Self-regulatory efficacy and sources of efficacy in elementary school pupils: Self-regulatory experiences in a population sample and pupils with attention and executive function difficulties

Mika Paananen MA [2, 3], Tuija Aro PhD [2,3], Helena Viholainen PhD [1], Tuire Koponen PhD [1], Asko Tolvanen PhD [2], Jari Westerholm MA[3], and Mikko Aro PhD [1]

[1] *Department of Education, University of Jyväskylä, Finland*

[2] *Department of Psychology, University of Jyväskylä, Finland*

[3] *Niilo Mäki Institute, Jyväskylä, Finland*

Mika Paananen, Department of Psychology, P.O. BOX 35, 40014 University of Jyväskylä, Finland. Email: mika.j.paananen@jyu.fi, ORCiD: 0000-0002-2576-1530

Tuija Aro, Department of Psychology, P.O. BOX 35, 40014 University of Jyväskylä, Finland. Email: tuija.i.aro@jyu.fi, ORCiD: 0000-0003-0004-3062

Helena Viholainen, Department of Education, P.O. BOX 35, 40014 University of Jyväskylä, Finland, Email: helena.j.k.viholainen@jyu.fi, ORCiD: 0000-0002-8164-9180

Tuire Koponen, Department of Education, P.O. BOX 35, 40014 University of Jyväskylä, Finland, Email: tuire.k.koponen@jyu.fi, ORCiD: 0000-0003-0039-1016

Asko Tolvanen, Department of Psychology, P.O. BOX 35, 40014 University of Jyväskylä, Finland. Email: asko.j.tolvanen@jyu.fi, ORCiD: 0000-0001-6430-8897

Jari Westerholm, Niilo Mäki Institute, BOX 35, 40014 University of Jyväskylä, Finland. Email: jari.westerholm@nmi.fi, ORCiD: 0000-0001-9915-2351

Mikko Aro, Department of Education, P.O. BOX 35, 40014 University of Jyväskylä, Finland, Email: mikko.t.aro@jyu.fi, ORCiD: 0000-0002-0545-0591

Correspondence concerning this article should be addressed to Mika Paananen, Department of Psychology, P.O. BOX 35, 40014 University of Jyväskylä, Finland. E-mail: mika.j.paananen@jyu.fi. Tel. +358 50 3685208. Fax +358 14 260 1021

Abstract

In this study, we examined self-regulatory efficacy and sources of self-efficacy (mastery experiences, vicarious experiences, social persuasion and physiological/emotional states) and the relationships between self-efficacy and its sources among elementary school pupils. Two groups were compared: a population sample (PS, N = 1284) and pupils with difficulties in attention and executive functions (AED, N = 61). Data gathered from self-report questionnaires indicated that pupils in the PS group had more positive efficacy beliefs and mastery experiences and fewer negative physiological/emotional states than the AED group. Analyses showed strong connections between sources and self-regulatory efficacy. In the PS group, the sources had small unique influences on self-regulatory efficacy, indicating that most of the variance was shared between the sources. In the AED group, sources had less shared variance compared to the PS group. Mastery experiences alone had a strong effect on self-regulatory efficacy, while vicarious experiences had a negative effect on self-efficacy.

Keywords: Self-regulatory efficacy; Sources of self-efficacy; Attention deficits; Executive function deficits.

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1. Introduction

Learning and academic achievement in the school environment not only require cognitive and basic academic skills, i.e. reading and mathematics, but also the capability to regulate and organise actions, namely the ability to master one's own learning processes, such as control of attention, cognition (or executive control), affect (Blair & Diamond, 2008; Diamond, 2013; Nigg, 2017) and behaviour in a learning context (Schunk & Zimmerman, 2007; Zimmerman, 2008). In addition to actual self-regulatory skills, a sense of confidence and agency in organising and managing academic activities, i.e. self-regulatory efficacy (Bandura, 1997), has a significant influence on educational development and learning outcomes (Caprara et al., 2008). It is assumed that these learning-related self-beliefs evolve rapidly during a child's first few years at school (Bandura, 1997). In this study, we aimed to investigate self-regulatory efficacy and self-regulation–related experiences among children with difficulties in attention and executive functions (EF) and their peers.

1.1. Self-regulatory efficacy and its sources

A salient theoretical framework for the study of self-beliefs is social cognitive theory, particularly the construct of *self-efficacy* (Bandura, 1997). In the school context, *self-regulatory efficacy* (also *self-efficacy for self-regulated learning*), defined as the confidence to achieve control over one's own attention and actions in different task situations and to use adaptive strategies, is associated with motivation, persistence and effort in a variety of academic learning situations (Klassen, 2010). Thus, self-regulatory efficacy is also one of the key elements for predicting academic achievement (Caprara et al., 2008).

According to social cognitive theory (Bandura, 1997), self-efficacy is developed and modified through four sources: (1) interpretations of past performance accomplishments (*mastery experiences*); (2) information obtained from reference groups' actions and modelling (*vicarious experiences*); (3) verbal persuasion, support and evaluative feedback from significant others (*social persuasion*); and (4) emotional and physical arousal and interpretations of these in on-task situations (*physiological and emotional states*). Of these four sources, mastery experiences have been shown to have the strongest association with academic self-efficacy among elementary school pupils (Butz & Usher, 2015; Joët, Usher, & Bressoux, 2011; Usher & Pajares, 2008) and with self-regulatory efficacy among high school students (Hampton, 1998).

