristics (e.g., peer norms; for example, see Yeager et al., 2019) would influence the effects of the intervention. Finally, as schools were closed due to the COVID-19 pandemic immediately after the intervention, we were unable to reach all the participants for the post-assessment of the quantitative data. Therefore, data from several participants from this assessment point was missing, and this lack of data was not completely random. Thus, the results regarding the quantitative data immediately after the intervention should be considered with caution. Another limitation resulting from the start of the COVID-19 pandemic is that the last lessons of the intervention occurred when the students were already somewhat anxious about the spread of the disease, potentially affecting their focus and engagement during these sessions.

Future research

The effects of the intervention found in the qualitative data seemed to fade away in the subsequent months and were undetectable in the follow-up data. Mindset scholars have increasingly begun to acknowledge the limits to what can be achieved with sporadic interventions if the every-day educational environment does not support the development and maintenance of growth mindsets; therefore, holistic approaches to developing growth mindset cultures are required (Dweck & Yeager, 2019; Schmidt et al., 2015; Yu et al., 2022). Teachers' mindsets impact their pedagogical thinking and practice (Rissanen et al., 2019) and are conveyed to students through subtle cues. Therefore, it is vital to engage teachers in the development of growth mindset cultures and pay attention, also, to the development of their mindsets. We suggest that design-based approaches could represent the potential next step in mindset research. The contextuality of the mindset phenomenon cannot be escaped – successful interventions have been carefully adapted to the particularities of the context and target populations (Dweck & Yeager, 2019). Design-based research, which relies on a participatory approach and multiple methods, not only allows for the construction of a theory but also provides actionable knowledge; then, the appropriate generalization and particularization can be pursued by aligning the theoretically driven hypothesis with the unique practices and contexts of the interventions (Anderson & Shattuck, 2012; Hoadley & Campos, 2022). For instance, the Finnish educational system, which is generally supportive of growth mindset pedagogies, contains its own particularities – for example, it's tendency to promote the development of a fixed mindset among high achievers – which have become visible through fine-grained qualitative analyses and design-based studies (Rissanen et al., 2019, 2021). Additionally, another future direction would be to integrate teacher-led mindset intervention programs with subject learning. This would be especially applicable in the elementary school context, where students learn many subjects with the same class-teacher, who could integrate learning activities in different subjects with a mindset intervention and, as such, help students see the growth of their abilities in different subject domains. In all, compiling findings from such research as well as studies examining context-specificity in the applicability of growth-mindset is important for the further development of mindset theory and growth mindset pedagogies and for achieving deeper understanding of the complexities of their implementation.

Disclosure statement

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References

Alderson-Day, B., & Fernyhough, C. (2015). Inner speech: Development, cognitive functions, phenomenology, and neurobiology. *Psychological Bulletin*, *141*(5), 931–965. https://doi.org/10.1037/BUL0000021

Anderson, T., & Shattuck, J. (2012). Design-based research: A decade of progress in education research? *Educational Researcher*, *41*(1), 16–25. https://doi.org/10.3102/0013189X11428813

Arnesen, A. L., Mietola, R., & Lahelma, E. (2007). Language of inclusion and diversity: Policy discourses and social practices in Finnish and Norwegian schools. *International Journal of Inclusive Education*, *11*(1), 97–110. https://doi.org/10.1080/13603110600601034

Aronson, J., Fried, C. B., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology*, *38*(2), 113–125. https://doi.org/10.1006/jesp.2001.1491

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1). https://doi.org/10.18637/jss.v067.i01

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, *78*(1), 246–263. https://doi.org/10.1111/j.1467-8624.2007.00995.x

Boaler, J. (2013). Ability and mathematics: The mindset revolution that is reshaping education. *Forum (Chicago, Ill)*, *55*(1), 143. https://doi.org/10.2304/forum.2013.55.1.143

Boaler, J. (2019). *Limitless mind: Learn, lead, and live without barriers*. HarperCollins.

