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THE PSYCHOMETRIC PROPERTIES OF THE MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE (MSLQ): MULTIDIMENSIONAL RASCH ANALYSIS ON PRIMARY SCHOOL DATA

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The paper investigates the psychometric properties, construct and concurrent validity of the Italian version of the Motivated Strategies for Learning Questionnaire (MSLQ) in an Italian primary school student sample through multidimensional Rasch analysis. The aim is fivefold: to identify the factorial structure for the Italian primary school sample using both the multidimensional rating scale model and the multidimensional partial credit model; to test the internal consistency of the subscales of the MSLQ; to investigate the item fit of each item of the MSLQ; to detect the item bias based on gender; and to explore the concurrent validity of the MSLQ with the Academic Self-Efficacy Beliefs Scale and anxiety and concentration subscales of AMOS QAS. Participants included 692 primary school students (grades 3 to 5). The MSLQ resulted a reliable measure in the Italian context for the evaluation of motivational beliefs and cognitive strategy use among primary school students.

Keywords: Motivated Strategies for Learning Questionnaire; Primary school children; Psychometric properties; Multidimensional Rasch model.

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Educational and psychological researchers over the past decade have found that the factors more strongly predictive of success in learning are related to students' motivation and use of learning strategies. Students typically perform better, develop efficient lifelong learning (Garcia & Pintrich, 1996; Pintrich, Smith, Garcia, & McKeachie, 1993), and report higher levels of academic satisfaction and achievement (e.g., Chang, 2007; Chung, 2000; Paris & Paris, 2001; Pintrich, 2000; Zimmerman & Schunk, 2001) when they organize and manage their own learning effectively, using appropriate cognitive, motivation-

al, and metacognitive strategies. The use of these strategies, indeed, facilitates the transition from dependent to autonomous learner.

Although literature has demonstrated the crucial importance of metacognition, self-regulation, and emotional–motivational aspects for learning, these variables have been studied mostly in adults (Paris & Newman, 1990; Zimmerman, 1990).

Given the relevance of the topic and its wide interest, it is essential to have sensitive and reliable instruments to measure these metacognitive and motivational variables in the developmental age. Among these instruments, the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991) is one of the most employed instruments to assess self-regulated learning and self-efficacy, exhibiting good validity and reliability (Honicke & Broadbent, 2016; Roth, Ogrin, & Schmitz, 2016). In the Italian context, few researchers have investigated students' motivation and learning strategies using the MLSQ with university (Albanese et al., 2010) and junior high school students (Caputo, 2014). Only recently has this instrument been validated on a sample of Italian adolescents (Bonanomi, Olivari, Mascheroni, Gatti, & Confalonieri, 2018), but no researchers have investigated its reliability among children. We believe this would be useful since we lack a sensitive validated measure to assess self-regulation, emotional and motivational aspects in children. Therefore, in this study we aim to assess the psychometric properties of the MLSQ among primary students in Italy.

Theoretical Background

Constructivism and, to an even greater extent, social constructivism, by replacing theories of classical and transmissive education, which assigned a reactive rather than a proactive role to the learner, have led to the idea that students should take responsibility for their own learning and should play an active role in the learning process (Zimmerman & Schunk, 2001). This perspective change highlighted the need for students of all ages to develop self-regulated learning skills, which are a key competence to start and maintain lifelong learning (see European Framework of Life-long Learning; EU Council, 2002). When children self-regulate their own learning, they develop a sense of personal agency and awareness of their role in learning, which in turn can empower them to take ownership of the learning process (Schunk & Ertmer, 2000).

Recent definitions of self-regulated learning (SRL) commonly describe self-regulated students as metacognitively, motivationally, and behaviorally active participants in their own learning process, who self-generate thoughts, feelings, and actions to attain their learning goals (Jossberger, Brand-Gruwel, Boshuizen, & Van de Wiel, 2010; Zimmerman 2008). Although there are a variety of theoretical perspectives on SRL, it is generally indicated as a complex, multifaceted process that integrates metacognitive and cognitive variables as well as motivational aspects to effectively regulate one's learning process (Perry, Phillips, & Dowler, 2004; Pintrich, 2004; Zimmerman, 2002). Metacognitive variables include planning, self-evaluation, self-control (Bandura, 1982), executive treatment processes (Lindner, Harris, & Gordon, 1996), metacognitive control for learning and performance (Sink, Barnett, & Hixon, 1991), and self-teaching, self-monitoring, and self-evaluation (Zimmerman & Martinez-Pons, 1986). Cognitive variables refer to information processing and are therefore specific for the different domains: techniques for solving problems and settling ideas (Bandura, 1982), circumstance control and environment control (Corno, 1986), memory, elaboration, organization, time management, effort management, environmental condition management, and seeking assistance (Pintrich, 1989). Among the motivational factors that have been identified are self-enhancement and self-efficacy (Bandura, 1982); academic goals and self-schema (Garcia & Pin-

trich, 1993); internal orientation, importance of task, and expectations for success (Pintrich, 1989); intrinsic motivation and tendency of completeness (Sink et al., 1991); anxiety (Zimmerman, 1989); and meta-motivation (Park, 1995).

We believe that the role of metacognition is particularly important because it appears to be one of the most relevant predictors of learning (Lee & Stankov, 2013; Wang, Haertel, & Walberg, 1993), enabling individuals to monitor their knowledge and skill levels, plan and allocate limited learning resources with optimal efficiency, and evaluate their learning state. The regulation of cognition can take place throughout the whole learning process (e.g., Brown, 1978). Prior to learning, students engage in planning to predict the results or choose strategies. During learning, monitoring and the rescheduling of strategy use occur. After learning, the outcome is checked and evaluated against criteria of efficiency (Brown, Bransford, Ferrara, & Campione, 1983).

A number of researchers have argued that cognitive strategies and high motivation alone are insufficient for skilled self-regulation (Battistelli, Cadamuro, Farneti, & Versari, 2009; Butler & Winne, 1995; White & Mitchell, 1994). To understand how and why people perform as they do on cognitive tasks, examining metacognitive factors is of primary importance (Paris & Winograd, 1990; Pintrich & DeGroot, 1990).

Metacognitive competence allows pupils to be able to organize, direct, and control their own mental processes, adapting them to task needs; it allows construction of their own knowledge using cognitive strategies personally developed from information (Gulikers, Bastiaens, Kirschner, & Kester, 2006; Michalsky, Mevarech, & Haibi, 2009). Pupils with good metacognitive skills are able to properly recognize the difficulty of a task, ask themselves what they need to do, evaluate if planned strategies fit the task or not, schedule their time among activities, and know what to expect as a result of their efforts in learning (Boekaerts, 1999).

Although literature has demonstrated the importance of metacognition, self-regulation, and emotional–motivational aspects for learning success, these variables have been examined especially in adults. Most of the research on SRL in school settings has been conducted with older students, from upper elementary grades to college (Perry et al., 2004), while research on young children is still lacking (Dignath, Buettner, & Langfeldt, 2008). According to the suggestions resulting from most of the research conducted during the 1980s and 1990s, primary school children and younger children could have difficulty applying metacognitive strategies (Paris & Newman, 1990; Zimmerman, 1990). More recently, however, it has been reported that even though self-regulated learning increases during the elementary school years, self-regulation of learning already exists in preschool children (Schneider & Lockl, 2002). To foster lifelong learning processes, education in self-regulation should begin in the early stages of childhood (Perels & Otto, 2009). In this regard, it appears necessary to have reliable assessment tools for evaluating these soft skills in childhood.