1.2. Self-regulatory efficacy, its sources and children with learning-related problems

Although it has been suggested that the four sources are also essential for the formation of one's self-regulatory efficacy (Joët et al., 2011), little is known about self-beliefs concerning self-regulatory confidence in elementary school pupils with learning-related problems, especially those with attention and EF difficulties. The lack of previous research is lamentable since self-regulatory difficulties are core problems for children with ADHD (Hinshaw & Arnold, 2015) as well as children with no formal ADHD diagnosis but who have deficits in attention and EF (Loe & Feldman, 2007). Many of the pupils' school activities are affected by these self-regulation problems, which manifest themselves not only in their behaviours but also in their mental processes in several ways, impairing learning and academic achievements (Barkley, 2006).

Although the existing literature on self-regulatory efficacy does not contain studies on children with attention deficits, some research has been conducted on general academic efficacy among students with ADHD. These studies have shown that students with ADHD have a tendency to rate their academic self-efficacy lower compared to non-ADHD and

typically achieving peers (Tabassam & Grainger, 2002). In addition, academic self-efficacy has a stronger connection with academic achievements among students with ADHD than non-ADHD students (Martin, Burns, & Collie, 2017).

Studies that have investigated self-regulatory efficacy among children with learning disabilities (LD) in comparison to their peers have yielded differences in efficacy and source-related experiences. In Klassen's (2010) study, high school students with reading and mathematics LD reported lower self-regulatory efficacy than non-LD students. Hampton and Mason (2003) found that high school students with diagnosed LD (reading and mathematics LD or comorbid LD and language deficits) not only reported lower self-regulatory efficacy but also fewer mastery experiences, vicarious experiences, weaker social persuasion and more physiological arousal (a more negative physiological/emotional state) than non-LD students. There are also contradictory findings, showing that both students with LD and ADHD may overestimate their ability to carry out future tasks as well as their past performances and skills (Klassen, 2007; Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007). However, it seems that only a subset of students with ADHD have this tendency to overestimate (Bourchtein, Langberg,, Owens, Evans, & Perera, 2017).

Previous studies have also shown that the relationships between sources and self-regulatory efficacy may differ as a function of LD or the level of academic skills. In Hampton and Mason's (2003) study, LD status had an indirect effect on self-regulatory efficacy through sources. Because Hampton and Mason used aggregated scores of the sources of self-efficacy, the effects of individual sources could not be determined. However, in an earlier study with a sample of LD students, Hampton (1998) found that only mastery and vicarious experiences were correlated with self-regulatory efficacy among students with LD. In this study, however, the use of hierarchical regression analysis might explain the observed low effects of the two remaining source variables (social persuasion and physiological/emotional

states) on efficacy. More research is needed to reveal the unique effect of different sources on efficacy in subgroups with scholastic difficulties. More recently, Usher and Pajares (2006) examined self-regulatory efficacy and sources of academic self-efficacy in groups of children with different levels of reading ability, and they found differences among the groups in the relationships between sources and efficacy. Mastery experiences were the most influential source of self-regulatory efficacy for groups of pupils whose reading ability was at or above the expected level for their grade, whereas in pupils whose reading ability was below the expected level for their grade, physiological and emotional states alone significantly (negatively) influenced self-regulatory efficacy.

Since attention and EF deficits influence the development of self-regulation skills (Brocki, 2007) and, thus, also on-task performance in school settings (Abikoff et al., 2013; Miller & Hinshaw, 2012), pupils with attention difficulties may have fewer positive experiences to support self-regulatory efficacy. This could mean that, similar to pupils with LDs, pupils with attention and EF difficulties are trapped in an unfavourable cycle; they have fewer learning- or self-regulation–related positive experiences, which consequently leads to lower self-regulatory efficacy and, thus, further affects academic achievements negatively (Usher & Pajares, 2008).

1.3. Rationale for the present study

In diagnostic processes or the customary special education procedures with elementary school children, parents and teachers usually provide information about the child's self-regulation–related behaviour, i.e. problems with attention and on-task behaviour, and less attention is paid to the child's experiences and his or her confidence to master learning situations (see Farrington et al., 2012). Knowledge of pupils' levels of confidence from different subgroups in self-regulation with regard to managing schoolwork and the type of self-regulation–related experiences they have had would provide more tools to support

pupils' motivation as well as their sense of efficacy and agency to organise and manage academic activities. An improved understanding would not only help educators respond to the needs of pupils with self-regulation–related problems, but it would also inform the development of interventions. Since no studies have addressed the self-regulatory efficacy of children with attention and EF difficulties, particular attention should be paid to this group of elementary school pupils in this respect. The theory of self-efficacy offers a valuable framework to scrutinise self-regulatory confidence and the experiences of pupils with attention deficits.

Despite the growing interest in the sources of self-efficacy among elementary school pupils, studies assessing the sources of self-regulatory efficacy with questions directly related to self-regulation are lacking. Previous studies have approached sources with questions related to general academic domains, e.g. 'I got good grades in school last term' (Usher & Pajares, 2006), or to specific academic subjects, e.g. 'I have always done well on mathematics assignments' (Joët et al., 2011), but not with questions that directly tap into self-regulation. Therefore, the present study used source-related questions covering core areas of self-regulation in the school setting and school-related activities: control of attention and interference (Diamond, 2013), executive control and emotion regulation (Nigg, 2017). The items used aimed to tap into the four source areas in the context of self-regulative behaviour in typical school-related tasks.

