Primary school students' profiles of self-regulatory efficacy sources—Transitions and association with self-regulatory efficacy

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Primary school students' profiles of self-regulatory efficacy sources—Transitions and association with self-regulatory efficacy[☆],[☆☆],[☆☆☆]

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ABSTRACT

This study investigated stability and changes in primary school students' (N = 345) profiles of self-regulatory efficacy sources including mastery and vicarious experience, social persuasion, and psychological and emotional arousal within one school year, and how profile memberships associate with gender, support for learning, and self-regulatory efficacy. Latent profile and transition analyses identified four profiles among students: *Highly positive*, *Average*, *Stressed*, and *Highly positive but stressed*. All profiles showed stability during the school year, yet some students transitioned into more maladaptive profiles. Gender was significantly associated with some profile memberships and transitions, while support for learning was not. Students who remained *Highly positive* showed higher self-regulatory efficacy, while students remaining in profiles showing stress reported lower levels of self-regulatory efficacy. Additionally, transitioning to a more maladaptive profile within the school year was related to lower self-regulatory efficacy.

Educational relevance and implications statement: This study identified four different profiles among primary school students based on their self-regulatory efficacy sources: *Highly positive*, *Average*, *Stressed*, and *Highly positive but stressed*. Most students showed a positive combination of self-regulatory efficacy sources, but some students' profiles were more maladaptive, characterized by relatively high levels of stress. While most of the students remained in their initial profile during the school year, some transitions into maladaptive profiles did occur. These stabilities and transitions, in general, predicted students' self-regulatory efficacy, so that students showing more positive and stable profiles reported higher self-regulatory efficacy, whereas students belonging or transitioning to more stressed profiles reported lower self-regulatory efficacy. These findings suggest that experiencing stress may be harmful for student's self-efficacy, even when they otherwise have positive bases (that is, sources) for self-efficacy.

1. Introduction

Self-efficacy refers to individuals' beliefs about their own abilities to perform various tasks (Schunk, 1991). It is strongly associated with various learning outcomes (e.g., Talsma et al., 2018) as well as with effort while facing difficulties (Bandura, 1997). Social cognitive theory states that self-efficacy is domain-specific, as individuals evaluate their abilities differently across life areas (Bandura, 1997). The basis for students' self-efficacy is formed through four sources of self-efficacy (Schunk & DiBenedetto, 2020), namely mastery experience, vicarious experience, social persuasion, and physiological and emotional arousal.

Research has often focused on academic domains, showing that

students' self-efficacy and its sources differ across these domains (e.g., Joët et al., 2011; Kiran & Sungur, 2012; Peura et al., 2021; Street et al., 2022; Usher & Pajares, 2009). Less emphasis has been placed on efficacy and its sources in the cognitive or emotional domains of learning, such as in self-regulation (Paananen et al., 2019, 2023; Usher & Pajares, 2006). However, students' confidence to successfully direct and regulate themselves, that is, self-regulatory efficacy, is a pivotal predictor of their classroom behavior (e.g., Harter, 2012), engagement in pursuing goals (Zimmerman, 2008), and academic achievements (Blair & Raver, 2015; Caprara et al., 2008; Usher et al., 2023). The importance of supporting students' self-efficacy development has recently been emphasized (Usher et al., 2023), because the primary school years are an important phase when children continuously practice their self-regulatory skills in educational context (FNBE [Finnish National Board of Education], 2016).

According to social cognitive theory (Bandura, 1997) students' interpretations are heterogeneous, which means that not only do students report the self-regulatory efficacy sources at different levels, but also that experiences are not always aligned across the four sources. In addition, gender and other individual characteristics may challenge or support students' school functioning, shaping self-efficacy and its sources. However, empirical studies on the heterogeneity of self-regulatory efficacy sources are scarce. Thus, this study aimed to examine (1) what kinds of self-regulatory efficacy source profiles can be identified among primary school students, (2) how stable the profiles are during a school year, (3) how gender and support for learning predicts profile membership, and (4) how stability and change in the profile memberships relate to students' self-regulatory efficacy.

1.1. Theoretical framework: self-regulatory efficacy sources in the school context

The present study draws on the social cognitive theory (Bandura, 1997). It proposes that when individuals make judgments about what they can and cannot do in different domains, including self-regulation and build their sense of self-regulatory efficacy, they interpret information utilizing four different sources: mastery experiences, vicarious experiences, social persuasion, and physiological and emotional arousal. Previous research has shown that these four sources form the basis of students' diverse academic efficacy beliefs (Byars-Winston et al., 2017; Peura et al., 2021: Phan, 2012; Phan & Ngu, 2016; Sheu et al., 2018; Usher & Pajares, 2009, for self-regulation: Joët et al., 2011; Paananen et al., 2019; Usher & Pajares, 2006). However, less is known about what kinds of student groups can be identified in relation to self-regulatory efficacy sources, although students can differ significantly in their experiences of how confidently they have been to regulate their behaviors and emotions in learning situations (cf. Paananen et al., 2019).

Mastery experience refers to previous accomplishments and successes that provide a genuine indicator of whether one can or cannot succeed (Bandura, 1997). Experiences of succeeding in a task are more likely to build a sense of efficacy and to pursue similar tasks, while a sense of failure can undermine a sense of personal ability (Schunk & Usher, 2019). Based on the theory (Bandura, 1997), perceived mastery experiences can be a better predictor of future performance than past actions itself. In terms of self-regulation, students assess whether they have succeeded in controlling their behaviors in on-task situations and in classrooms.

Vicarious experience means observations of peers' behaviors (Bandura, 1997). Social modelling allows a student to observe how well peers do, and thus one can more easily assess or make a judgement about one's own capabilities (Schunk & DiBenedetto, 2020; Schunk & Usher, 2019). The theory suggests especially younger students are more likely to engage in such comparative behavior (Bandura, 1997). According to Bandura (1997), vicarious experiences become increasingly important in activities where there are no absolute measures on adequacy, such as self-regulation.

Social persuasion refers to verbal feedback from significant others that younger students, in particular, tend to rely on while interpreting own performance and building perceptions of their own efficacy (Bandura, 1986, 1997). In self-regulation, social persuasion refers to feedback on students' capability to regulate themselves during tasks. Students with high levels of social persuasion are more aware of expected and required abilities (e.g., maintaining concentration on tasks) and tend to put more effort even when difficulties arise (Bandura, 1997). The effectiveness of feedback on self-efficacy is closely linked to how it is structured and from whom it comes (Pajares, 2006), whether it is perceived as genuine (Hattie & Timperley, 2007) and realistic in relation to one's own abilities (Bandura, 1997).