To determine motivation levels and SRL, Pintrich and colleagues developed the MSLQ (Pintrich, et al., 1991, 1993), an 81-item self-report instrument designed to assess college students' motivational orientation and their use of different learning strategies (Pintrich et al., 1991). Pintrich and DeGrooth (1990) also ideated a shorter version of the MSLQ, composed of 44 items, for junior high school students.

Despite the worldwide employment of this instrument (Credé & Phillips, 2011), the MSLQ psychometric properties have been little studied (see Bonanomi et al., 2018). Limiting our attention to the employment of the MSLQ with primary school students, several researchers employed it, evaluating its reliability only through the computation of Cronbach's alpha (i.e., Bong, Cho, Ahn, & Kim, 2012; Kaldi, Filippatou, & Govaris, 2011; Kitsantas, Steen, & Huie, 2009; Metallidou & Vlachou, 2007; Shores & Shannon, 2007). To our knowledge, only two studies have assessed the construct validity of the MSLQ by carrying

out confirmatory factor analyses (CFAs), necessary to the assessment of the entire factorial structure. Kaya and Kablan (2013) employed the 81-item version of the MSLQ, and their sample consisted of fourth-grade Turkish school students between ages 10 and 11. They carried out a CFA on the 50 items of the Learning Strategies section (comprising rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, and help seeking) and obtained appropriate model fit indices and reliability coefficients between .53 and .75. Law, Chan, and Sachs (2008) employed the Chinese version of the MSLQ, validated for Hong Kong students by Rao and Sachs (1999), and their sample consisted of fifth- (mean age = 10.8 years) and sixth-grade (mean age = 11.9 years) Chinese students from Hong Kong primary schools. Following the suggestion of Rao and Sachs (1999) of a four-factor structure of the MSLQ, comprising cognitive strategy use and self-regulation subscales, Law et al. (2008) carried out a CFA on the cognitive strategy and self-regulation subscales and obtained a one-factor model with 18 items, suggesting that cognitive strategy use and self-regulation items formed a unidimensional scale among Chinese students.

To our knowledge, no studies have been carried out on the 44-item version of MSLQ in Italy, where the lack of available assessment tools for this age range is evident. The only Italian contribution to the evaluation of this measure was provided by Poliandri, Cardone, Muzzioli, and Romiti (2011) who adapted the MSLQ subscale of test anxiety to the Italian context and tested its validity in a sample of fifth-grade primary students using the Andrich rating scale model, an extension of Rasch's simple logistic model, demonstrating good reliability.

For this reason, we aimed to assess the psychometric properties of the MSLQ among primary students through multidimensional Rasch analysis. Recently, in fact, this method was successfully employed in the assessment of the MSLQ psychometric properties with high school students in Italy (Bonanomi et al., 2018) and China (Lee, Zhang, & Yin, 2010). The multidimensional Rasch model is particularly useful when a general construct can be considered a set of unidimensional correlated subscales. The model, in fact, preserves the structure of each subscale, the calibration of the common general construct, and the correlations between subscales, significantly increasing the measurement precision. Moreover, it is a natural analysis method in the presence of ordinal data and when the aim is essentially confirmatory. This model can transform ordinal data into interval scores and determine if the response categories of a scale can differentiate participants by their responses (Rost & Carstensen, 2002). The advantages of the multidimensional approach are especially relevant when each dimension is not determined by the same number of items and the subscales are highly correlated (Briggs & Wilson, 2003). Moreover, the multidimensional Rasch model has a confirmatory aim. Typically, indeed, items are "pre-assigned" to dimensions based on theoretically grounded hypotheses or empirical evidence in previous studies. This approach has already been successfully employed in the evaluation of MSLQ among high school students (Bonanomi et al., 2018; Lee et al., 2010).

Therefore, our aim was to investigate the psychometric properties and construct validity of an adaptation of the Italian version of the MSLQ (Bonanomi et al., 2018) in an Italian primary school student sample using a multidimensional random coefficients multinomial logit model (MRCMLM; Adams, Wilson, & Wang, 1997). In particular, our aim was fivefold: (a) to identify the best factorial structure for the Italian primary school sample, choosing between the original five-factor structure (Pintrich & DeGroot, 1990) and the four-factor structure proposed by Rao and Sachs (1999), using both the multidimensional rating scale model (MRSM) and the multidimensional partial credit model (MPCM); (b) to test the internal consistency of the subscales of the MSLQ; (c) to investigate the item fit of each item of the MSLQ; (d) to detect the item bias based on gender; and (e) to explore the concurrent validity of the MSLQ with the Academic Self-Efficacy Beliefs Scale (Pastorelli & Picconi, 2001) and anxiety and concentration subscales of

the Abilities and Motivations to Study Questionnaire on Study Approach **(**AMOS QAS; Cornoldi, De Beni, Zamperlin, & Meneghetti, 2005). In particular, we expected that the MSLQ would positively correlate with the Academic Self-Efficacy Beliefs Scale (except for the test anxiety subscale, which was expected to negatively correlate with it), negatively correlate with the AMOS QAS anxiety subscale (except for the test anxiety subscale, which was expected to positively correlate with it), and positively correlate with the AMOS QAS concentration subscale (except for the test anxiety subscale, which was expected to negatively correlate with it).

METHOD

Participants

A total of 692 primary school students participated in the three studies. Table 1 reports the characteristics of the three samples.

TABLE 1
Sociodemographic characteristics of the sample

Variables		Study 1	Study 2	Study 3
Age (*M* ± *SD*)		8.9 ± 0.8	9.1 ± 0.9	8.9 ± 1.0
Grade	Third	36.8%	29.9%	31.8%
	Fourth	35.6%	32.7%	30.2%
	Fifth	27.6%	37.4%	38.0%
Gender	Male	48.0%	46.3%	46.9%
	Female	52.0%	53.7%	53.1%
	Sample size	416	147	129

Procedure and Instruments

We recruited participants through convenience sampling from five schools in the provinces of Modena, Reggio Emilia, and Bologna in Northern Italy. Prior to conducting the study, we secured consent from the children's parents, teachers, and school heads. We conducted this research in adherence to the legal requirements of the study country and in accordance with the American Psychological Association ethical guidelines. We ensured anonymity and confidentiality of responses.

The instruments were administered collectively in class by students enrolled in educational academic courses at a Northern Italian university. We trained all student researchers accurately.

Sociodemographic characteristics. Participants were asked about their gender, age, and class attended.

Motivated Strategies for Learning Questionnaire. A 41-item adaptation of the Italian version of the MSLQ (Bonanomi et al., 2018) was administered to participants. For the purposes of this study, we slightly modified the items' language to be more appropriate for third, fourth, and fifth graders. To arrive at the 41-item version, we carried out a pilot study administering the 44-item questionnaire (Bonanomi et al., 2018) to 15 primary school students (five students of third, fourth, and fifth grade, respectively). In addi-

tion to the compilation of the questionnaire, we interviewed the children regarding the item clarity and asked for their opinions on the item formulation. The pilot study permitted us to identify three items that were too difficult for primary school students. The three items belonged respectively to the self-efficacy, cognitive strategy use, and self-regulation scales (i.e., Items 9, 24, and 38 of the 44-item Italian version of Bonanomi et al., 2018).