Our study aimed to extend the literature by assessing self-regulatory efficacy and its four sources, i.e. mastery experiences, vicarious experiences, social persuasion and physiological/emotional states, in two groups: pupils from a population-based sample and pupils with symptoms of attention and EF deficits observed in the classroom. First, we conducted a preliminary analysis to test the factor structure of the questionnaires of self-regulatory efficacy and theory-based sources of self-regulatory efficacy. To answer the main

questions of the study, we first explored self-regulatory efficacy and the sources of efficacy in both groups and examined whether self-regulatory efficacy and source-related experiences varied between the groups. Based on previous studies (Hampton, 2003; Klassen, 2010), we assumed that pupils with learning-related problems, in this case attention and EF problems, have lower self-regulatory efficacy and fewer sources of efficacy experiences than pupils in the population sample. Second, we analysed the associations between the four sources of efficacy and self-regulatory efficacy in both groups, and we assumed, based on previous findings (Hampton, 1998; Usher & Pajares, 2006), that mastery experiences have the greatest influence on self-regulatory efficacy. Third, we explored whether associations differed between the groups. Since only a small number of previous studies have studied self-appraisals, and to the best of our knowledge, no studies have approached self-regulatory efficacy and the sources of self-regulatory efficacy among pupils with attention and EF deficit symptoms, we did not set any specific hypotheses for the question concerning differences in source-efficacy connections in the two groups of interest.

2. Materials and methods

2.1. Participants and procedure

The participants were 1348 elementary school pupils (Grades 2 to 6, M = 3.56, ages 7–13 years with M = 9.94 years, SD = 1.08, 46.4% girls) who followed the standard curriculum. The study was part of the *Self-Efficacy and Learning Disability Intervention* (SELDI: 2013–2015) research project. Participation was voluntary for both the schools and the pupils, and written consent for the children to participate was obtained from their parents. In addition, the Ethical Committee of the University of Jyväskylä approved the study before the research began.

Two different samples from 34 different schools were used to examine self-regulatory efficacy and sources of self-regulatory efficacy and to answer the research questions. The first

of these was the *population sample* (PS group; n = 1284, elementary school Grades 2 to 5, M = 3.61 and SD = 0.98, ages 7–13 years with M = 9.96 years, SD = 1.06, 48.3% girls and 51.7% boys) collected in 20 different primary schools across urban, suburban and rural districts in Eastern and Central Finland.

The second sample consisted of the pupils identified with attention and EF deficit symptoms. These pupils were from 14 other schools across urban, suburban and rural areas in Southern, Central and Eastern Finland. All pupils in this group followed the standard curriculum and were in inclusive classrooms. The initial identification for this group was based on the teachers' evaluations of three inclusion criteria: (1) symptoms of attention and EF deficits in classroom settings, (2) symptoms that caused problems in daily school routines, and (3) attention and EF problems were reasons for attending special education support. After the initial identification made by the teacher, the problems of attention and EF in classroom setting were evaluated using the Attention and Executive Function Rating Inventory (ATTEX; Klenberg, Jämsä, Häyrinen, Lahti-Nuuttila, & Korkman, 2010; see below); the final inclusion criterion for the attention and EF deficit symptoms group was that the ATTEX score, as rated by a teacher, showed at least moderate attention and EF problems. A total score of 17 on the ATTEX was set as the cut-off point, which corresponds to the 75th percentile for elementary school pupils (see Klenberg et al., 2010). Originally, 64 children were identified, but three participants obtained fewer than 17 points in the ATTEX and were thus judged not to have attention and EF problems and were excluded from the group. Eventually, this group consisted of 61 elementary school pupils from Grades 2 to 6 (M = 3.49 and SD = 1.06), ages 8–12 years (M = 9.94 months and SD = 1.19), 12.7% girls and 87.3% boys. Their ATTEX scores ranged from 17 to 99 (maximum 110) with an average score of 55.75. We named this group *an attention and EF difficulties group* (AED group). In the AED

group, the grade range was larger since two participants were in the sixth grade. However, there was no difference in the mean ages of the groups.

The participants in both groups completed questionnaires related to self-regulatory efficacy and sources of self-regulatory efficacy and were also given tasks assessing their reading and arithmetic skills. The AED group completed the questionnaires in small groups, and the PS group completed them in classrooms. For both groups, a trained research assistant supervised the assessments, familiarising the pupils with the questionnaires and the scales, and reading aloud the questionnaire items. The AED group were given reading and mathematics tests individually, while the PS group completed these tests in group situations in their classrooms.

2.2. Measures

2.2.1. Self-regulatory efficacy and sources of self-regulatory efficacy

The self-regulatory efficacy questionnaire, based on Bandura's (2006) guidelines, consisted of eight items. The items were tailored to meet the object of interest of the present study and covered three areas of self-regulatory efficacy in academic tasks: control of cognition, affect and behaviour (for example, *How confident are you that you finish your homework even if it is difficult for you?*, *How confident are you that you get yourself to study when there are other interesting things to do?* and *How confident are you that you get yourself to do schoolwork during class even when the tasks make you nervous?*). The questions aimed to tap into functions relevant to control of attention and interference and executive control in the classroom setting and school-related activities. The participants gave their responses on a 7-point Likert-type scale with the opposing poles of *I'm totally confident I can't* (at 1) and *I'm totally confident I can* (at 7). Reliability calculated for factor scores was .93 for the self-regulatory efficacy factor.

The sources of the self-regulatory efficacy questionnaire were closely based on the ideas of Usher and Pajares (2008, 2009) and consisted of 14 items, all of which were related to self-regulation in the school setting or in school-related activities. Four items assessed mastery experiences, e.g. *I have always been able to focus on tasks during class*, two items assessed vicarious experiences regarding peers, e.g. *My friends focus on teaching during class*, four items assessed social persuasion, e.g. *My teacher said that I pay attention to teaching during class*, and three items assessed physiological and emotional states, e.g. *I feel nervous when I do my homework*. Each statement was rated using a Likert scale: 1 (*never true*), 2–3 (*almost never true*), 4 (*sometimes true*), 5–6 (*almost always true*) and 7 (*always true*). Reliability calculated for the factor scores was .94 for the mastery experiences factor, .84 for the vicarious experiences factor, .94 for the social persuasion factor and .83 for the physiological and emotional factor. The factor structures and loadings obtained from confirmatory factor analysis are presented in the Appendix.