Borgers, N., de Leeuw, E., & Hox, J. (2000). Children as respondents in survey research: Cognitive development and response quality 1. *Bulletin of Sociological Methodology/Bulletin de Méthodologie Sociologique*, *66*(1), 60–75. https://doi.org/10.1177/075910630006600106

Broda, M., Yun, J., Schneider, B., Yeager, D. S., Walton, G. M., & Diemer, M. (2018). Reducing inequality in academic success for incoming college students: A randomized trial of growth mindset and belonging interventions. *Journal of Research on Educational Effectiveness*, *11*(3), 317–338. https://doi.org/10.1080/19345747.2018.1429037

Burgoyne, A. P., Hambrick, D. Z., & Macnamara, B. N. (2020). How firm are the foundations of mind-set theory? The claims appear stronger than the evidence. *Psychological Science*, *31*(3), 258–267. https://doi.org/10.1177/0956797619897588

Burnette, J. L., Boyle, E. H. O., Vanepps, E. M., Pollack, J. M., & Finkel, E. J. (2013). Mind-sets matter: A meta-analytic review of implicit theories and self-regulation.. *Psychological Bulletin*, *139*(3), 655–701. https://doi.org/10.1037/a0029531

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, *20*(1), 37–46. https://doi.org/10.1177/001316446002000104

Donohoe, C., Topping, K., & Hannah, E. (2012). The impact of an online intervention (Brainology) on the mindset and resiliency of secondary school pupils: A preliminary mixed methods study. *Educational Psychology*, *32*(5), 641–655. https://doi.org/10.1080/01443410.2012.675646

Dweck, C. S. (2000). *Self-theories: Their role in motivation, personality and development*. Psychology Press.

Dweck, C. S. (2006). *Mindset: The new psychology of success*. Random House.

Dweck, C. S., & Yeager, D. S. (2019). Mindsets: A view from two eras. *Perspectives on Psychological Science*, *14*(3), 481–496. https://doi.org/10.1177/1745691618804166

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), 107–115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/BF03193146

Finnish National Board of Education. (2014). *Perusopetuksen opetussuunnitelman perusteet* [National core curriculum for basic education 2014]. Suomen yliopistopaino.

Gandhi, J., Watts, T. W., Masucci, M. D., & Raver, C. C. (2020). The effects of two mindset interventions on low-income students' academic and psychological outcomes. *Journal of Research on Educational Effectiveness*, *13*(2), 351–379. https://doi.org/10.1080/19345747.2019.1711272

Good, C., Aronson, J., & Inzlicht, M. (2003). Improving adolescents' standardized test performance: An intervention to reduce the effects of stereotype threat. *Journal of Applied Developmental Psychology*, *24*(6), 645–662. https://doi.org/10.1016/j.appdev.2003.09.002

Gouëdard, P. (2021). *Can a growth mindset help disadvantaged students close the gap?* https://doi.org/10.1787/20922f0d-en

Gunderson, E. A., Park, D., Maloney, E. A., Beilock, S. L., Levine, S. C., Gunderson, E. A., Park, D., Maloney, E. A., & Beilock, S. L. (2018). Reciprocal relations among motivational frameworks, math anxiety and math achievement in early elementary school. *Journal of Cognition and Development*, *19*(1), 21–46. https://doi.org/10.1080/15248372.2017.1421538

Hemming, K., & Taljaard, M. (2023). Key considerations for designing, conducting and analysing a cluster randomized trial. *International Journal of Epidemiology*, *52*(5), 1648–1658. https://doi.org/10.1093/ije/dyad064

Hoadley, C., & Campos, F. C. (2022). Design-based research: What it is and why it matters to studying online learning. *Educational Psychologist*, *57*(3), 207–220. https://doi.org/10.1080/00461520.2022.2079128