Physiological and emotional arousal is defined theoretically as stress and anxiety, which individuals often interpret as an indicator of their own incapabilities (Bandura, 1997). However, these reactions can be associated with both negative (e.g., failures) and positive (e.g., desire to succeed, importance) emotional experiences; in both cases, these emotions may become burdensome for students (Bandura, 1997; Caprara et al., 2008). In terms of self-regulatory efficacy, varying emotional interpretations may rise—as most tasks involve persistent focus to seek and adapt new information and taking initiative actions to ask for help (Zimmerman, 2008). Constantly changing learning tasks and demands may exceed students' resources to stay focused and persistent, and lead to impression of failure occasionally or even several times a day (Burger & Samuel, 2017). Students are expected to practice and control their behavior and emotions during class, which can cause anticipation of both fear of failure and/or highlight the importance to succeeding in these skills (Carver & Connor-Smith, 2010). The use of term stress takes both more positive and more negative interpretations into account (e.g., Burger & Samuel, 2017; Carver & Connor-Smith, 2010), thus in this study physiological and emotional arousal is referred to as stress rather than stress and anxiety.

1.2. The role and the development of sources of self-efficacy

Bandura (1986, 1997) posits that, in general, positive and multiple self-efficacy building experiences (i.e., sources) enhance self-efficacy, while negative experiences weaken it. Supporting this, research suggests that higher levels of mastery and vicarious experience and social persuasion, and lower levels of physiological and emotional arousal, predict higher levels of self-efficacy, whereas more negative sources predict lower levels of self-efficacy (e.g., Byars-Winston et al., 2017; Sheu et al., 2018). Whereas students with higher self-efficacy are more likely to engage in activities and tasks that will help them gain more positive experiences (Schunk & Usher, 2019), resulting in an additive effect (Bandura, 1997).

Prior studies concerning different academic domains show that some sources play a greater role with respect to self-efficacy outcomes. In general, Bandura (1997) and empirical findings (Sheu et al., 2018; Usher & Pajares, 2008) emphasize the importance of mastery experience for self-efficacy. In addition, adolescents are found to rely more on mastery experience in science domains (Chen & Usher, 2013), and on both mastery experience and social persuasion in math and reading (Butz & Usher, 2015). While younger students rely more on social persuasion in the academic domain (academic self-efficacy: Usher & Pajares, 2006) and in science (Phan, 2012). Additionally, mastery experience and physiological and emotional arousal have been found to play a role in younger students' self-efficacy outcomes (Phan, 2012; Usher & Pajares, 2006).

In regard to sources role in self-regulatory efficacy, few prior studies have established that all four sources play an important and predictable role in self-regulatory efficacy (Joët et al., 2011; Paananen et al., 2019; Usher & Pajares, 2006), and that the presence of negative emotions or fewer positive experiences are associated with lower self-regulatory efficacy (Paananen et al., 2023).

Social cognitive theory suggests that students' self-efficacy beliefs

develop from early childhood onwards (Bandura, 1986, 1997, 2001), and the school context functions as an important everyday context for the development of these beliefs (Usher et al., 2023). In terms of self-regulation, students practice regulating and controlling their own behavior on a daily basis, they evaluate their own actions and receive feedback on it, and these interpretations of their own self-regulatory abilities then accumulate relatively rapidly. According to Bandura (1997) students assess their efficacy over a relatively short period of time (within weeks and months) in relation to standards of regulated behavior and obtained feedback from the social environment and models. The most repeated experiences are seen to be the ones that carry the greatest role in understanding the efficacy development (Bandura, 1997; Bong & Skaalvik, 2003), and younger students' cognitive development and frequent feedback make their self-efficacy more sensitive to recent events, suggesting that the development in their self-regulatory efficacy sources can occur in a short period of time, such as during the school year (Bandura, 1997). Therefore, the present study focuses on a five-month period from the beginning of a school year in Fall to the beginning of the Spring term.

1.3. The person-centered approach: profiles of self-regulatory efficacy sources

The social-cognitive theory recognizes the heterogeneity of students' self-efficacy and its sources meaning that students experience self-regulatory efficacy sources at different levels and these experiences are not always aligned (Bandura, 1997). For example, some students may report having heightened mastery experience and low stress, while others may report heightened mastery experiences and high stress. Person-centered methods are needed to specify how different constructs, in this case self-regulatory efficacy sources, are organized within individuals. However, to our best knowledge, only a few previous studies have utilized these methods to identify different patterns of sources of self-efficacy (Chen & Usher, 2013; Paananen et al., 2023). Chen and Usher (2013) studied the patterns of sources of self-efficacy in the domain of science among middle and high school students. They identified four profiles: moderate profile with average levels for all four sources, at-risk profile with high physiological and emotional arousal, multi-source profile with multiple positive sources rather than one or two, and mastery profile with high mastery experience and rather low other sources. Paananen et al. (2023), in turn, examined self-regulatory efficacy sources and identified one relatively positive and four rather negative profiles: positive multi-sources with equally high levels of all four sources, low social support with low vicarious experiences and social persuasion, negative states with negative physiological and emotional arousal alongside average mastery experience, negative multi-source with low levels in all four sources, and extreme negative states with very negative physiological and emotional arousal and average levels for the other three.

While traditional variable-centered approaches inform us about the linear relations between various constructs, they do not take into account how different patterns of these constructs are related to other variables. Theoretically speaking, students are seen as active agents in their own learning, and they interpret their experiences (i.e., sources) to develop beliefs and understanding of their own abilities (i.e., self-regulation). From previous variable-centered studies we know that self-regulatory efficacy sources and self-efficacy are associated among primary school aged students (Joët et al., 2011; Paananen et al., 2019; Usher & Pajares, 2006). However, it is important to note that different patterns of self-regulatory efficacy sources may be differently related to further self-regulatory efficacy. In the previous person-centered studies by Paananen et al. (2023) and Chen and Usher (2013) it was found that students with multiple positive sources reported significantly higher self-efficacy, while students with fewer positive experiences reported the lowest levels of self-efficacy.

However, these studies were cross-sectional and, therefore, not able

to consider the developmental aspect, that is, the possible stability and transitions between the profiles, and the relations of this development and further self-efficacy. In line with the theory (Bandura, 1997), some prior variable-centered studies suggest that younger students' self-efficacy sources can change rapidly within one year (e.g., Peura et al., 2021; Phan & Ngu, 2016). However, it is likely that these changes are not similar for all students, but previous variable-centered research has not examined this. Therefore, this person-centered study extends the previous knowledge by examining inter- and intraindividual differences in students' self-regulatory efficacy sources by identifying meaningful patterns of those among primary school students, and by examining the stability and changes of these patterns across time, as well as the relation of stability and changes with self-regulatory efficacy outcomes.

1.4. Gender and support for learning

Alongside repeated experiences, gender and other individual characteristics such as learning support needs which can either challenge or support students' ability to function at school, contribute to individual differences in the development of self-efficacy and its sources (Bandura, 1986, 1997).