2.2.2. Attention and EF symptoms

A norm-referenced rating scale filled in by the teacher, the ATTEX questionnaire (Klenberg et al., 2010), was used to assess problems of attention and EF in the school setting. The ATTEX has high internal consistency (total score $\alpha = 0.98$) and good criterion validity (Klenberg et al., 2010). Among 61 pupils in the AED group, the alpha for the ATTEX was 0.96. The ATTEX contains 55 items covering 10 areas of attention and EF as follows: distractibility (four items), impulsivity (nine items), motor hyperactivity (seven items), directing attention (five items), sustaining attention (six items), shifting attention (four items), initiation (five items), planning (four items), execution of action (eight items), and evaluation (three items). The items were rated on a 3-point scale: 0 (*not a problem*), 1 (*sometimes a problem*), and 2 (*often a problem*).

2.2.3. *Academic skills*

Reading performance was assessed using two different reading skills tests. The Word Recognition test (Lindeman, 1998) assessed basic reading skills and consisted of 78 word-chains containing two to four words. The pupils were asked to use a pencil to mark word boundaries within each chain, e.g. minä/ei/me/tulla (I/no/we/come), as fast and as accurately as they could. The time limit was 3.5 min, and the score was the number of correctly identified words. In the Luksu Reading Fluency test (Salmi, Eklund, Järvisalo, & Aro, 2011), the pupils were provided with a sheet showing 70 simple sentences and were instructed to read these as fast as possible and then decide whether the sentences were true or false, e.g. 'Strawberries are red'. The time limit was 2 min, and the test score was the number of correct answers. The test scores of both reading tests were standardised with data obtained from the PS, and z-score values were calculated by grade level. The mean of the two reading tests' z-scores was used as the basic reading skills variable. Cronbach's alpha for the reading skills test was .83.

Basic arithmetic skills were assessed using two time-limited paper-and-pencil group tasks. The first test comprised the two-minute addition fluency task (Koponen & Mononen, 2010a) and the two-minute subtraction fluency task (Koponen & Mononen, 2010b), both consisting of 120 simple tasks—the addition task with addends smaller than 10 and the subtraction task with results in the range of 1–9. The total number of correct answers during the two-minute time limit formed the task score. The addition and subtraction scores were summed, and this total was used as the test score of the arithmetic fluency. Second, the three-minute basic arithmetic test (Aunola & Räsänen, 2007) consisted of 30 addition, subtraction, division and multiplication items of increasing difficulty. The total number of correct answers in the three-minute time limit formed the test score. The test scores were standardised as z-score values by grade level with the PS data. The mean of the two z-scores (the arithmetic

fluency test and the basic arithmetic test) was used as the basic arithmetic skills variable. Cronbach's alpha for the basic arithmetic skills test was .85.

2.3. Statistical analysis

2.3.1. Preliminary analysis

Analyses were conducted with Mplus version 7.3 (Muthén & Muthén, 1998–2017). First, with data from the PS group, we tested the measurement structure using confirmatory factor analysis, consisting of one self-regulatory efficacy factor and four sources of efficacy factors. With the help of modification indices, the measurement model was modified by adding residual covariances to the model.

All of the models were estimated using the full information maximum likelihood method with robust standard errors and scale corrected chi-square test values (MLR estimator in Mplus). The proportion of missing values varied from 0.1% to 4.2%. Little's Missing Completely At Random (MCAR) test showed statistically non-significant results for sources of self-regulatory efficacy variables. The MCAR test result was statistically significant for self-regulatory efficacy items, although only 32 to 36 (2.5% to 2.8%) values were missing per question. As the number of missing values was this low for such a large sample, the results can still be considered unbiased.

Model fit was evaluated with the comparative fit index (CFI), the Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA) and standardised root mean square residual (SRMR). For a good fitting model, CFI and TLI are close to .95, RMSEA is lower than .06 and SRMR is lower than .08 (Hu & Bentler, 1999; Mplus Technical Appendix; Muthén, 1998–2004). Usually the chi-square test is part of the model testing, and for good model fit, the chi-square test is non-significant. However, the chi-square test is highly sensitive when the sample size is large, like in this study.

Based on the prevalence of attention problems, it was expected that the PS sample would include 5% (ADHD diagnosed; Polanczyk, de Lima, Horta, Biederman, & Rohde, 2007) to 16% (diagnosed with ADHD or exhibiting symptoms without clinical diagnosis; Barbaresi et al., 2002) pupils with attention difficulties. Furthermore, it was assumed that the measurement structure of the questionnaires was similar across the population, and children in AED group were expected to correspond to those individuals with similar problems in the PS group. Accordingly, we expected the measurement structure to be similar between the PS and AED samples.