The questionnaire consists of 41 items and permits evaluation of motivational beliefs and self-regulated learning strategies. The motivational beliefs section (21 items) is divided into three subscales: self-efficacy (eight items), intrinsic value (nine items), and test anxiety (four items). The self-regulated learning section (20 items) is composed of two subscales evaluating cognitive strategy use (12 items) and self-regulation (eight items). The respondents indicated their degree of agreement on a 5-point Likert scale ranging from 1 (*completely false for me*) to 5 (*completely true for me*).

Academic Self-Efficacy Beliefs Scale. We administered to participants the second section of Pastorelli and Picconi's (2001) 19-item scale, comprising 12 items investigating students' perceived motivation and ability to self-regulate learning activities, to plan and organize study times, to employ cognitive strategies, and to ask teachers and peers for help when needed. The participants rated items on a 5-point Likert scale ranging from 1 (*perceived incapability*) to 5 (*complete self-assurance in one's capability*). The internal consistency (Cronbach's alpha) calculated on the current sample is .76.

Abilities and Motivations to Study Questionnaire on Study Approach. We administered to participants the anxiety and concentration subscales of the AMOS 8-15 QAS (Cornoldi et al., 2005). The participants rated items on a 3-point scale ranging from 1 (*not true*) to 3 (*very true*). The internal consistency (Cronbach's alpha) calculated on the current sample is, respectively, .67 and .60, for the anxiety and concentration subscales.

Data Analyses

We conducted three studies to determine the best structure of the Italian version of the MSLQ among primary school students using an MRCMLM (Adams et al., 1997). In the first study, the MPCM and MRSM were compared. For both models, the five-factor and four-factor structures were considered, respectively proposed by Pintrich and DeGroot (1990) and by Rao and Sachs (1999), on the 41-item scale using a 5-point scale. The goodness-of-fit indices were evaluated by a comparison of deviance of each model and a chi-square test to verify the better model (MPCM or MRSM) and better factorial structure (five or four factors). To evaluate the internal consistency and reliability of each subscale, we determined Cronbach's alpha and expected a posteriori (EAP) measures. To check whether the items fit the expected model, we computed two-item fit mean square (MNSQ) statistics (infit and outfit). These statistics permit the determination of the good contribution of each item to define a single underlying construct. Infit statistic is more sensitive to the pattern of responses to items targeted on the person, and vice-versa, while outfit statistic is more sensitive to responses to items with difficulty far from a person, and vice versa.

The optimal range of these statistics should be between 0.6 and 1.4 (Wright, Linacre, Gustafson, & Manrtin-Lof, 1994), since 1.0 is their expected values. We performed analyses of difficulty and step parameters to guarantee a sufficient ranking of the different response categories.

We conducted the second and third studies to evaluate psychometric proprieties on the same proposed items by using a different number of response modalities, with a 4-point scale (Study 2) and a 3-point scale (Study 3). This choice was based on the difficulty that children faced using a 5-point scale and some problems that emerged in the first study related to the monotonicity of the response categories of several items.

In Study 3, we used a 3-point scale. Due to the ordinal nature of a 3-point scale, we performed the reliability analysis by the ordinal alpha via empirical copula index (Bonanomi, Cantaluppi, Ruscone, & Osmetti, 2015). This approach relaxes the hypotheses of the classical Cronbach alpha normally used for metric data and is particularly useful in presence of ordinal data or a Likert scale with a low number of response categories.

We implemented a differential item functioning (DIF) analysis to detect item distortion into different groups, only for the better emerged version of the scale. DIF detection was based on gender (male or female). We calculated the differences in the overall item difficulties between females and males to detect the DIF effect. We calculated the effect size of DIF by means of the logit difference of the item difficulty parameters from different groups. The optimal value of the logit difference is less than 0.40.

We calculated the correlation between the MSLQ and Academic Self-efficacy Beliefs Scale (Pastorelli & Picconi, 2001) and the two subscales of AMOS QAS (anxiety and concentration; Cornoldi et al., 2005) to evaluate the concurrent validity.

To verify the robustness of the 3-point Likert scale on a bigger sample size, we aggregated the 5-points Likert scale proposed in Study 1 into a 3-point Likert scale, and we tested the consistency and the performance of this scale on the sample of Study 1. Finally, a confirmatory factor analysis (CFA) was performed to verify the factorial structure, with an asymptotically distribution free estimation method, suitable for ordinal data (3-point Likert Scale) and not-Guassian distribution. The comparative fit index (CFI) and the root mean square error of approximation (RMSEA) were calculated to evaluate the goodness of fit. Each variable was allowed to load on only one factor, and one variable loading in the latent factor was fixed at 1.0. For the remaining factor loadings, residual variances were freely estimated. Measurement invariance for gender was also tested.

We used the TAM packages of R.3.5.1 (Robitzsch, Kiefer, & Wu, 2020) for the MRCMLM estimates (item calibration and fit, DIF analysis), we used IBM SPSS 25.0 for correlation and reliability analyses and AMOS 25.0 for CFA.

Results

Study 1: Five-Point Scale

In the first study (N = 416), we conducted a comparison of the goodness of fit between MPCM and MRSM on the 41-item scale and a 5-point scale. We calculated the values of the deviance of each model (MPCM and MRSM), both the five-factor model and the four-factor model, and the comparison by using a chi-square test. In the five-factor model MPCM (deviance = 46221.1, parameters = 220) performed better than MRSM (deviance = 4 6926.2, parameters = 60), showing a significant better result ($\Delta\chi^2$ = 705.1, df = 160, p < .01). Also in the four-factor model the deviance of MRSM (deviance = 46611.9, parameters = 55) was greater than that of the MPCM (deviance = 46097.9, parameters = 215) and the chi-square test for the comparison was statistically significant ($\Delta\chi^2$ = 51.0, df = 160, p < .01), showing a better performance for the MPCM. Moreover, the comparison between the five-factor MPCM and four-factor MCPM showed that the four-factor structure better fits the dataset ($\Delta\chi^2$ = 123.2, df = 5, p < .001). We evaluated the internal consistency of the five subscales using Cronbach's alpha and EAP measure of Rasch reliability. Self-efficacy (M = 3.62, SD = 0.60), intrinsic value (M = 4.03, SD = 0.59), and test anxiety (M = 2.84, SD = 1.06) yielded an internal consistency of .77, .79, and .79, respectively, showing moderate internal consistency, and a reliability of .80, .78, and .79. Cognitive strategy (M = 3.53, SD = 0.55) reached an internal

consistency of .67, showing sufficient internal consistency and a reliability of .70. Self-regulation (M = 3.56, SD = 0.57) had an internal consistency of .49 and a reliability of .53, showing nonacceptable internal consistency, confirming that the five-factor structure does not fit with the data. For all these reasons, the psychometric properties of the four-factor structure of the 33-item MSLQ will be henceforth investigated.