Previous findings on gender have shown that girls report higher levels of vicarious experiences and social persuasion in academic domains (Usher & Pajares, 2006), and higher levels of stress in math and languages compared to boys (Joët et al., 2011; Usher & Pajares, 2009), whereas boys report higher mastery experience and social persuasion in math (Joët et al., 2011). However, no previous studies have focused solely on gender differences in self-regulatory efficacy sources. In addition to mean level differences, previous studies have reported that among girls especially their social persuasion predicts their further self-efficacy (Butz & Usher, 2015; Usher & Pajares, 2006), whereas boys seem to rely more on their mastery experience (Usher & Pajares, 2006). These studies have, however, focused on academic domains and no previous studies have examined these differences in self-regulation.

General findings related to support for learning have shown that students with learning-related difficulties and disabilities report weaker sources in academic domains (Hampton & Mason, 2003; Usher & Pajares, 2006). In regard to self-regulation, Paananen et al. (2019) found that students receiving support for learning reported lower mastery experience and higher stress than their peers without such needs. Self-regulatory skills are important for all students and practiced daily in schooling. Students with challenges related to learning may be more vulnerable to difficulties (Kendall, 2012), and struggle with on-task skills, that can lead to experiences of incapability and distress. Consequently, support for learning needs may relate to individual differences in self-regulatory efficacy sources.

The Finnish education system and support for learning is provided for all students in both academic skills (e.g. reading, mathematics) and other skills needed in learning, such as self-regulation skills (cf. FNBE, 2016; Jahnukainen & Itkonen, 2016). Students have a right to flexible and individualized support in all needed forms as soon as need arises (Basic Education Act 628/1998; Ministry of Education, 2007; Jahnukainen & Itkonen, 2016). Daily support is provided by the classroom teacher (commonly in co-operation with the special education teacher) without need for any diagnosis. Support for learning is divided into three different intensity levels. General support is provided to all students including guidance and pedagogical solutions as a part of everyday schooling. If this is not sufficient, the support practices will be modified to be more intensive and continuous with intensified support through a pedagogical assessment. If the intensified support is not sufficient, a pedagogical statement and an administrative decision for special support is made.

1.5. The present study

While self-efficacy sources has been broadly studied (Morris et al.,

2017), little is known about the inter- and intraindividual differences in such sources and their development over time. Several theoretical notions (e.g., Situated expectancy value theory; Eccles & Wigfield, 2020), social cognitive theory; Bandura, 1997) have emphasized the importance of considering also short-term changes in students' motivational beliefs, as it may better capture the rapid changes in self-efficacy and developmental dynamics of different school and learning related aspects. Yet to our knowledge, none have studied short-term stability (e.g., across school year) in students' profiles of self-efficacy sources. To address these gaps in research, this study investigated the heterogeneity in students' patterns of self-regulatory efficacy sources (i.e., mastery experience, vicarious experience, social persuasion, and physiological and emotional arousal), as well as the stability in them across one school year while also considering gender differences, support for learning, and self-regulatory efficacy outcomes. We aimed to investigate four research questions:

(1) What kinds of profiles of self-regulatory efficacy sources can be identified among primary school students? Based on social cognitive theory (Bandura, 1997) and previous study results (Chen & Usher, 2013; Paananen et al., 2023), we hypothesized that we would find an adaptive profile with overall positive sources (i.e., high mastery and vicarious experiences and social persuasion) combined with low stress (i.e., physiological and emotional arousal), one profile with average levels on all sources, and one maladaptive profile with relatively low mastery experience, vicarious experience, and social persuasions combined with high stress. We also expected some mixed profiles to emerge: profiles emphasizing only one positive source of self-regulatory efficacy (e.g., mastery experience). However, due to the lack of previous studies, we did not make specific hypotheses regarding what kinds of additional profiles may be identified.

(2) How stable are primary school students' profiles of self-regulatory efficacy sources during a school year? We expected the profiles to be relatively stable across time, but that transitions into nearby profiles would emerge as self-regulation experiences may change during relatively short terms, as self-regulation skills are practiced continuously in daily schooling (cf. Bandura, 1997; Peura et al., 2021; Phan & Ngu, 2016).

(3) How does gender and support for learning predict profile membership and changes that occur in them during one school year? Theory suggests that gender differences among school-age students may emerge (cf. Bandura, 1986, 1997), yet previous empirical findings concerning gender differences in self-efficacy sources are rather mixed (Butz & Usher, 2015; Joët et al., 2011; Pajares, 2006; Usher & Pajares, 2008). Thus, while exploring the predictive role of gender is theoretically grounded and valuable, no specific hypotheses were made regarding gender. Bandura (1997) also suggests that individual characteristics, such as the need for learning support may influence how students perceive their experiences, and thus may account for individual differences. Previous studies show that students who need intensifying support for learning report more negative sources than their peers who did not need such support in relation to academic self-efficacy sources (Hampton & Mason, 2003; Usher & Pajares, 2006) and also in self-regulatory efficacy sources (Paananen et al., 2019). Therefore, we hypothesized that students' needs for intensifying learning support would be related to more maladaptive profiles.

(4) How are the stability and changes in students' self-regulatory efficacy sources related to self-regulatory efficacy? Based on the social cognitive theory (Bandura, 1986, 1997) and empirical evidence (Chen & Usher, 2013; Paananen et al., 2019, 2023; Peura et al., 2021), we hypothesized that profiles characterized by high levels of mastery and vicarious experiences and social persuasion would have higher self-regulatory efficacy, whereas

profiles characterized by elevated levels of physiological and emotional arousal would be associated with lower self-regulatory efficacy (Byars-Winston et al., 2017; Chen & Usher, 2013; Paananen et al., 2023). As no previous studies, to our knowledge, have investigated how changes in the patterns of self-regulatory efficacy sources are related to self-regulatory efficacy outcomes, no specific assumptions were made.

2. Materials and methods

2.1. Participants and procedures

Data came from a research project [blinded] conducted in [blinded] Finland aiming to identify and support students' well-being. Two primary schools participated in the project twice during the school year 2019–2020, when students from Grades 4–6 participated (i.e., 10–12-year-olds). Finnish primary school consist of Grades 1–6, after which there is a transition to lower secondary school (Grades 7–9). Studying self-regulation experiences in this context is highly relevant, as understanding primary school students' emerging self-regulation experiences and their confidence to self-regulate, is recognized as one of the priorities in teaching (FNBE, 2016). Participation approval was obtained from the schools' principals, teachers, and student caregivers, as well as from the students themselves. All parties were informed about the project, research and data collection in written and video format. The participating students completed electronic questionnaires during school hours under the supervision of trained research team members. The final sample resulted in 345 students from 14 classes ($M_{age} = 11.07$, $SD_{age} = 0.89$, 53.1 % girls); 30.7 % were in grade 4, 35.8 % in grade 5, and 33.5 % in grade 6. Only students who responded to the survey at both time points (T1 September 2019, T2 February 2020) were included in the analysis. Of all participants, 68 (19.8 %) received intensified or special educational support, aligning with the national statistics (20.1 % of students receive such support; OSF, 2020). Finnish students typically attend their local school, and all schools follow the same national core curriculum (FNBE, 2016). School differences in Finland are exceptionally small (OECD, 2016). Thus, the sample of this study may be considered relatively representative of the Finnish population regarding this age group, and the sample size to ensure adequate estimation of longitudinal structural equation models (e.g., Wolf et al., 2013). The EU GDPR (2016/679) and National Data Protection Act (1050/2018), the Finnish National Board on Research Integrity (TENK) guidelines for the ethical principles of research with human participants (TENK, 2009), as well as APA ethical guidelines were strictly followed.