Hong, Y., Chiu, C., Dweck, C. S., Lin, D. M.-S., & Wan, W. (1999). Implicit theories, attributions, and coping: A meaning system approach. *Journal of Personality and Social Psychology*, *77*(3), 588–599. https://doi.org/10.1037/0022-3514.77.3.588

Kim, M. S., & Park, S. (2021). Growth of fixed mindset from elementary to middle school: Its relationship with trajectories of academic behavior engagement and academic achievement. *Psychology in the Schools*, *58*(11), 2175–2188. https://doi.org/10.1002/pits.22583

Kinlaw, C. R., & Kurtz-Costes, B. (2003). The development of children's beliefs about intelligence. *Developmental Review*, *23*(2), 125–161. https://doi.org/10.1016/S0273-2297(03)00010-8

Kinlaw, C. R., & Kurtz-Costes, B. (2007). Children's theories of intelligence: Beliefs, goals, and motivation in the elementary years. *The Journal of General Psychology*, *134*(3), 295–311. https://doi.org/10.3200/GENP.134.3.295-312

Kuusisto, E., Laine, S., & Tirri, K. (2017). How do school children and adolescents perceive the nature of talent development? A case study from Finland. *Education Research International*, *2017*(1), 1–8. https://doi.org/10.1155/2017/4162957

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest Package: Tests in Linear Mixed Effects Models. *Journal of Statistical Software*, *82*(13), 1–26. https://doi.org/10.18637/jss.v082.i13

Laine, S., Kuusisto, E., & Tirri, K. (2016). Finnish teachers' conceptions of giftedness. *Journal for the Education of the Gifted*, *39*(2), 151–167. https://doi.org/10.1177/0162353216640936

Laine, S., Kuusisto, E., & Tirri, K. (2024). Finnish students' conceptions of giftedness and intelligence in basic education. *Scandinavian Journal of Educational Research*, *68*(2), 141–159. https://doi.org/10.1080/00313831.2022.2117242

Lenth, R. (2024). *emmeans: Estimated Marginal Means, aka Least-Squares Means*. R package (Version 1.10.1). https://cran.r-project.org/package=emmeans

Li, Y., & Bates, T. C. (2019). You can't change your basic ability, but you work at things, and that's how we get hard things done: Testing the role of growth mindset on response to setbacks, educational attainment, and cognitive ability. *Journal of Experimental Psychology: General*, *148*(9), 1640–1655. https://doi.org/10.1037/xge0000669

Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association*, *83*(404), 1198–1202. https://doi.org/10.1080/01621459.1988.10478722

MacDonald, P. L., & Gardner, R. C. (2000). Type I error rate comparisons of post hoc procedures for I × J chi-square tables. *Educational and Psychological Measurement*, *60*(5), 735–754. https://doi.org/10.1177/00131640021970871

Makkonen, T., Lavonen, J., & Tirri, K. (2019). General and physics-specific mindsets about intelligence and giftedness: A study of gifted Finnish upper-secondary-school students and physics teachers. *International Journal for Talent Development and Creativity*, *7*(1), 39–52.

Martín-Arbós, S., Castarlenas, E., & Dueñas, J. M. (2021). Help-seeking in an academic context: A systematic review. *Sustainability*, *13*(8), 4460. https://doi.org/10.3390/su13084460

Moser, J. S., Schroder, H. S., Heeter, C., Moran, T. P., & Lee, Y. H. (2011). Mind your errors: Evidence for a neural mechanism linking growth mind-set to adaptive posterror adjustments. *Psychological Science*, *22*(12), 1484–1489. https://doi.org/10.1177/0956797611419520

Mueller, C. M., & Dweck, C. S. (1998). Praise for intelligence can undermine children's motivation and performance. *Journal of Personality and Social Psychology*, *75*(1), 33–52. https://doi.org/10.1037/0022-3514.75.1.33