Deviances of the MPCM and MRSM for the 33-item Italian version of the MSLQ among primary students were evaluated. The deviance of the MRSM (deviance = 37195.9, parameters = 47) was greater than that of the MPCM (deviance = 36749.7, parameters =175), and the chi-square test of the difference was statistically significant ($\Delta\chi^2$ = 446.2, df = 128, p < .01). The MPCM fit the data better.

We conducted the model data fit on the 33 items related to the four subscales and computed infit and outfit statistics. The ideal range of these statistics is between 0.6 and 1.4 (Wright et al., 1994). Step parameter analysis guaranteed the check of the sufficient ranking of the different response categories. Step parameters have to be monotonically increasing. Table 2 reports infit, outfit, difficulty, and step parameter values.

TABLE 2
Descriptive statistics, infit and outfit statistics, item and step difficulty parameter estimates — 5-point scale (range 1-5)

Item	*M*±*SD*	Difficulty (*SE*)	Infit MNSQ	Outfit MNSQ	Step 1	Step 2	Step 3	Step 4
Item 1	3.38±1.11	–1.41 (0.04)	1.00	1.00	–4.65	1.04	0.05	1.89
Item 2	3.60±1.04	–1.40 (0.05)	1.00	1.00	–4.09	1.31	–0.53	1.58
Item 3	2.51±1.32	–1.38 (0.04)	1.03	1.02	–6.90	1.81	1.00	2.22
Item 4	4.40±0.84	–1.61 (0.06)	1.00	1.00	–1.54	0.17	–0.44	1.21
Item 5	4.20±0.92	–1.50 (0.05)	1.00	1.00	–2.48	0.96	–0.53	0.98
Item 6	3.81±0.90	–1.54 (0.05)	1.00	1.00	–1.43	–1.78	–0.07	1.37
Item 7	3.64±1.12	–1.42 (0.04)	1.00	1.00	–3.90	0.80	0.15	1.58
Item 8	4.21±0.90	–1.51 (0.05)	1.00	1.00	–2.33	1.01	–0.78	1.05
Item 9	3.43±1.20	–1.43 (0.04)	1.00	1.00	–4.71	1.14	0.39	1.70
Item 10	3.87±0.86	–1.43 (0.06)	1.00	1.00	–2.64	0.71	–1.09	1.10
Item 11	2.76±1.39	–1.37 (0.04)	1.00	1.00	–5.92	1.60	1.14	2.00
Item 12	3.84±0.89	–1.42 (0.05)	1.00	1.00	–2.86	0.25	–0.35	0.95
Item 13	4.14±0.99	–1.48 (0.05)	1.00	1.00	–2.84	0.89	–0.07	1.03
Item 14	4.63±0.69	–1.71 (0.07)	1.00	1.00	–1.01	0.51	–0.75	1.00
Item 15	2.75±1.07	–1.30 (0.05)	1.00	1.00	–6.28	1.24	0.33	2.45
Item 16	4.06±0.92	–1.65 (0.06)	0.97	0.97	–2.34	0.40	–0.91	1.41
Item 17	2.70±1.14	–1.32 (0.04)	1.00	1.00	–6.26	1.30	0.60	2.42
Item 18	4.12±0.86	–1.48 (0.06)	1.00	1.00	–2.18	1.04	–1.20	0.91
Item 19	3.03±1.45	–1.41 (0.03)	1.00	1.00	–5.50	1.62	1.03	1.99
Item 20	4.35±0.89	–1.54 (0.06)	1.00	1.00	–2.45	1.69	–1.01	1.07
Item 21	3.05±1.26	–1.46 (0.04)	0.99	0.99	–5.67	1.17	0.65	2.24
Item 22	3.89±1.07	–1.43 (0.05)	1.00	1.00	–3.53	1.02	0.06	1.07
Item 24	3.35±1.28	–1.43 (0.04)	1.00	1.00	–4.75	0.89	0.88	1.74
Item 26	4.03±1.08	–1.47 (0.05)	1.00	1.00	–3.37	1.07	0.19	1.04
Item 27	4.02±1.07	–1.46 (0.05)	1.00	1.00	–3.49	1.64	–0.38	1.16
Item 28	4.50±0.81	–1.59 (0.06)	1.00	1.00	–2.36	1.79	–0.76	0.80
Item 29	2.61±1.36	–1.40 (0.04)	0.99	0.99	–6.82	2.00	0.85	1.89

(Table 2 continues)

Table 2 (continued)

Item	*M*±*SD*	Difficulty (*SE*)	Infit MNSQ	Outfit MNSQ	Step 1	Step 2	Step 3	Step 4
Item 32	3.68±1.23	–1.61 (0.04)	1.02	1.02	–4.69	1.17	0.51	1.51
Item 34	3.21±1.23	–1.40 (0.04)	1.00	1.00	–5.12	1.37	0.28	2.04
Item 36	2.63±1.22	–1.33 (0.04)	1.00	1.00	–6.37	1.66	0.58	2.41
Item 38	3.64±1.14	–1.42 (0.04)	1.00	1.00	–4.01	0.79	0.37	1.37
Item 39	3.88±1.28	–1.64 (0.04)	1.00	0.99	–4.49	1.48	0.66	1.31
Item 41	2.60±1.25	–1.31 (0.04)	1.00	1.00	–6.38	1.60	0.84	2.05

The values of infit and outfit MNSQ statistics ranged from 0.97 and 1.03, indicating an excellent fit of the model to the data. There were several problems with the step difficulty parameters. In many cases, the order of the steps was not preserved. In particular, the value of Step 2 was often greater than the value of Step 3 and close to the value of Step 4. This is because children tended to polarize the responses on the extreme response categories (*Completely false* or *Completely true*) or on the central and neutral response category (*Sometimes true and Sometimes false*). The choice of intermediate response categories (*Almost false* and *Almost true*) was unlikely.

The step parameters of adjacent response categories did not increase monotonically and in the expected direction; because the monotonicity of the step parameters is a basic assumption of the partial credit model and because a lack of step parameter monotonicity is considered disordered and suspect, the 5-point Likert scale is not a good solution for the MSLQ among primary students.

Study 2: Four-Point Scale

We conducted the second study (N = 147) on the 33-item 4-point scale due to the problems that children had using a 5-point scale. We performed a comparison of the goodness of fit between MPCM and MRSM. The deviance of the MRSM (deviance = 10717.4, parameters = 46) was greater than that of the MPCM (deviance = 10543.6, parameters = 142), and the chi-square test of the difference was statistically significant ($\Delta\chi^2$ = 173.8, df = 96, p < .01). The MPCM fit the data better. The four-factor structure presented good internal consistency, evaluated by Cronbach's alpha and EAP reliability measure. Self-efficacy (M = 2.96, SD = 0.44), intrinsic value (M = 3.39, SD = 0.43), and test anxiety (M = 2.26, SD = 0.83) yielded an internal consistency of .75, .79, and .83, respectively, and a reliability of .76, .75, and .81, showing good internal consistency and reliability. Cognitive strategy (M = 2.92, SD = 0.40) reached an internal consistency of .62 and a reliability of .67, showing a sufficient internal consistency. The item fit results are reported in Table 3.