2.2. Measurements

2.2.1. Sources of Self-efficacy in Self-regulation questionnaire

The Sources of Self-regulatory Self-efficacy questionnaire (Paananen et al., 2019; Paananen et al., 2023) consisted of four subscales: mastery experience (5 items; e.g., *I have always been able to concentrate on the teaching during class*), vicarious experiences (3 items; e.g., *My friends focus on teaching during class*), social persuasion (4 items; e.g., *My teacher has told me that I concentrate well in classes*), and physiological and emotional arousal (5 items; e.g., *Answering the teacher's questions makes me nervous*). The questionnaire used a five-point Likert-type scale (1 = never true–5 = always true). Mean sum scores based on these four subscales were created after examining the factor structure and confirming longitudinal measurement invariance of the scale (see supplementary Tables S1, S2). Two items were removed from the analysis (see Table S1). Reliability with Cronbach's alpha ranged from 0.66 to 0.88 for all constructs at each time points (see Table 1).

2.3. Self-regulatory Efficacy questionnaire

The Self-regulatory Efficacy questionnaire (see also Paananen et al.,

Table 1
Correlation coefficients, means, and internal consistencies of the studied variables.

	ME1	VE1	SP1	PEA1	ME2	VE2	SP2	PEA2	SRE2
ME1									
VE1	0.40***								
SP1	0.58***	0.31***							
PEA1	−0.15**	0.03	−0.07						
ME2	0.51***	0.16**	0.35***	−0.27***					
VE2	0.25***	0.33***	0.25***	−0.07	0.47***				
SP2	0.40***	0.19**	0.53***	−0.21**	0.53***	0.36***			
PEA2	−0.16**	−0.02	−0.14*	0.66***	−0.26***	−0.18**	−0.22***		
SRE2	−0.35***	0.17**	0.28***	−0.18**	0.53***	0.26***	0.40***	−0.24***	
M (SD)	4.14 (0.66)	4.10 (0.76)	3.75 (0.94)	2.53 (1.15)	4.02 (0.74)	4.08 (0.74)	3.78 (0.91)	2.70 (1.19)	3.86 (0.86)
α	0.87	0.69	0.84	0.85	0.88	0.66	0.84	0.87	0.95

Note. ME, mastery experience; VE, vicarious experience; SP, social persuasion; PEA, physiological and emotional arousal; SRE, self-regulatory efficacy. Number refers to the timepoint.

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

2019; Paananen et al., 2023) consisted of 11 items (e.g., "*How confident are you that you can…*", "*…ask for help when you need it for difficult tasks at school?*") to study students' confidence to control their attention and emotions. This included important areas of self-regulation, such as control of behaviors, emotions, and cognition in learning and on-task occasions. Students self-assessed using a five-point Likert-type scale (1 = I can't–5 = I'm totally confident I can). Reliability with Cronbach's alpha was 0.95 at both time points.

2.4. Gender and support for learning

Students' *gender* was dichotomized into 1 = girls and 2 = boys for the analyses (the options *other and do not want to display* were excluded due to a very small number of respondents). Information about *support for learning* was received from the schools' register. The information was three-tiered: general support, intensified support, and special support. The support data was dichotomized into 1 = general support (n = 276) and 2 = intensifying support, including both intensified and special support (n = 68). The latter group was combined due to the nature of support in the educational system (FNBE, 2016) and reported dichotomized format in the Official Statistics (OSF, 2020).

2.5. Data analyses

2.5.1. Profiles of self-regulatory efficacy sources and their stability

First, latent profile analyses were conducted with self-regulatory efficacy sources mean scores. To properly find the best fitting class solutions, we included the following statistical criteria: Akaike information criterion (AIC), Bayesian information criterion (BIC), Adjusted Bayesian information criterion (aBIC), Vuong-Lo-Mendell-Rubin (VLMR*p*) adjusted likelihood ratio test, Lo-Mendell-Rubin (LMR*p*) adjusted *p*-value, and Entropy (to provide information about classification accuracy >0.70; Nylund-Gibson & Choi, 2018). Generally, a lower BIC value is suggested to provide a better fit to the data (Nylund et al., 2007). When comparing different models, consideration was given to the meaningfulness and interpretability of the latent profiles of the solutions and their consistency with theory and previous research. Second, latent transition analysis (LTA) was conducted to study the stability and change in the memberships in profiles, from time 1 (September) to time 2 (February). We followed the LTA procedure as described by Nylund-Gibson et al. (2023) by building (a) a measurement model (cross-sectional LPAs) and, (b) an extended structural model (i.e., the LTA) that relates the latent class variables to each other over time using a multi-nomial logistic regression.

2.5.2. Profiles of self-regulatory efficacy sources: gender and support for learning

Third, to investigate the predictive role of gender and special educational needs on profile membership and transitions, we added these covariates in the mixture model by following the BCH-LTA approach (Asparouhov & Muthén, 2021; see also Widlund et al., 2024). The BCH-LTA method operates with weights that replicate measurement error of the latent class variable. The analyses were performed in two steps. First, a latent class model was estimated including time 1 and time 2 variables, and BCH weights were saved. Second, a general auxiliary model was specified and estimated with BCH weights as training data (Asparouhov & Muthén, 2021).

2.5.3. The relation between profile membership and stability with self-regulatory efficacy

Similarly, the BCH-LTA approach for a distal outcome was used to investigate whether profile membership or transitions were associated with students' self-regulatory efficacy (Asparouhov & Muthén, 2021). In this model, the mean of self-regulatory efficacy is estimated in every pattern of latent class values, proceeded with a series of model constraints to compute pairwise differences in means of each outcome across transition patterns with Wald's test (McLarnon et al., 2019). All analyses were conducted with Mplus Version 8.7 (Muthén & Muthén, 1998–2021).

3. Results

Descriptive analyses, correlations and internal consistencies between studied variables are reported in Table 1.

3.1. Profiles of self-efficacy in self-regulation sources

At both time points (Table 2), the BIC value started to increase at five profiles, clearly indicating that the four-profile solution fitted the data best. At T2, both the VLMR and LMR also supported the four-profile solution, and while it never turned statistically significant at T1, it came close to significance also at the four-profile solution. As Entropy values at both time points also pointed to clear profile classifications, we opted to continue with the four-profile solution at both time points. A further inspection of the four profiles revealed that the profiles were clearly differentiated and theoretically justifiable.