2.3.2. Group comparisons

To study the factor mean differences between the PS and the AED groups, we estimated the data of the AED group simultaneously with the PS group using a multigroup method. In this model, factor loadings, intercepts of observed variables and residual covariances were set as equal between the groups. The model made it possible to test factor (mastery experiences, vicarious experiences, social persuasion and physiological/emotional states) mean differences between the groups. In this model, factor means of the PS group were set to zero. Cohen's *d* was calculated from the differences between factor means divided by the standard deviations of the PS group. Since the gender ratio was not equal in the two groups, the effect of gender was controlled in the model. As grade levels ranged from 2 to 6 among the participants, the effect of the age was also controlled in the model. As the prevalence rates of specific LDs, i.e. deficits in basic academic skills, in population samples are known to range from 4% to 9% in reading and from 3% to 7% in mathematics (see, e.g., Landerl & Moll, 2010), and at least a quarter of children with attention and EF deficits are assumed to exhibit LDs (see Miller & Hinshaw, 2012), this may affect self-regulatory efficacy (Klassen, 2010). Therefore, in the analyses, we also controlled for the effect of the level of basic reading and mathematics skills.

2.3.3. Regression analysis

Next, to analyse the specific effect of each source, we regressed self-regulatory efficacy on mastery experiences, vicarious experiences, social persuasion and physiological/emotional states. Since our main focus was to analyse the specific influence of each source of efficacy on self-regulatory efficacy in the two groups, we used the Cholesky decomposition method to build a hierarchical model (see de Jong, 1999). The Cholesky method can be used when independent variables are correlated, and it deconstructs the explained variance of each variable into unique and common proportions. Following the Cholesky procedure, we conducted four separate analyses in which mastery experiences, vicarious experiences, social persuasion and physiological/emotional states were set to four pre-specified orders. In these four consecutive Cholesky analyses, each source factor was set into the regression equation in the last step. With this procedure, we removed all the influences of the previous variables so that we could determine the unique proportion of variance of each variable on self-regulatory efficacy. Similar to previous analyses, the effects of gender, age, reading and mathematical skills were controlled in the model.

Last, we compared regression coefficients between the two groups. Comparisons could be conducted using estimates of coefficient differences and corresponding standard error (Muthén & Muthén, 1998–2017).

In Finland, differences in students' performances are very small between schools (Linnakylä, Välijärvi, & Arffman, 2011). Therefore, no variation between students' abilities and schooling was expected. However, we calculated the intraclass correlation coefficient (ICC) for schools. The results showed that four out of five (self-regulatory efficacy [.020], vicarious experiences [.012], social persuasion [.010] and physiological/emotional states [.014]) ICCs were not significant. In mastery experiences, the ICC reached significance, but the ICC value was only .017 and, therefore, a single-level analysis was conducted.

3. Results

3.1. Preliminary analysis

Correlations between the variables are presented in Table 1. Table 1 shows that in the PS group, the strength of positive correlations between the factors of interest (self-regulatory efficacy and four sources) varied from .39 to .69 and negative correlations from -.51 to -.19, and in the AED group, the strength of positive correlations varied from .14 to .67 and negative correlations from -.36 to -.20. In the PS group, all correlations between the factors were significant, whereas in the AED group, 4 out of 10 correlations were significant. Non-significant correlations were probably due not only to the smaller coefficients but also to the smaller AED group size. Also, it is noteworthy that in the PS group, the sources correlated on average more highly than in the AED group, indicating a considerable amount of common variance between the four sources of self-regulatory efficacy in the PS group (see Table 1).

The unconstrained theoretical measurement model did not provide a satisfying model fit: χ^2 (179) = 690.60, p < .001, CFI = .931, TLI = .919, RMSEA = .047, RMSEA 90% C.I. (.043 – .051) and SRMR = .052. Therefore, based on large modification indices, five residual covariances within the same factor and with same valence (between three efficacy items [1, 2 and 3; see Appendix], two mastery experience items [3 and 4; see Appendix] and two physiological/emotional state items [3 and 4; see Appendix]) were allowed to estimate freely. It was concluded that these items had some shared information and evaluated closely similar experiences. The final model consisting of one efficacy factor and four source factors fitted the data well: χ^2 (174) = 380.84, p < .001, CFI = .972, TLI = .966, RMSEA = .030, RMSEA 90% C.I. (.026 – .035) and SRMR = .036 (factor structures and loadings are presented in the Appendix). The chi-square value was statistically significant due to the large sample size in this study.

In the PS group, skewness of variables ranged from -2.11 to 2.05 and kurtoses from -1.99 to 5.45. In the AED group, skewness ranged from -2.19 to 0.57 and kurtoses from -1.20 to 2.78. Therefore, as it was assumed that not all variables were normally distributed, a robust estimation method that is resistant to distribution abnormalities was used in the regression models.

Table 1 about here

3.2. Group comparisons

To answer the main questions of the study, first, we tested whether the means of self-regulatory efficacy and source-related experiences differed between the groups. The estimates (deviations from zero as factor means of the PS group are set to zero) and standard errors of factor means of the AED group for self-regulatory efficacy and the sources of efficacy are presented in Table 2. The results revealed statistically significant group differences in self-regulatory efficacy, mastery experiences and physiological/emotional states after controlling for gender, age, reading and arithmetic skills (see Table 2). Effect sizes varied from moderate to strong. The PS group gave more positive responses regarding self-regulatory efficacy and mastery experiences, while pupils in the AED group reported experiencing more negative physiological/emotional reactions.

Table 2 about here

3.3. Regression analysis

Second, we conducted regression analysis using factor scores and Cholesky decomposition to estimate the unique influence of the four sources of efficacy on self-

regulatory efficacy, which was our main interest. The source factors together explained 54% of the variance of the self-regulatory efficacy factor in the PS group and 56% in the AED group (see Table 3). The model showed that in the PS group, three of the four sources, i.e. mastery experiences, social persuasion and physiological/emotional states, were significantly related to self-regulatory efficacy (see Table 3). However, in the PS group, the explanation ratio showed that the social persuasion factor had no unique effect ($\Delta R^2 = .01$) on self-regulatory efficacy.