The values of infit and outfit MNSQ statistics ranged from 0.87 to 1.29, indicating a good fit of the model to the data. As in the previous study, also using a 4-point scale, there were several problems with the step difficulty parameters. In many cases, the order of the steps was not preserved. In particular, the value of Step 2 was often greater than the value of Step 3. A 4-point scale seems to be an inadequate typology of scale for children, who struggle to use the different response categories correctly. For this reason, we conducted a third study using a 3-point scale.

TABLE 3
Descriptive statistics, infit and outfit statistics, item and step difficulty parameter estimates — 4-point scale (range 1-4)

Item	*M*±*SD*	Difficulty	Infit MNSQ	Outfit MNSQ	Step 1	Step 2	Step 3
Item 1	2.87±0.74	–1.79 (0.11)	1.00	1.00	–4.27	0.57	0.61
Item 2	2.93±0.86	–1.87 (0.10)	1.00	1.00	–4.24	0.80	1.00
Item 3	1.94±0.93	–1.62 (0.09)	1.00	1.00	–6.62	1.77	2.16
Item 4	3.67±0.64	–2.06 (0.13)	1.00	1.00	–2.58	1.54	0.31
Item 5	3.44±0.65	–2.27 (0.13)	0.93	0.93	–2.52	0.55	–0.11
Item 6	3.30±0.68	–2.24 (0.13)	1.00	1.00	–2.04	–0.91	0.53
Item 7	3.12±0.87	–1.84 (0.09)	1.00	1.00	–3.41	0.49	1.13
Item 8	3.41±0.66	–2.26 (0.13)	0.94	0.94	–2.54	0.41	–0.02
Item 9	2.95±0.93	–2.11 (0.10)	0.96	0.95	–4.90	1.24	1.10
Item 10	3.22±0.66	–1.89 (0.13)	1.00	1.00	–1.72	–0.91	0.30
Item 11	2.24±1.07	–1.75 (0.08)	1.00	1.00	–5.86	1.77	2.12
Item 12	3.21±0.68	–1.84 (0.12)	1.00	1.00	–2.70	0.36	0.01
Item 13	3.61±0.68	–2.02 (0.12)	1.00	1.00	–2.52	1.16	0.41
Item 14	3.80±0.49	–2.94 (0.17)	1.00	1.00	0.04	–2.88	1.90
Item 15	2.16±0.89	–1.59 (0.09)	1.00	1.00	–6.37	1.33	1.69
Item 16	3.42±0.66	–1.92 (0.13)	1.00	1.00	–2.11	0.51	–0.15
Item 17	1.99±0.84	–1.51 (0.10)	1.00	1.00	–6.76	1.26	2.05
Item 18	3.49±0.62	–2.29 (0.14)	0.94	0.95	–2.49	1.11	–0.65
Item 19	2.47±1.08	–1.76 (0.08)	1.00	1.00	–5.38	1.63	1.76
Item 20	3.60±0.64	–2.38 (0.14)	0.92	0.87	–2.47	0.77	0.21
Item 21	2.40±0.96	–1.86 (0.09)	1.24	1.29	–5.64	0.75	2.50
Item 22	3.32±0.77	–1.90 (0.11)	1.00	1.00	–2.51	0.09	0.78
Item 24	2.76±0.98	–1.80 (0.08)	1.00	1.00	–4.57	0.92	1.60
Item 26	3.27±0.77	–1.94 (0.11)	1.00	1.00	–1.58	–1.35	1.25
Item 27	3.35±0.79	–1.93 (0.10)	1.00	1.00	–2.52	0.02	1.10
Item 28	3.73±0.50	–2.98 (0.17)	1.00	1.00	–0.01	–2.61	0.92
Item 29	2.17±1.12	–1.75 (0.07)	1.00	1.00	–6.00	2.12	2.06
Item 32	3.23±0.87	–1.98 (0.10)	1.00	1.00	–3.64	0.87	1.11
Item 34	2.61±1.02	–1.76 (0.08)	1.00	1.00	–5.22	1.63	1.19
Item 36	2.15±1.04	–1.72 (0.08)	1.00	1.00	–6.15	1.92	1.90
Item 38	3.10±0.87	–1.89 (0.10)	1.00	1.00	–3.73	0.74	1.03
Item 39	2.95±1.14	–1.85 (0.07)	1.00	1.00	–4.67	2.25	1.13
Item 41	2.18±1.05	–1.80 (0.09)	1.07	1.08	–6.59	1.97	1.84

Study 3: Three-Point Scale

We conducted the third study (N = 127) on the 33-item 3-point scale due to the problems children had using a 4-point scale. In line with the previous studies, we performed a comparison of the goodness of fit between the MPCM (deviance = 7623.3, parameters = 109) and MRSM (deviance = 7782.4, parameters = 45), as well as model and item fit analyses. Once again, the MPCM fit the data better ($\Delta\chi^2$ = 159.1, df = 64, p < .01). We performed the internal consistency analysis by the ordinal alpha via empirical copula and

the reliability by EAP measure. The results are absolutely comparable with the ones obtained in the previous studies. Self-efficacy (M = 2.17, SD = 0.36), intrinsic value (M = 2.48, SD = 0.34), and test anxiety (M = 1.71, SD = 0.60) yielded an internal consistency of .76, .72, and .79, respectively, and a reliability of .80, .70, and .75, showing moderate internal consistency and reliability. Cognitive strategy (M = 2.17, SD = 0.29) reached an internal consistency of .62 and a reliability of .60, showing sufficient performances. The item fit results and DIF analysis for gender are reported in Table 4.

TABLE 4
Descriptive statistics, Infit and Outfit statistics, item and step difficulty parameter estimates, DIF analysis for gender – 3-point scale (range 1-3)