The profiles at both time points were highly similar and were named *Highly positive* (high mastery and vicarious experiences and social persuasion with low stress, T1: 29.57 %/T2: 28.77 %), *Average* (relatively average mastery and vicarious experiences and social persuasion with relatively low stress, T1: 37.24 %/T2: 32.81 %), *Stressed* (high stress, low mastery and vicarious experiences and social persuasion, T1:

Table 2
Information criteria and fit indices of different profile solutions.

Time point	k	AIC	BIC	aBIC	pVLMR	pLMR	Entropy
1	1		3300.906	3275.531			
	2	3121.574	3170.643	3129.409	0.0754	0.0807	0.773
	3	3063.825	3131.766	3074.673	0.0554	0.0592	0.750
	4	3031.660	3118.474	3045.521	0.0865	0.0930	0.787
	5	3014.589	3120.277	3031.465	0.7483	0.7533	0.816
	6	3002.105	3126.665	3021.993	0.7361	0.7373	0.834
	7	2988.711	3132.144	3011.613	0.5891	0.5927	0.779
	1		2981.298	2955.930			
	2	2789.041	2836.523	2795.299	0.0001	0.0001	0.725
	3	2744.898	2810.643	2753.564	0.3564	0.3675	0.792
2	4	2724.447	2808.455	2735.520	0.0425	0.0458	0.841
	5	2715.086	2817.356	2728.566	0.6963	0.7047	0.773
	6	2703.617	2824.149	2719.504	0.0916	0.0945	0.806
	7	2695.470	2834.265	2713.765	0.6550	0.6641	0.789

Note. k profile (*n*); *AIC*, Akaike Information Criterion; *BIC*, Bayesian Information Criterion; *aBIC*, adjusted Bayesian Information Criterion; *p*VLMR, Vuong-Lo-Mendell-Rubin likelihood ratio test; *p*LMR, Lo-Mendell-Rubin.

10.02 %/T2: 17.66 %), and *Highly positive but stressed* (high mastery and vicarious experiences and social persuasion with high stress, T1: 23.17 %/T2:20.76 %).

### 3.2. Stability and change in students' self-regulatory efficacy sources

Next, LTA was conducted based on the four-profile solutions identified in the initial LPAs to study stability and change from T1 (September) to T2 (February). Transition probabilities and time-invariant means of self-regulatory efficacy sources are reported in Fig. 1 and Table 3 (see also supplementary Table S3). The results indicated that primary school students' profiles of self-regulatory efficacy sources were relatively stable over time, as the highest transition probabilities were found among students who stayed in the same profile (0.71–0.91). In total, 87 % of all students showed a stable transition pattern. The highest stability was found among students in the *Highly positive but stressed* profile (stability: 91 %).

The results also showed some transitions between profiles with relatively high transition probabilities ($p \geq 0.10$). 27 % ($n = 16$) of those who initially were in the *Highly positive but stressed* profile transitioned to

Table 3
Transition probabilities for the latent transition analysis.

Time 1	Time 2			
	Highly positive	Stressed	Average	Highly positive but stressed
Highly positive	0.911	0.000	0.000	0.089
Stressed	0.072	0.729	0.033	0.166
Average	0.019	0.110	0.872	0.000
Highly positive but stressed	0.019	0.271	0.000	0.710

the *Stressed* profile, indicating that these students experienced some decrease in their mastery and vicarious experiences and social persuasion, while their stress remained high. Also, 11 % ($n = 13$) who initially were in the *Average* profile also transitioned to the *Stressed* profile, suggesting that there were some maladaptive changes in their self-regulatory efficacy sources. However, a few students experienced some positive transitions as well, as 17 % of those who initially were in the *Stressed* profile transitioned to the *Highly positive but stressed* profile,
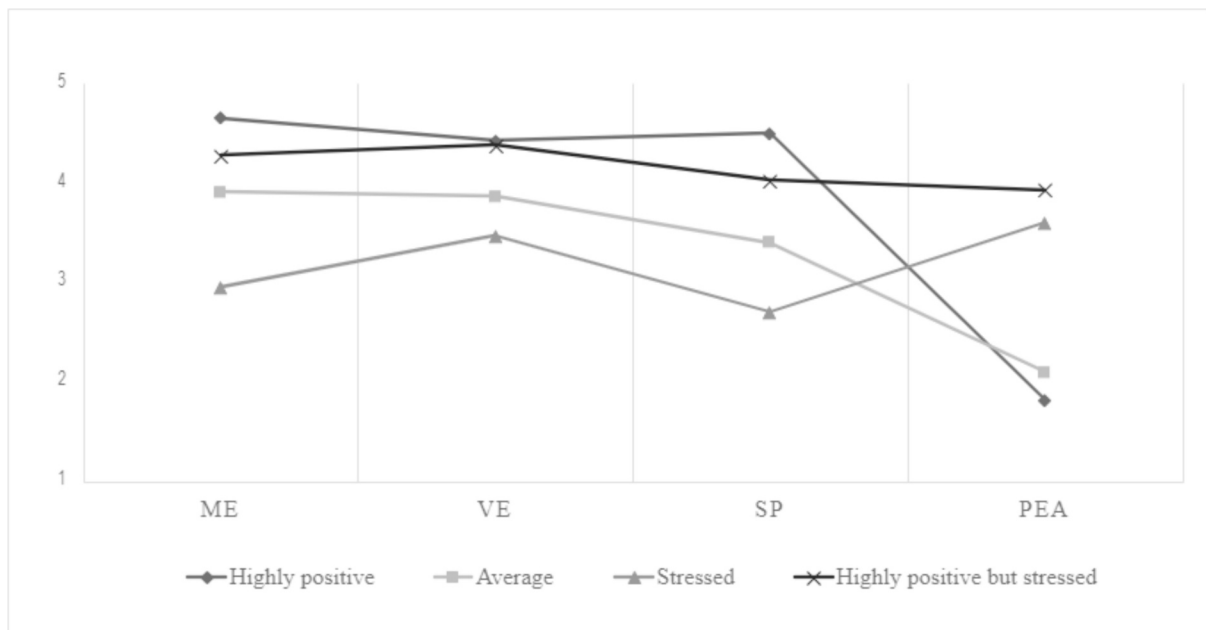
Fig. 1. Time-invariant profiles of self-regulatory efficacy sources.
Note. *ME*, mastery experiences; *VE*, vicarious experiences; *SP*, social persuasion; *PEA*, physiological and emotional arousal.

meaning that their mastery and vicarious experiences and social persuasion increased, but so did their levels of stress. It should be noted that this transition concerned only three students (Fig. 2).

3.3. Associations with gender and support for learning

Initial cross tabulation analyses revealed that there were no significant differences in gender or support for learning in the *Highly positive* profile, and therefore this was used as a reference group in the BCH-LTA analyses. Associations between profile membership and gender indicated that boys, compared to girls, in both time points were significantly more likely to be in the *Average* profile ($OR = 0.89$, $p < 0.01$) than in the *Highly positive* profile. Girls at time 2 were significantly more likely to be in the *Highly positive but stressed* profile ($OR = -1.43$, $p < 0.01$) than in the *Highly positive* profile compared to boys. Support for learning was not associated with profiles in either time points.