Orosz, G., Péter-Szarka, S., Bothe, B., Tóth-Király, I., & Berger, R. (2017). How not to do a mindset intervention: Learning from a mindset intervention among students with good grades. *Frontiers in Psychology*, *8*(MAR), 1–11. https://doi.org/10.3389/fpsyg.2017.00311

Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology*, *8*(APR), 1–28. https://doi.org/10.3389/fpsyg.2017.00422

Paunesku, D., Walton, G. M., Romero, C., Smith, E. N., Yeager, D. S., & Dweck, C. S. (2015). Mind-set interventions are a scalable treatment for academic underachievement. *Psychological Science*, *26*(6), 784–793. https://doi.org/10.1177/0956797615571017

Rege, M., Hanselman, P., Solli, I. F., Dweck, C. S., Ludvigsen, S., Bettinger, E., Crosnoe, R., Muller, C., Walton, G., Duckworth, A., & Yeager, D. S. (2020). How can we inspire nations of learners? An investigation of growth mindset and challenge-seeking in two countries. *American Psychologist*, *76*(5), 755–767. https://doi.org/10.1037/amp0000647

Rissanen, I., Kuusisto, E., Tuominen, M., & Tirri, K. (2019). In search of a growth mindset pedagogy: A case study of one teacher's classroom practices in a Finnish elementary school. *Teaching and Teacher Education*, *77*, 204–213. https://doi.org/10.1016/j.tate.2018.10.002

Rissanen, I., Laine, S., Puusepp, I., Kuusisto, E., & Tirri, K. (2021). Implementing and evaluating growth mindset pedagogy – A study of Finnish elementary school teachers. *Frontiers in Education*, *6*(September), 1–14. https://doi.org/10.3389/feduc.2021.753698

R Studio Team. (2024). R: A language and environment for statistical computing. In *R Foundation for Statistical Computing* (p. https://www.R-project.org). R Foundation for Statistical Computing. http://www.r-project.org

Rutterford, C., Copas, A., & Eldridge, S. (2015). Methods for sample size determination in cluster randomized trials. *International Journal of Epidemiology*, *44*(3), 1051–1067. https://doi.org/10.1093/ije/dyv113

Sarrasin, J. B., Nenciovici, L., Foisy, L. M. B., Allaire-Duquette, G., Riopel, M., & Masson, S. (2018). Effects of teaching the concept of neuroplasticity to induce a growth mindset on motivation, achievement, and brain activity: A meta-analysis. *Trends in Neuroscience and Education*, *12*(April), 22–31. https://doi.org/10.1016/j.tine.2018.07.003

Savvides, H., & Bond, C. (2021). How does growth mindset inform interventions in primary schools? A systematic literature review. *Educational Psychology in Practice*, *37*(2), 134–149. https://doi.org/10.1080/02667363.2021.1879025

Schmidt, J. A., Shumow, L., & Kackar-Cam, H. (2015). Exploring teacher effects for mindset intervention outcomes in seventh-grade science classes. *Middle Grades Research Journal*, *10*(2), 17–32.

Shively, R. L., & Ryan, C. S. (2013). Longitudinal changes in college math students' implicit theories of intelligence. *Social Psychology of Education*, *16*(2), 241–256. https://doi.org/10.1007/s11218-012-9208-0

Smalley, R. T., & Hopkins, S. (2020). Social climate and help-seeking avoidance in secondary mathematics classes. In *The Australian educational researcher* (Vol. 47, Issue 3). Springer Netherlands. https://doi.org/10.1007/s13384-020-00383-y

Thomaes, S., Tjaarda, I. C., Brummelman, E., & Sedikides, C. (2020). Effort self-talk benefits the mathematics performance of children With negative competence beliefs. *Child Development*, *91*(6), 2211–2220. https://doi.org/10.1111/cdev.13347

Tirri, K. (2011). Holistic school pedagogy and values: Finnish teachers' and students' perspectives. *International Journal of Educational Research*, *50*(3), 159–165. https://doi.org/10.1016/j.ijer.2011.07.010