Item	*M*±*SD*	Difficulty (*SE*)	Infit MNSQ	Outfit MNSQ	Step 1	Step 2	DIF for gender (0 = male, 1 = female)
Item 1	2.06±0.65	–2.43 (0.14)	1.00	1.00	–4.57	1.25	–0.07
Item 2	2.12±0.66	–2.46 (0.13)	1.00	1.00	–4.34	1.24	0.01
Item 3	1.57±0.78	–2.41 (0.11)	1.00	1.00	–6.04	3.44	0.01
Item 4	2.81±0.45	–3.22 (0.20)	0.98	0.96	–2.74	1.33	0.03
Item 5	2.56±0.61	–2.75 (0.14)	1.00	1.00	–3.19	1.11	–0.04
Item 6	2.26±0.55	–2.56 (0.16)	1.00	1.00	–3.35	0.11	–0.03
Item 7	2.18±0.74	–2.50 (0.12)	1.00	1.00	–4.37	1.77	–0.09
Item 8	2.57±0.57	–2.82 (0.16)	1.00	1.00	–2.88	0.62	–0.02
Item 9	2.12±0.79	–2.50 (0.11)	1.00	1.00	–4.60	2.15	–0.12
Item 10	2.39±0.58	–2.67 (0.15)	1.00	1.00	–3.09	0.25	–0.05
Item 11	1.61±0.74	–2.40 (0.12)	0.98	0.98	–6.11	2.98	0.00
Item 12	2.28±0.61	–2.54 (0.14)	1.00	1.00	–3.62	0.67	0.00
Item 13	2.65±0.59	–2.95 (0.15)	1.00	1.00	–3.38	1.59	–0.10
Item 14	2.74±0.52	–2.95 (0.17)	1.00	1.00	–2.90	1.37	0.08
Item 15	1.53±0.60	–2.17 (0.15)	1.00	1.00	–6.62	2.41	–0.04
Item 16	2.52±0.56	–2.75 (0.16)	1.00	1.00	–2.61	0.14	–0.11
Item 17	1.52±0.64	–2.25 (0.14)	1.00	1.00	–6.48	2.68	0.04
Item 18	2.66±0.52	–2.85 (0.17)	1.00	1.00	–2.31	0.30	0.11
Item 19	1.71±0.75	–2.48 (0.12)	0.98	0.99	–5.95	2.73	0.03
Item 20	2.65±0.57	–2.98 (0.16)	0.99	0.99	–3.16	1.19	0.05
Item 21	1.98±0.80	–2.55 (0.11)	1.00	0.99	–5.17	2.38	0.08
Item 22	2.42±0.65	–2.62 (0.14)	1.00	1.00	–3.47	1.05	–0.05
Item 24	2.32±0.75	–2.68 (0.12)	1.07	1.09	–4.27	1.93	0.07
Item 26	2.53±0.64	–2.72 (0.14)	1.00	1.00	–3.36	1.33	0.03
Item 27	2.4±0.67	–2.60 (0.13)	1.00	1.00	–3.61	1.21	–0.06
Item 28	2.74±0.46	–2.90 (0.19)	1.00	1.00	–1.21	–0.56	0.11
Item 29	1.53±0.65	–2.29 (0.14)	0.99	0.98	–6.53	2.74	–0.01
Item 32	2.23±0.81	–2.55 (0.11)	1.00	1.00	–4.41	2.29	0.02
Item 34	1.93±0.78	–2.45 (0.11)	1.00	1.00	–5.12	2.32	0.04
Item 36	1.6±0.72	–2.37 (0.12)	1.00	1.00	–6.08	2.86	0.01
Item 38	2.33±0.66	–2.55 (0.13)	1.00	1.00	–3.72	1.11	–0.06
Item 39	2.31±0.82	–2.60 (0.11)	1.00	1.00	–4.33	2.53	0.14
Item 41	1.71±0.68	–2.37 (0.13)	1.00	1.00	–5.95	2.25	0.02

The infit and outfit statistics ranged from 0.96 to 1.07, indicating an excellent fit of the model. The step difficulty parameters for all the items had a sufficiently large range. By using a 3-point scale, the problem of monotonicity of the step parameters was solved. For all items, the difficulties of the steps were ordered so that second steps were more difficult than the first ones. A simplified scale structure was found to be more accessible for responding children. We used DIF analysis for detection purposes, and it was based on gender. We calculated the absolute values of differences of the overall item difficulties between the two groups determined by the gender to detect the DIF effect. All differences were smaller than 0.20 logits. Therefore, no items had substantial DIF for gender.

We obtained the score of each subscale as the summed score of the corresponding items. The correlations between the subscales are shown in Table 5, as well the correlations between the four subscales of the MSLQ and Academic Self-efficacy Beliefs Scale and the two subscales of AMOS QAS (anxiety and concentration) to evaluate the concurrent validity.

TABLE 5
Correlation between the subscales of the four-factor structure of MSLQ and between the subscales of the four-factor structure of MSLQ and Academic Self-efficacy Beliefs Scale and the two subscales of AMOS QAS (anxiety and concentration)

	Self-efficacy	Intrinsic value	Test anxiety	Cognitive strategy
Self-efficacy	-			
Intrinsic value	.49*	-		
Test anxiety	–.26*	–.04	-	
Cognitive strategy	.43*	.54*	.02	-
Academic Self-efficacy Beliefs Scale	.52*	.63*	–.20*	.53*
AMOS anxiety	–.33*	–.15*	.61*	–.04
AMOS concentration	.42*	.47*	–.25*	.41*

Note. *$p < .01$.

In this last study we verified that the Likert scale with 3 points had the best performance, on a sample of 129 respondents. In order to verify the robustness of the 3-point Likert scale on a bigger sample size, we aggregated the 5 points the Likert scale proposed in Study 1 in this way: we aggregated Categories 1 and 2 in the same Category 1, we left alone Category 3 (now it corresponds to Category 2), and we aggregated Categories 4 and 5 in the same Category 3. In this way we obtained a 3-points scale, and we tested the consistency and the performance of this scale on the sample of Study 1. Given the small number of categories, we performed the reliability analysis by using the ordinal alpha via empirical copula. Self-efficacy (M = 2.42, SD = 0.38), intrinsic value (M = 2.62, SD = 0.38), and test anxiety (M = 1.90, SD = 0.64) yielded an internal consistency of .76, .72, and .79, respectively, while cognitive strategy (M = 2.31, SD = 0.33) had an internal consistency of .62. The item fit results are reported in Table 6. This last check confirms the robustness of a 3-point Likert scale in this context.

CFA showed reasonable goodness- of- fit indices. The fit indices met the criteria of fit for the hypothesized factorial structure. Goodness-of-fit indices (CFI = .906, RMSEA = .036) suggested that the model is coherent with the data. All factor loadings had an acceptable value: they ranged from .34 to .64 for self-efficacy, from .46 to .61 for intrinsic value, from .54 to .77 for test anxiety, and from .33 to .68 for cognitive use.

To verify the validity and generalizability of the factor structure, a multigroup CFA tested measurement invariance in the two subsamples divided by gender. The $\Delta\chi^2$ between the unconstrained and constrained models did not yield significant results ($\Delta\chi^2 = 34.45$, $df = 29$, $p < .22$). The factorial structure was invariant by gender.

TABLE 6
Descriptive statistics, infit and outfit statistics, item and step difficulty parameter estimates — 3-point scale (range 1-3) on data of Study 1