The results regarding covariate effects on transitions with probabilities ≥ 0.10 indicated that boys were more likely than girls to transition from the *Highly positive but stressed* profile to the *Stressed* profile ($OR = 4.6$, $p < 0.01$). Also, boys were less likely ($OR = 0.2$, $p < 0.01$) than girls to transition from the *Stressed* profile to the *Highly positive but stressed* profile. Further, gender was not found to predict transition from the *Average* profile to the *Stressed* profile. Support for learning did not predict any transition.

3.4. Self-regulatory efficacy as an outcome of profile memberships

Mean differences in self-regulatory efficacy across transition patterns, including stable transitions, are presented in Table 4.

When comparing all stable transition patterns, we found that students who remained in the *Highly positive* profile across both time points showed significantly the highest mean score ($M = 4.10$) in self-regulatory efficacy beliefs. This profile was followed by students who remained in the *Highly positive but stressed* and the *Average* profiles, who

did not differ from each other in self-regulatory efficacy beliefs. Lastly, students who remained in the *Stressed* profile over time had significantly the lowest mean scores in self-regulatory efficacy. Regarding the other transitions, we found that more maladaptive transitions between profiles was associated with lower self-regulatory efficacy beliefs: students who transitioned from the *Highly positive but stressed* profile to the *Stressed* profile, and from the *Average* profile to the *Stressed* profile, both had significantly lower self-regulatory self-efficacy beliefs compared to students who remained in the initial profile. Although we also identified a significant transition from the *Stressed* profile to the *Highly positive but stressed* profile, there were only three students with this transition pattern. Consequently, there was little to no variance in the outcome, and the transition pattern was therefore excluded from this analysis.

4. Discussion

This person-oriented study examined what kinds of individual patterns of self-regulatory efficacy sources could be identified among primary school students, how stable such profiles were within a school year, and how profile membership and transitions were related to gender, support for learning, and self-regulatory efficacy. Four different profiles were identified: *Highly positive*, *Average*, *Stressed*, and *Highly positive but stressed*. The majority of students belonged to profiles that reflected relatively positive or even highly positive combinations of self-regulatory efficacy sources. Some students showed more maladaptive patterns, characterized by elevated levels of physiological and emotional arousal (i.e., stress). Some gender differences were found in profile memberships and transitions, whereas needs for learning support did not play a role. Stabilities and transitions predicted students' self-regulatory efficacy so that transitioning to a more maladaptive profile was related to lower self-regulatory efficacy. Overall, the results of the study highlights the importance of understanding that individuals—in this case, primary school-aged students—show individual variation in their self-regulatory efficacy-building experiences in classroom.
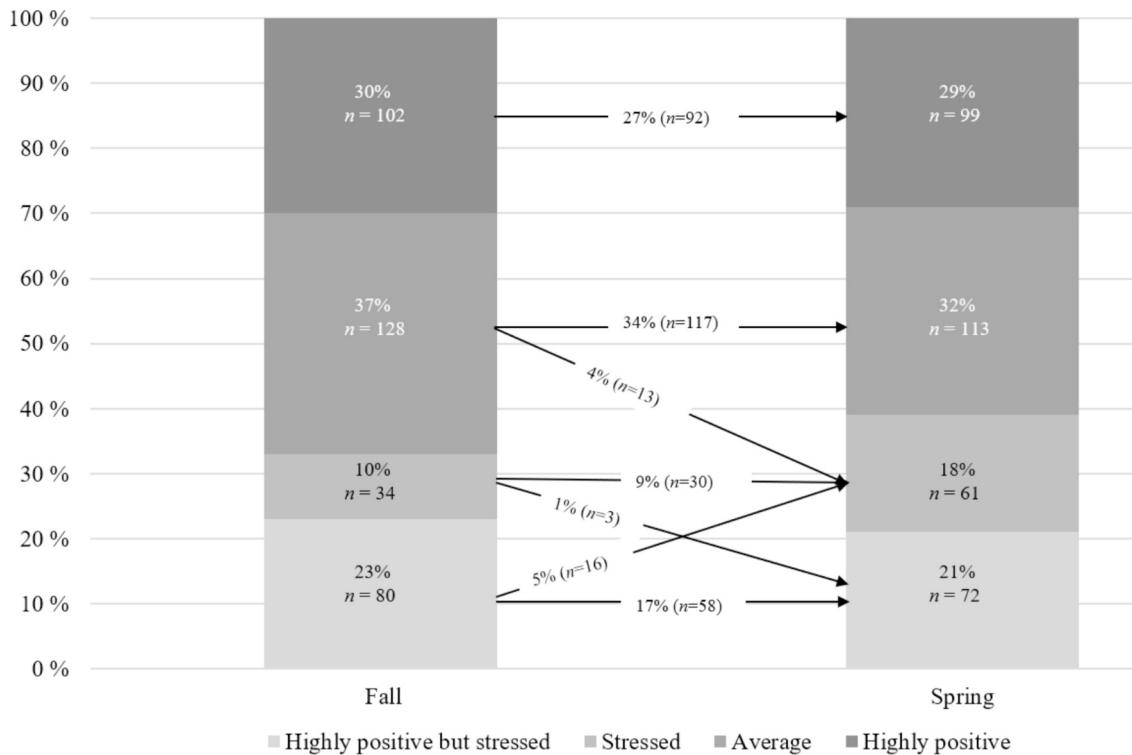

Fig. 2. Proportions of students in latent profiles and for each transition.
Note. Only transitions with probabilities ≥ 0.10 are presented. Percentages represent the proportion of students with respect to the total sample ($N = 345$). The odds ratios (OR) for all profile transitions were statistically significant (see supplementary Table S4).

Table 4

Mean differences in self-regulatory efficacy outcome across transitions.

	$M_{\text{self-regulatory efficacy (SD)}}$	1	2	3	4	5	6
1 Stable highly positive but stressed	4.10 (0.10)	–					
2 Highly positive but stressed → Stressed	2.74 (0.22)	1.32***	–				
3 Stable stressed	3.10 (0.16)	1.01***	−0.31	–			
4 Average → Stressed	2.99 (0.22)	1.07	−0.25	0.06	–		
5 Stable average	3.95 (0.05)	0.11	−1.21***	−0.90***	−0.97***	–	
6 Stable highly positive	4.62 (0.07)	−0.57***	−1.88***	−1.57***	−1.63***	−0.67***	–

Note. Values reported in columns 1–6 represent the mean differences between each transition pattern.