In the AED group, mastery experiences, vicarious experiences and physiological/emotional states were significantly related to self-regulatory efficacy (see Table 3). The coefficient of vicarious experiences was negative (-.39), indicating a negative influence of vicarious experiences on self-regulatory efficacy in the AED group. In both groups, physiological/emotional states were associated with self-regulatory efficacy (coefficient for the PS group -.26 and for the AED group -.30), indicating that heightened negative emotions were associated with lower self-regulatory efficacy.

The mastery experiences accounted for the greatest proportion of the variance in self-regulatory efficacy in both the PS and AED groups. The explanation ratios showed that in the AED group, mastery experiences had a large positive unique effect ($\Delta R^2 = .27$) and vicarious experiences ($\Delta R^2 = -.15$) had a medium negative effect on self-regulatory efficacy (see Table 3). Although the strength of correlations between self-regulatory efficacy and sources varied from .39 to .69 in the PS group (see Table 1), source factors had a small or no unique additional influence on self-regulatory efficacy (ranging from .00 to .12; see Table 3), indicating that in the PS group, sources overlapped and most of the variance was shared between the sources.

Finally, we compared the regression coefficients of the sources of efficacy between the groups (see Table 3). No significant differences were found between the groups.

Table 3 about here

4. Discussion

The present study investigated self-rated self-regulatory efficacy and its four sources (mastery experiences, vicarious experiences, social persuasion and physiological/emotional states) in two groups of elementary school pupils: a large population-based sample (PS group) and pupils with attention and EF difficulties (AED group). Concerning the preliminary analysis, it was found that the proposed model with one efficacy factor and four source factors fitted the data well and supported the theory-based structure of the sources of efficacy questionnaire and the assumed structure of the self-regulatory efficacy questionnaire among elementary school-age children.

The results of the main analyses indicated, as assumed, that attention and EF difficulties are associated with self-appraisals. First, as assumed, the AED group rated their self-regulatory efficacy lower than pupils in the PS group. This finding is consistent with those of previous studies showing lower self-regulatory efficacy in pupils with LD (Hampton & Mason, 2003; Klassen, 2010). Significant differences between the groups were also observed in the sources of self-regulatory efficacy. The AED group reported fewer mastery experiences and higher physiological and emotional arousal than their peers. Previously, Hampton and Mason (2003) reported similar differences in mastery experiences and interpretations of physiological and emotional states between LD pupils and non-LD pupils, and Usher and Pajares (2006) between groups with different levels of reading ability. According to Bandura (1997), unfavourable interpretations of physiological and emotional states are more potent when indicators of positive mastery experiences are weak. Following

this argument, it is possible that a lack of experiences of control over one's actions can potentially predispose a pupil to negative affective-state interpretations.

The second aim of the study was to investigate the relationship between sources of efficacy and self-regulatory efficacy and compare these relationships in the PS and AED groups. Overall, the model fitted the data well, and the sources explained 54% of the total variation of self-regulatory efficacy in the PS group and 56% in the AED group. From four sources, mastery experiences explained the largest proportion of variance in self-regulatory efficacy in both groups, which was in accordance with the results of previous studies (Butz & Usher, 2015; Chen & Usher, 2013; Hampton, 1998; Joët et al., 2011; Usher & Pajares, 2006). In the PS group, besides mastery experiences, two other sources – social persuasion and physiological/emotional states – were related to self-regulatory efficacy. In the AED group, mastery experiences, vicarious experiences and physiological/emotional states were related to self-regulatory efficacy. As the items in the physiological/emotional states factor were problem-oriented, in both groups, the relationships between efficacy and physiological/emotional states were negative; heightened negative emotions were associated with lower self-regulatory efficacy. Interestingly, in the AED group, vicarious experiences had negative influence on self-regulatory efficacy, whereas in the PS group, vicarious experiences had no unique influence on efficacy.

Third, we explored differences in source-efficacy connections in the two groups of interest. The interactions between the groups and sources of self-regulatory efficacy were not significant. However, when examining the regression models and correlations more closely, some group-related variability was observed. Mastery experiences alone accounted for 27% of the variance in self-regulatory efficacy in the AED group, whereas in the PS group, mastery experiences only accounted for 12%. This result is in line with Hampton's (1998) findings among students with LD, where mastery experiences covered most of the variance

(33%) of self-regulatory efficacy. These findings suggest that pupils with attention and EF difficulties or LDs build their confidence in self-regulation by relying mostly on past performance accomplishments that give immediate feedback and can be easily interpreted. It is also possible that weak self-regulatory skills result in poor knowledge and self-awareness of successful on-task behaviours or performances (Klassen & Lynch, 2007), which then weaken the connection between information originating from multiple sources of efficacy and self-regulatory efficacy. Accordingly, in the present study, mastery experiences, which have been shown to be the most potent source of efficacy (Usher & Pajares, 2008), had a high unique association with self-regulatory efficacy in the AED group.

As mentioned above, in the AED group, vicarious experiences had a negative association with self-regulatory efficacy. This result suggests that peers' successful accomplishments in the classroom may increase sense of inabilities in task-related activities among pupils with attention deficits. This is contradictory to Hampton's (1998) findings with children with LDs; in his study, vicarious efficacy had a significant positive influence on self-regulatory efficacy. One reason for the different findings stems from the content of the questionnaire items; the items used by Hampton (1998) reflected modelling from adults, whereas the present study used peer-related items. The items assessing vicarious experiences from different models are likely to produce inconsistent results (Ahn, Bong, & Kim, 2017).