Item	*M*±*SD*	Difficulty (*SE*)	Infit MNSQ	Outfit MNSQ	Step 1	Step 2
Item 1	2.26±0.73	–2.43 (0.14)	1.00	1.00	–4.57	1.25
Item 2	2.43±0.67	–2.46 (0.13)	1.00	1.00	–4.34	1.24
Item 3	1.73±0.81	–2.45 (0.12)	1.07	1.13	–6.25	3.46
Item 4	2.80±0.45	–3.31 (0.20)	0.99	1.00	–2.77	1.30
Item 5	2.74±0.52	–2.75 (0.14)	1.00	1.00	–3.19	1.11
Item 6	2.56±0.61	–2.70 (0.16)	0.96	0.96	–3.54	0.12
Item 7	2.41±0.72	–2.50 (0.12)	1.00	1.00	–4.37	1.77
Item 8	2.75±0.50	–2.82 (0.16)	1.00	1.00	–2.88	0.62
Item 9	2.28±0.77	–2.62 (0.12)	0.99	0.99	–4.81	2.17
Item 10	2.63±0.55	–2.67 (0.15)	1.00	1.00	–3.09	0.25
Item 11	1.85±0.85	–2.40 (0.12)	1.00	1.00	–6.05	2.99
Item 12	2.61±0.60	–2.54 (0.14)	1.00	1.00	–3.62	0.67
Item 13	2.70±0.58	–2.83 (0.15)	1.00	1.00	–3.22	1.54
Item 14	2.90±0.33	–2.95 (0.17)	1.00	1.00	–2.90	1.37
Item 15	1.86±0.72	–2.17 (0.15)	1.00	1.00	–6.62	2.41
Item 16	2.67±0.54	–2.75 (0.16)	1.00	1.00	–2.61	0.14
Item 17	1.82±0.75	–2.28 (0.14)	1.00	1.00	–6.69	2.70
Item 18	2.74±0.49	–2.85 (0.17)	1.00	1.00	–2.31	0.30
Item 19	2.00±0.87	–2.61 (0.12)	1.00	1.00	–6.18	2.88
Item 20	2.79±0.47	–2.85 (0.16)	1.00	1.00	–2.99	1.14
Item 21	2.02±0.81	–2.46 (0.11)	1.00	1.00	–5.00	2.33
Item 22	2.58±0.66	–2.62 (0.14)	1.00	1.00	–3.47	1.05
Item 24	2.20±0.82	–2.57 (0.12)	1.00	1.00	–4.08	1.87
Item 26	2.63±0.64	–2.89 (0.14)	0.98	0.97	–3.54	1.34
Item 27	2.63±0.62	–2.60 (0.13)	1.00	1.00	–3.61	1.21
Item 28	2.85±0.42	–3.09 (0.20)	0.98	0.97	–1.35	–0.57
Item 29	1.82±0.84	–2.27 (0.14)	1.00	1.00	–6.43	2.72
Item 32	2.43±0.76	–2.55 (0.11)	1.00	1.00	–4.41	2.29
Item 34	2.14±0.78	–2.45 (0.11)	1.00	1.00	–5.12	2.32
Item 36	1.79±0.77	–2.37 (0.12)	1.00	1.00	–6.08	2.86
Item 38	2.42±0.74	–2.55 (0.13)	1.00	1.00	–3.72	1.11
Item 39	2.52±0.75	–2.60 (0.11)	1.00	1.00	–4.33	2.53
Item 41	1.78±0.80	–2.37 (0.13)	1.00	1.00	–5.95	2.25

Discussion and Conclusion

Since its construction, the MSLQ has been successfully used to evaluate the motivation and the use of learning strategies among students of different grades. The assessment of motivation and cognitive strategies at an early age and during the whole school career can be very important given their major influence on the students' achievement (Pintrich, 2000; Zimmerman & Schunk, 2001). Moreover, assessing these aspects may prove useful from the perspective of prevention, namely, to implement interventions aimed at developing these competences and limiting subsequent situations of early school dropout. It is therefore important that this evaluation is carried out during primary school using tools adapted to the different cultural contexts and that demonstrate validity and psychometric consistency. Despite its large employment, few researchers have assessed the psychometric properties of MSLQ among primary school students. Moreover, in the Italian context, there is a lack of available assessment tools evaluating metacognition, self-regulation, and emotional–motivational aspects in this age range; therefore, we believed that the validation of a relevant tool such as the MSLQ would be especially valuable. To evaluate the psychometric properties of MSLQ we employed Rasch analysis, a modern advanced psychometric method, widely used to investigate the psychometric properties of instruments in humanities and social sciences. This approach has been recently employed in the evaluation of MSLQ among high school students (Bonanomi et al., 2018; Lee et al., 2010).

This paper had different aims. We aimed to comparatively test the factorial structure for our Italian primary school sample, taking into account Pintrich and DeGroot's (1990) five-factor structure and the four-factor structure proposed by Rao and Sachs (1999) and evaluating the internal consistency of the MSLQ subscales. This analysis allowed us to identify the four-factor structure, composed by 33 items, as the most fitting solution. Rao and Sachs (1999) obtained a four-factor solution because in their study cognitive strategy use and self-regulation subscales saturated the same factor. In our study, instead, we obtained a four-factor solution because in our sample the self-regulation subscale did not fit the data. Indeed, self-efficacy, intrinsic value, test anxiety, and cognitive strategy use showed moderate or sufficient internal consistency. On the contrary, measurement of self-regulation was problematic, and this subscale showed nonacceptable internal consistency. Possibly, self-regulation is still a competence under construction in this age group: Consistent with this argument, other studies have shown that 7- to 8-year-old children seldom monitor, control, and evaluate their cognitive processes compared to 11- to 12-year-olds (Paris & Newman, 1990; Zimmerman, 1989). The awareness of the effectiveness of strategies and the ability to regulate effort according to objectives increases with age, starting from preadolescence (Pressley, Levin, & Ghatala, 1984), when children become able to reflect more precisely on their cognitive processes and therefore monitor their performance in different contexts (Berk, 2003; Veenman & Spaans, 2005). Moreover, it is worth noting that other researchers who have analyzed the factorial structure of the MSLQ used samples of primary students of older ages. For example, Kaya and Kablan (2013) considered a sample of children aged 10 to 11 years, and Law et al. (2008) reported an average age of 11 years and 9 months. Consistent with these findings, our results show that the tool proved to be valid for measuring the general metacognitive competence in children, in terms of knowledge and use of effective study strategies. The most problematic aspect, therefore, appears to be self-regulation rather than the metacognitive attitude of children, which is instead appropriately captured. These considerations, along with our findings, lead to the conclusion that academic self-regulation is probably a difficult competence to investigate in children aged 8-9 years, especially when self-report measures are used.

Then, we investigated the item fit of the MSLQ and we found that the 5-point Likert scale is not a good solution for the MSLQ among primary students. The children of our sample, in fact, tended to polarize the responses on the categories *Always false*, *Always true*, and on the central response category (*Sometimes true* and *Sometimes false*). Therefore, we carried out second and third studies to evaluate the psychometric proprieties of the 33-item version by using a 4-point scale and a 3-point scale, respectively. From these studies it emerged that a simplified number of response modalities (3-point scale) was more accessible to primary school students. Previous researchers had already modified the response format using a 4-point Likert-like format with 10- to 11-year-old children (Altun, 2005; Milner, Templin, & Czerniak, 2011). We believe that with younger children, such as the ones in our sample, a 3-point scale results in clearer ratings. DIF analysis showed that no items had substantial DIF for gender, suggesting that this instrument can be administered to both male and female students, as previously found with high school students (Bonanomi et al., 2018). Having a valid tool for both males and females will allow considering in future studies gender differences regarding motivation and cognitive strategies. This solution has been confirmed by a check of robustness of the 3-point Likert scale on a bigger sample size, aggregating the 5-point Likert scale proposed in Study 1. Moreover, a CFA has validated the factorial structure of the instrument and the invariance by gender.