 *** $p < 0.000$.

4.1. Profiles of self-regulatory efficacy sources

First, we identified four distinct profiles among primary school students, indicating significant individual variation between students' self-regulatory efficacy sources (Chen & Usher, 2013; Paananen et al., 2023). The profiles were largely in line with our expectations based on previous empirical research (Chen & Usher, 2013; Paananen et al., 2023), as we found a profile characterized by high positive sources combined with low stress (i.e., *Highly positive*), a group with relatively average levels on all sources (i.e., *Average*), and students characterized by low mastery and vicarious experiences and social persuasion combined with high stress (i.e., *Stressed*). In addition, we found a fourth group that demonstrated similarly high levels in the positive self-regulatory sources as students in the *Highly positive* group, but who also reported high levels of stress (i.e., *Highly positive but stressed*).

The *Highly positive* profile resembles a profile previously identified by both Chen and Usher (2013) and Paananen et al. (2023), demonstrating a positive balance of desirable self-regulatory sources. These students seem to have had successful experiences in regulating their behavior and similar observations of their peers. Moreover, their experience of feedback aligned with their own expectations and non-stressful classroom situations, suggesting that multiple positive experiences may reinforce each other.

The *Average* profile showed significantly lower, yet rather average, levels of mastery and vicarious experiences and social persuasion, and relatively low levels of stress. Some previous studies have argued that students who display average levels on multiple sources may experience an uncertainty of their sources (Chen & Usher, 2013). However, while the average profile in this study had similar mean levels of several sources, the mean levels were all rather positive. In fact, the majority of our sample belonged to either the highly positive or average profiles, indicating that a big proportion of students have been supported in the classroom and in on-task activities and have gained positive experiences, which can be seen as a positive finding. These findings also align with the core curriculum of Finnish Basic Education (FNBE, 2016), emphasizing equal opportunities and positive learning experiences including self-regulation.

The *Stressed* profile demonstrated the lowest levels of mastery and vicarious experiences and social persuasion, combined with high stress. This maladaptive combination of sources draws a picture of students who face challenges in situations where self-regulation skills are needed and who are aware of these challenges and may therefore feel stressed. The finding aligns with Paananen et al. (2023), who found that stressful patterns in relation to self-regulatory efficacy sources can be found among relatively young students. To avoid negative consequences in further self-regulatory development, it is particularly important to create opportunities for successful self-regulation experiences and to consider how to support students in dealing with negative feelings in the classroom. It would also be important to consider how this self-regulatory development is related to academic skill development, as Paananen et al. (2023) suggested that students with such negative patterns may have lower basic academic (e.g., reading and arithmetic) skills.

Fourth, the mixed *Highly positive but stressed* profile was identified.

Students in this profile had highly positive mastery and vicarious experiences and social persuasion simultaneously reporting the highest levels of stress. This combination was interesting given the previous findings of profiles with an emphasis on social persuasion and vicarious experiences (Paananen et al., 2023) or high mastery experience combined with average levels on other sources (Chen & Usher, 2013), while we found high values in all sources. These students reported succeeding in regulating their behaviors and emotions, and having gained encouraging feedback in this regard, but they are also highly stressed about succeeding in these skills. Somewhat similar patterns have been detected in behavior and emotions of school-age students (e.g., high engagement yet high exhaustion, or high interest and self-concept combined with high emotional cost; Tuominen et al., 2020; Widlund et al., 2018, 2024). These findings suggest that positive experiences in the classroom may not be enough to protect against stressful experiences. Considering that students who report high levels of mastery and vicarious experiences and high social persuasion are also, most likely, highly motivated and successful in school, there is a risk that their potential emotional struggles go unnoticed in the school environment, making these students particularly vulnerable.

4.2. Stability and change in students' self-regulatory efficacy sources

In line with our hypotheses, we found that profiles were highly stable across time, but some transition between profiles also emerged. Most students (86.7 %) remained in their initial profile during the school year, indicating a stability in students' perceptions of their self-regulatory efficacy sources. Roughly 13 % of students transitioned to another profile, which is understandable based on the theoretical assumption that different aspects of self-efficacy develop rapidly, especially among younger students who are still building understanding of themselves as learners while facing daily new learning tasks and challenges as well as positive and negative experiences in school context (Bandura, 1997; Schunk & DiBenedetto, 2020; Wigfield et al., 2015). To the best of our knowledge, prior studies have not explored the stability and changes in self-regulatory efficacy source profiles. However, some variable-oriented evidence supports our findings, suggesting that changes in self-efficacy sources in other domains can be expected within one year (e.g., Peura et al., 2021). Most transitions were negative ones: students transitioned from the *Highly positive but stressed* or the *Average* profile to the *Stressed* profile. It is possible that during the school year students become more aware of their successes and failures, which then causes some students to experience more stress. These findings may also indicate that students have faced difficulties in their self-regulation without possibilities to overcome them, thus decreasing their overall experiences in these efficacy-building sources (cf. Bandura, 1997). For example, during the school year, tasks become more challenging and the pace of studying increases, while expectations and pressures related to the future begin to weigh on students even more (Usher & Pajares, 2008). This, consequently, may escalate the demands placed on self-regulation and regulation strategies. Additionally, environmental cues and feedback may be provided that may also have a negative influence on self-regulatory efficacy (Bandura, 1997; Schunk & DiBenedetto, 2020).

Some of the transitions showed a combination of positive and

negative changes. There were students who transitioned from the *Stressed* profile to the *Highly positive but stressed* profile, indicating adaptive changes in mastery and vicarious experiences, and in social persuasion, while stress remained high. One explanation for this could be a heightened understanding of the importance of self-regulation in learning (cf. Wigfield et al., 2015), meaning that these students have understood the importance of self-regulation in learning, and have engaged in activities leading to successful self-regulation experiences and received positive feedback. Consequently, an increase in positive experiences occurs, but knowledge about the importance of successes can also raise one's own expectations of future successes and, increase stress. The findings provide an important perspective on the heterogeneity in students short-term change and stability of their self-regulatory efficacy sources, as the majority of previous studies related to motivational beliefs have considered longer time periods (Caprara et al., 2008; Hornstra et al., 2013). However, theoretical notions (e.g., Situated EVT; Eccles & Wigfield, 2020, social cognitive theory; Bandura, 1997) suggest that studying motivational beliefs across shorter time frames may better capture the rapid changes and developmental dynamics of different school and learning related aspects that may otherwise go unnoticed. Our findings support these claims, as we were able to detect changes in students' self-regulatory sources even within a school year.

4.3. Associations with gender and support for learning

Gender predicted profile membership so that boys, compared to girls, had a higher likelihood of belonging to a relatively adaptive profile (*Average*), while girls, compared to boys, had an increased likelihood of belonging to an asynchronous profile (*Highly positive but stressed*). While no existing study has investigated gender differences in profiles of self-regulatory sources, the results echo previous person-centered research studying other motivational and emotional factors; for example, Widlund et al. (2024) also found girls to be significantly overrepresented in profiles characterized by high self-concept and engagement, along with high levels of exhaustion and feelings of inadequacy. This suggests that girls, despite having otherwise positive self-regulatory sources or motivational beliefs, may be more vulnerable to stress, even among primary school students. Boys were also more likely to be associated with negative transitions from *Highly positive but stressed* to *Stressed* and girls, vice versa, with more positive transitions occurring from *Stressed* to *Highly positive but stressed*. Overall, these findings add to prior cross-sectional findings (Joët et al., 2011; Usher & Pajares, 2009), indicating that girls and boys might differ in their experiences related to self-regulation, which can hinder or promote their efficacy-building sources. Moreover, highlighting existing gender differences in general may help us to be more aware of our own behaviors and stereotypical biases that may contribute to further, unnecessary differences in boys' and girls' motivational beliefs.