In the PS group, the sources had a low unique explanation ratio or no unique effect on efficacy, and at the same time, the sources of self-regulatory efficacy correlated highly, which indicates that the sources had a substantial amount of shared variance. Thus, it can be assumed that in the PS group, multiple experiences have a positive effect on self-regulatory efficacy. It has previously been shown that this type of effect of multiple sources is related to favourable achievements (see Chen & Usher, 2013). Our findings suggest that the multiple sources available to the PS group contribute to their more favourable self-regulatory efficacy.

Interestingly, in the AED group, the sources had higher unique explanation ratios and shared less common variance than in the PS group. This finding suggests that attention and EF-related problems might decrease the accumulation of positive experiences and contribute to less positive efficacy beliefs concerning regulative competence.

The findings of the present study offer evidence that attention and EF difficulties are related to pupils' sources of efficacy-related experiences, and furthermore, that these difficulties and experiences can affect pupils' confidence in their self-regulatory competencies. Pupils' negative self-regulatory experiences may be a risk for decreased motivation and self-regulatory effort in demanding task situations and, thus, may continue the cycle of negative behavioural control and negative feedback. These negative trajectories can result in a tendency to avoid these situations, further limiting their opportunities to practice and develop self-regulation and EF (Sonuga-Barke, 2005). Some research findings suggest that teachers also have influence on these trajectories. Teachers may become frustrated with pupils with self-regulatory difficulties and expect poor on-task behaviour, and thus strengthen the negative cycle (Blair & Diamond, 2008). Although some pupils fail to manage academic activities due to lower self-regulatory abilities, teachers may not always deliver sufficient support and opportunities to effectively practise and develop self-regulatory skills in academic tasks (Peeters, De Backer, Kindekens, Triquet, & Lombaerts, 2016).

Since the pupils with attention deficits primarily build their confidence for managing tasks and learning situations on previous successful performances, the intervention methods should develop pupils' skills to manage learning tasks and situations in school, thereby raising the probability of positive self-regulatory mastery experiences (see Martin et al., 2017). It has been shown that interventions that target skills for working more effectively on academic tasks are beneficial with regard to attention and EF problems (see Evans, Owens, & Bunford, 2014). Improved self-regulatory skills can promote a pupil's self-efficacy and

consequently ‘enhance their motivation to continue additional cycles of learning’, as Zimmerman (2008, p. 179) stated. The results of the present study implicate that peer modelling in a classroom context is not necessarily a positive source for building confidence in self-regulatory skills for pupils with attention and EF difficulties and may even have a negative effect on efficacy, at least when the peer group does not have attentional and EF difficulties. In order to diminish the possible negative vicarious effects, interventions should also emphasise positive feedback methods that provide pupils with adequate and reliable information regarding their own performance and progress in regulatory skills.

Some limitations of the present study and its findings are worth noting. A major limitation of the present study was the small number of participants in the AED group compared to the PS group. Unequal group sizes affected the statistical power of the analyses, particularly in the regression analysis, making direct comparisons somewhat challenging. In the analyses, we did assume a measurement invariance across groups. However, due to the small number of participants in AED group, a full test of measurement invariance could not be conducted reliably. Future studies with larger samples are needed to further test the invariance. Second, in the present study, the data concerning efficacy and sources were obtained with newly constructed scales; therefore, these results should be considered as preliminary. Future research should be conducted with other samples, particularly a larger attention deficit sample, to examine further self-regulatory efficacy among elementary school pupils. Third, the problems of attention and EF were not evaluated in the PS group; therefore, it was not possible to identify pupils with attention and EF difficulties in this group. Based on the findings concerning the proportion of such problems in the general population (Barbaresi et al., 2002; Polanczyk et al., 2007), it can be assumed that the proportion ranged between 5% and 16% in the present sample. However, due to the large sample size of the PS group, it can be assumed that the ratings of these pupils did not affect the results. Last, the great difference

in gender ratio in AED group – 12.7% girls and 87.3% boys – was a limitation. This could be due to inclusion criteria that emphasise problems observable in classroom which are more prominent for boys.

The present study raises a few questions that are worth investigating in the future. This study showed that sources of efficacy and their relationships with self-regulatory efficacy could be investigated with questions that specifically address self-regulation–related concerns, i.e. control of attention and interference, executive control and emotion regulation. In the future, using the same method, it would be worthwhile to investigate different subgroups with different skills or achievement levels. This research design would provide greater insights into how self-regulatory experiences drive self-regulatory efficacy and how other learning-related indicators moderate these relationships. Previous studies have shown that among students with ADHD, self-appraisals may vary strongly (see Bourchtein et al., 2017); therefore, in the future, person-oriented methods should be used to investigate variations in self-regulatory efficacy and its sources in children with attention deficits. In this study, among pupils with attention and EF difficulties, vicarious experiences had a negative association with self-regulatory efficacy. Although the explanation ratio was high (15%), we have to consider this result as preliminary, and therefore, further studies that focus more on vicarious experiences are suggested (see also Ahn et al., 2017). Also, further research should be undertaken to investigate how other classroom-level factors influence self-regulatory efficacy and sources of efficacy. Such factors could be, for example, the teachers' practices in structuring the learning environments and situations, giving feedback or modelling task processes. The findings of the present study raise an important question regarding the role of physiological and emotional reactions. The results showed the greatest differences between the groups for this variable. Further work is required to investigate the role of physiological and emotional reactions in real time for on-task behaviour and self-regulation, and whether

these reactions have reciprocal connections with other sources of efficacy (see also Chen & Usher, 2013). Clarification of this relationship would direct both the assessment of attention and self-regulatory problems and the development of intervention methods.