Tirri, K. (2014). The last 40 years in Finnish teacher education. *Journal of Education for Teaching*, *40*(5), 1–10. https://doi.org/10.1080/02607476.2014.956545

Tsang, J. M., Blair, K. P., Bofferding, L., & Schwartz, D. L. (2015). Learning to "see" less than nothing: Putting perceptual skills to work for learning numerical structure. *Cognition and Instruction*, *33*(2), 154–197. https://doi.org/10.1080/07370008.2015.1038539

Tuohilampi, L., & Hannula, M. S. (2013). Matematiikkaan liittyvien asenteiden kehitys sekä asenteiden ja osaamisen välinen vuorovaikutus 3., 6. ja 9. luokalla [Development of math-related attitudes and the interplay between attitudes and skills in grades 3, 6 and 9]. In J. Metsämuuronen (Ed.), *Perusopetuksen matematiikan oppimistulosten pitkittäisarviointi vuosina 2005 – 2012* [Longitudinal evaluation of academic achievement in math in basic education from years 2005-2012 (Issue 4)]. Juvenes Print – Suomen Yliopistopaino Oy. https://doi.org/10.13140/2.1.1403.6805

Vermunt, J. D. (1996). Metacognitive, cognitive and affective aspects of learning styles and strategies: A phenomenographic analysis. *Higher Education*, *31*(1), 25–50. https://doi.org/10.1007/BF00129106

Vilkama, K., Lönnqvist, H., Väliniemi-Laurson, J., & Tuominen, M. (2014). *Differentiating metropolitan area: Socioeconomical differences between neighborhoods 2002–2012*.

Wolters, C. A. (2003). Regulation of motivation: Evaluating an underemphasized aspect of self-regulated learning. *Educational Psychologist*, *38*(4), 189–205. https://doi.org/10.1207/S15326985EP3804_1

Yeager, D. S., & Dweck, C. S. (2012). Mindsets that promote resilience: When students believe that personal characteristics can be developed. *Educational Psychologist*, *47*(4), 302–314. https://doi.org/10.1080/00461520.2012.722805

Yeager, D. S., & Dweck, C. S. (2020). What can be learned from growth mindset controversies? *American Psychologist*, *75*(9), 1269–1284. https://doi.org/10.1037/amp0000794

Yeager, D. S., Hanselman, P., Walton, G. M., Murray, J. S., Crosnoe, R., Muller, C., Tipton, E., Schneider, B., Hulleman, C. S., Hinojosa, C. P., Paunesku, D., Romero, C., Flint, K., Roberts, A., Trott, J., Iachan, R., Buontempo, J., Yang, S. M., Carvalho, C. M., … Dweck, C. S. (2019). A national experiment reveals where a growth mindset improves achievement. *Nature*, *573*(7774), 364–369. https://doi.org/10.1038/s41586-019-1466-y

Yeager, D. S., Romero, C., Paunesku, D., Hulleman, C. S., Schneider, B., Hinojosa, C., Lee, H. Y., Brien, J. O., Flint, K., Roberts, A., Trott, J., International, I. C. F., Greene, D., Walton, G. M., & Dweck, C. S. (2016). Using design thinking to improve psychological interventions: The case of the growth mindset during the transition to high school. *Journal of Educational Psychology*, *108*(3), 374–391. https://doi.org/10.1037/edu0000098

Yu, J., Kreijkes, P., & Salmela-Aro, K. (2022). Students' growth mindset: Relation to teacher beliefs, teaching practices, and school climate. *Learning and Instruction*, *80*(January), 101616. https://doi.org/10.1016/j.learninstruc.2022.101616

Zhang, J., Kuusisto, E., Nokelainen, P., & Tirri, K. (2020). Peer feedback reflects the mindset and academic motivation of learners. *Frontiers in Psychology*, *11*(July). https://doi.org/10.3389/fpsyg.2020.01701