Interestingly, our findings indicating that support for learning (general and intensifying) was not related to the profiles of self-regulatory efficacy sources nor to changes in these profiles contradict with prior studies (Hampton & Mason, 2003; Paananen et al., 2019; Usher & Pajares, 2006). It is possible that the Finnish school system's goals of supporting self-regulation skills in classrooms have succeeded in supporting all despite their general or intensifying need for support for learning (cf. FNBE, 2016; Sointu et al., 2024). This result is promising, as it has been suggested that students receiving intensifying support for learning may be underdogs when it comes to the positive development of self-efficacy experiences (cf. Bandura, 1997; Kendall, 2012).

4.4. Profiles of self-regulatory efficacy sources memberships associations with self-regulatory efficacy outcome

As was expected based on previous variable-oriented (e.g. Byar-Winston et al., 2017; Sheu et al., 2018), person-oriented (Chen & Usher, 2013; Paananen et al., 2023), and mix of both (Peura et al., 2021)

studies, we found that stability and transitions of primary school students' self-regulatory efficacy profiles predicted their self-regulatory efficacy outcomes. The stable patterns (i.e., stable transitions) differed significantly from each other in their associations with self-regulatory efficacy beliefs; profiles characterized by adaptive patterns (*Highly positive*) were associated with significantly higher self-regulatory efficacy compared to more maladaptive (*Stressed*) and mixed (*Highly positive but stressed*) profiles. Interestingly, students in the *Highly Positive but Stressed* profile did not differ from the *Average* profile in their self-regulatory efficacy even though they reported significantly higher mastery and vicarious experiences and social persuasion. This aligns with Paananen et al.'s (2023) suggestion that students reporting more negative emotions have lower levels of self-efficacy beliefs, even though other sources are very high. It might be that high levels of stress lower students' self-regulatory efficacy, even though the mastery and vicarious experiences and social persuasions are high.

The results further revealed that transitioning to a more maladaptive profile (from *Highly positive but stressed* to *Stressed* and from *Average* to *Stressed)* was associated with lower levels of self-regulatory efficacy compared to those who remained in their initial profile. To conclude, these findings suggest that even short-term negative changes in one's self-regulatory efficacy sources may predict one's overall levels of self-regulatory efficacy, highlighting the importance of providing opportunities to develop positive sources in schools.

4.5. Limitations and future research

There are limitations to this study. First, the study sample included students from three different class levels—4 to 6 (9–12 years-old). Nevertheless, including different grade-levels is justified in the light of theory (Bandura, 1997), as it does not specify exact age phases where the development is supposed to occur. Also, Finnish primary school students in grades 4 to 6 share a common educational environment, structure, and curriculum focus on self-regulatory skills (FNBE, 2016), reducing the environmental impact of changes (cf. Eccles et al., 1993). Thus, we believe that future research would benefit from investigating individual differences without directly linking them to grade levels as the phenomenon may not be strictly related to age.

Second, the data of this study was based on students' own perceptions of their self-regulatory efficacy and its sources and the use of only self-reports can be considered as a limitation of this study. However, there is a fairly consistent understanding that is also rooted in the social cognitive theory that the experiences that shape individuals' beliefs can best, or even only be accessed through individuals' own interpretations of them, i.e. through self-assessment. It is precisely the identification of students' own experiences that is the significant and central contribution of this study, since it is not possible to reliably examine students' emotions and thoughts by using objective measures. Nevertheless, it is possible that some objective measures about students' learning and behavior could have provided additional insight into these individual differences, and future longitudinal research could benefit including such data.

Third, the data were convenience sample. However, the data collection for the study has been carried out in a geographical and socio-economic area that can be seen as relatively representative of the Finnish context and population. Therefore the sample can be considered generalizable, as Finnish schools follow a nearby school system where students attend schools in their local area (Jahnukainen & Itkonen, 2016), all schools implement a national core curriculum (FNBE, 2016), statistics indicate one of the smallest differences between schools in the world (e.g., OECD, 2016), and data represented support for learning adequately (cf. OSF, 2020). It is also important to note that we were able to identify profiles that share several similarities with other profile findings (Chen & Usher, 2013; Paananen et al., 2023). However, in the future it would be important to examine the self-regulatory self-efficacy sources in different samples from various contexts.

Fourth, we used a relatively short five-month timeframe. Bandura (1997) noted that most repeated and recent experiences (within weeks and months) carry the greatest role in the development of efficacy. As students practice and assess their self-regulatory experiences on a daily basis, a five-month period may well capture the rapid changes in self-regulatory efficacy sources. Our findings, with transition probabilities over 0.10, indicating that over 10 % of the sample transitioned from one pattern to another represent these kind of rapid changes, thus providing support for the theoretical assumptions of short-term changes. Future investigations would benefit the use of more frequently collected data over longer time periods, such as an entire school year or even over several years.

5. Conclusions

This study provides a novel understanding of the heterogeneity of self-regulatory efficacy sources. Although most of the students showed relatively positive patterns of self-regulatory efficacy sources and stability in these across the school year, still 13 % of students had maladaptive transitions and reported lower self-regulatory efficacy compared to those who stayed in their initial profile. Bandura (1997) argued that individuals are prone to over rely on one specific source and ignore the others, which raises concerns that even in young students, stress can play a significant role. Stress was more likely to increase than decrease over the course of the school year, highlighting the fact that successful experiences of one's own and peers' performances and positive feedback may not be enough to build a higher self-efficacy, nor to reduce stress. Students who are more stressed are also more likely to lack self-efficacy and thus more prone to interpret stress as incompetence, while students with stronger self-efficacy are found to be more adaptable and capable of handling stress (Bandura, 1997; Usher & Pajares, 2008). Primary school-aged students are in a sensitive phase in which they are seeking and developing a sense of agency that can have a lifelong influence (Bandura, 1986, 1997; Schunk & Usher, 2019). Taken together, it appears crucial for school professionals to be sensitive to the kinds of emotions students display in relation to self-regulating in tasks and in the classroom.

CRediT authorship contribution statement

Minna Ikävalko: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Anna Widlund:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization. **Jaana Viljaranta:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Rebecca Lazarides:** Writing – review & editing, Methodology. **Matthew C. Lambert:** Writing – review & editing, Supervision. **Erkko T. Sointu:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Investigation, Funding acquisition, Data curation.

Declaration of competing interest

None.

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