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Table 1
Bivariate correlations of the factors basic reading and arithmetic skills and age for the PS group (n = 1,284; below the diagonal) and the AED group (n = 61; above the diagonal).

Variables	Self-regulatory efficacy	Mastery experiences	Vicarious experiences	Social persuasion	Physiological/ Emotional states	Reading skill	Arithmetic skill	Age	Gender
Self-regulatory efficacy	-	.56***	.19	.29	-.36*	-.04	-.04	-.10	.02
Mastery experiences	.69***	-	.67***	.56***	-.20	-.09	.12	-.08	.07
Vicarious experiences	.39***	.52***	-	.14	-.20	-.41**	-.18	.16	-.12
Social persuasion	.49***	.64***	.55***	-	.14	-.19	.20	-.09	.06
Physiological/Emotional states	-.51***	-38***	-.19***	-.25***	-	-.13	-.03	-.23	-.09
Reading skill	.20***	.14***	.02	.06*	-.22***	-	.41***	-.21*	-.18
Arithmetic skill	.24***	.17**	.08	.12***	-.20***	.49***	-	-.17	.14
Age	-.15***	-.19***	-.16***	-.11***	-.05	.00	-.01	-	.03
Gender [a]	-.09**	-.19***	-.12**	-.16***	.05	-.17***	.05	.04	-

Note. *** < .001 **< .01 * < .05. [a] Negative correlations denote lower values for boys.

Table 2

Unstandardised estimates (deviations from zero), standard errors (SE) and standard deviation (SD) of the factor means of the AED group and analysis of the mean differences between groups

Variable	Estimate	SE	Estimate/SE	p	AED group SD	PS group SD	Cohen's d
Self-regulatory efficacy	-0.29	0.12	-2.41	.016	0.86	0.60	0.48
Mastery experiences	-0.51	0.18	-2.74	.006	1.32	0.90	0.56
Vicarious experiences	-0.02	0.20	-0.09	.928	1.29	0.96	0.02
Social persuasion	0.10	0.23	0.42	.675	1.63	1.42	0.07
Physiological/ Emotional states	1.03	0.28	3.75	< .001	1.68	1.20	0.86

Note. Factor means of the PS group are set to zero. Cohen's d is calculated with an equation in which unstandardised estimates of deviations from zero are divided by standard deviations of unstandardised values of the population. Factor means of the population are set to 0.

Table 3

Unique influence of the four sources of efficacy on self-regulatory efficacy; test for coefficient differences between groups and unique explanation ratios (ΔR^2)

Variable	PS group (n = 1,210)	AED group (n = 61)	Difference	SE for difference	p	PS group ΔR^2	AED group ΔR^2
Mastery experiences	.35***	.52**	.17	0.31	.182	.12	.27
Vicarious experiences	.01	-.39*	.40	0.24	.100	.00	.15
Social persuasion	.08*	-.10	.18	0.24	.286	.01	.01
Physiological/Emotional states	-.26***	-.30*	.04	0.17	.816	.07	.09
Model	R^2 =.54	R^2 =.56					

Note. *** <.001 ** <.01 * <.05. Unique betas unstandardised values. Difference-value divided by the correspondent SE produce the t-values, and p-values are obtained from the t-distribution. Unique explanation ratios counted from the standardised values.

Appendix.

Standardised factor structure of the self-regulatory efficacy and sources of self-efficacy questionnaire.

Variables	Estimate	SE	Est/SE	P-Value
Self-regulatory efficacy by:				
How confident are you				
1. . . .*that you can finish your homework even if it is difficult for you?*	.53	0.03	17.60	< .001
2. . . .*that you can push on even if the tasks are difficult?*	.52	0.03	17.69	< .001
3. . . .*that you can do your best even if you notice that the test is difficult for you?*	.49	0.03	15.04	< .001
4. . . .*that you can always focus on school subjects during class?*	.67	0.02	28.34	< .001
5. . . .*that you can follow the instructions presented by the teacher?*	.63	0.03	19.62	< .001
6. . . .*that you get yourself to prepare for a test?*	.62	0.03	23.39	< .001
7. . . .*that you get yourself to study when there are other interesting things to do?*	.75	0.02	38.98	< .001
8. . . .*that you get yourself to do schoolwork during class even when the tasks make you nervous?*	.73	0.02	34.42	< .001

Mastery experiences by:				
1. *I have always been able to focus on homework.*	.68	0.02	28.63	< .001
2. *I always listen to the teacher when she/he is teaching.*	.78	0.02	41.59	< .001
3. *I have always been able to pay attention to teaching during class.*	.83	0.02	44.50	< .001
4. *I have always been able to focus on tasks during class.*	.86	0.01	60.10	< .001
Vicarious experiences by:				
1. *My friends pay attention to teaching during class.*	.66	0.03	19.78	< .001
2. *My friends work and try their best during class.*	.74	0.04	20.86	< .001
Social persuasion by:				
1. *My parents said that I concentrate well on homework.*	.72	0.02	37.66	< .001
2. *My teacher said that I pay attention to teaching during class.*	.82	0.02	51.64	< .001
3. *My friends say that I pay attention to teaching.*	.78	0.02	39.37	< .001

4. *Many have praised me for how I concentrate.*	.80	0.02	47.71	< .001
Physiological/Emotional states by:				
1. *I feel nervous when I do my homework.*	.70	0.04	17.12	< .001
2. *If there are any problems in class, I feel nervous and I am unable to do my tasks.*	.65	0.04	15.99	< .001
3. *If there are any problems in class, I feel nervous and I am unable to focus.*	.64	0.04	15.98	< .001