Lastly, our analyses permitted us to find good evidence for concurrent validity, an aspect that previous research on MSLQ has little considered (Bonanomi et al., 2018), despite its importance in the assessment of psychometric properties. The analysis showed that MSLQ presents coherent correlations with measures evaluating academic self-efficacy, anxiety, and concentration. In particular, the Academic Self-Efficacy Beliefs Scale (Pastorelli & Picconi, 2001) presents significant and positive correlations with self-efficacy, intrinsic value, and cognitive strategy use, and a significant and negative correlation with test anxiety, as already found with Italian adolescents (Bonanomi et al., 2018). In particular, the AMOS QAS anxiety subscale (Cornoldi et al., 2005) presented a significant and positive correlation with test anxiety and negative correlations with self-efficacy and intrinsic value. The AMOS QAS concentration subscale (Cornoldi et al., 2005) presented significant and positive correlations with self-efficacy, intrinsic value, and cognitive strategy use and a significant and negative correlation with test anxiety.

The study presents some limitations. First of all, findings cannot be generalized due to the use of a nonrandom sampling method. Secondly, the study design was cross-sectional. Longitudinal research is needed for a clearer understanding of change over time of motivation and self-regulating strategies.

Despite these limitations, we believe that this study fills two important gaps in research. Our study, in fact, is the first to validate the MSLQ in a sample of third-, fourth-, and fifth-grade students and permitted us to identify a reliable instrument to evaluate metacognition, emotional, and motivational aspects within the Italian context. We argue indeed for the importance of measuring these skills in primary school to offer teachers an opportunity to enhance metacognitive competences that can make a difference in learning performance. It seems important that teachers, in addition to transferring contents, focus on making children more aware of their learning process by teaching effective strategies and guiding them toward motivational attitudes functional to the school context.

References

Adams, R. J., Wilson, M., & Wang, W. C. (1997). The multidimensional random coefficients multinomial logit model. *Applied Psychological Measurement*, *21*, 1-23. https://doi.org/10.1177/0146621697211001

Albanese, O., Businaro, N., Cacciamani, S., De Marco, B., Farina, E., Ferrini, T., & Vanin, L. (2010). Riflessione metacognitiva in ambienti online e autoregolazione nell'attività di studio nei corsi universitari [Metacognitive reflexion in online environments and self-regulation in study activities in university courses]. *TD-Tecnologie Didattiche*, *49*, 50-61. https://doi.org/10.17471/2499-4324/291

Altun, S. (2005). *Öğrencilerin öz düzenlemeye dayali öğrenme stratejilerinin ve öz yeterlik algilarinin öğrenme stilleri ve cinsiyete göre matematik başarisini yordama gücü* [The predictive power of students' self-regulated learning strategies and self-efficacy perceptions on mathematics achievement according to learning styles and gender] [Unpublished doctoral dissertation]. Yıldız Teknik University, Turkey.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, *37*(2), 122-147.

Battistelli, P., Cadamuro, A., Farneti, A., & Versari, A. (2009). Do university students know how they perform? *International Electronic Journal of Elementary Education*, *2*(1), 181-198.

Berk, L. E. (2003). *Child Development* (6th ed.). Boston, MA: Allyn and Bacon.

Boekaerts, M. (1999). Self-regulated learning: Where we are today. *International Journal of Educational Research*, *31*, 445-457. https://doi.org/10.1016/S0883-0355(99)00014-2

Bonanomi, A., Cantaluppi, G., Ruscone, M. N., & Osmetti, S. A. (2015). A new estimator of Zumbo's Ordinal Alpha: A copula approach. *Quality & Quantity*, *49*, 941-953. https://doi.org/10.1007/s11135-014-0114-8

Bonanomi, A., Olivari, M. G., Mascheroni, E., Gatti, E., & Confalonieri, E. (2018). Using a multidimensional Rasch analysis to evaluate the psychometric properties of the Motivated Strategies for Learning Questionnaire (MSLQ) among high school students. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, *25*, 83-100. https://doi.org/10.4473/TPM25.1.5

Bong, M., Cho, C., Ahn, H. S., & Kim, H. J. (2012). Comparison of self-beliefs for predicting student motivation and achievement. *The Journal of Educational Research*, *105*, 336-352. https://doi.org/10.1080/00220671.2011.627401

Briggs, D. C., & Wilson, M. (2003). An introduction to multidimensional measurement using Rasch models. *Journal of Applied Measurement*, *4*(1), 87-100.

Brown, A. L. (1978). Knowing when, where, and how to remember: A problem of metacognition. In R. Glaser (Ed.), *Advances in Instructional Psychology* (vol. 1, pp. 77-165). Hillsdale, NJ: Erlbaum.

Brown, A. L., Bransford, J. D., Ferrara, R. A., & Campione, J. (1983). Learning, understanding, and remembering. In J. H. Flavell, & E. M. Markman (Eds.), *Handbook of child psychology: Vol. 3. Cognitive development* (4th ed., pp. 77-166). New York, NY: Wiley.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, *65*, 245-281. https://doi.org/10.3102/00346543065003245

Caputo, A. (2014). Psychological correlates of school bullying victimization: Academic self-concept, learning, motivation and test anxiety. *International Journal of Educational Psychology*, *3*, 69-99. https://doi.org/10.4471/ijep.2014.04

Chang, S. (2007). Academic perceptions of the use of Lectopia: A University of Melbourne example. In *ICT: Providing choices for learners and learning. Proceedings ascilite Singapore 2007*. Retrieved from http://www.ascilite.org.au/conferences/singapore07/procs/chang.pdf

Chung, M. K. (2000). The development of self-regulated learning. *Asia Pacific Education Review*, *1*(1), 55-66. https://doi.org/10.1007/BF03026146

Corno, L. (1986). The metacognitive control components of self-regulated learning. *Contemporary Educational Psychology*, *11*(4), 333-346. https://doi.org/10.1016/0361-476x(86)90029-9

Cornoldi, C., De Beni, R., Zamperlin, C., & Meneghetti, C. (2005). *AMOS 8-15. Abilità e motivazione allo studio: Prove di valutazione per ragazzi dagli 8 ai 15 anni. Manuale e protocolli* [AMOS 8-15. Ability and motivation to study: Assessment tests for children aged 8 to 15. Manual and protocols]. Trento, Italy: Edizioni Erickson.

Credé, M., & Phillips, L. A. (2011). A meta-analytic review of the Motivated Strategies for Learning Questionnaire. *Learning and Individual Differences*, *21*, 337-346. https://doi.org/10.1016/j.lindif.2011.03.002

Dignath, C., Buettner, G., & Langfeldt, H. P. (2008). How can primary school students learn self-regulated learning strategies most effectively? A meta-analysis on self-regulation training programmes. *Educational Research Review*, *3*, 101-129. https://doi.org/10.1016/j.edurev.2008.02.003

EU Council. (July 2002). *Council resolution of 27 June 2002 on lifelong learning*. Official Journal of the European Communities.

Garcia, T., & Pintrich, P. R. (1993). *Self-schemas, motivational strategies, and selfregulated learning*. Paper presented at the Annual Meeting of the American Educational Research Association, Atlanta, GA.

Garcia, T., & Pintrich, P. R. (1996). The Effects of autonomy on motivation and performance in the college classroom. *Contemporary Educational Psychology*, *21*, 477-486. https://doi.org/10.1006/ceps.1996.0032

Gulikers, J. T., Bastiaens, T. J., Kirschner, P. A., & Kester, L. (2006). Relations between student perceptions of assessment authenticity, study approaches and learning outcome. *Studies in Educational Evaluation*, *32*, 381-400. https://doi.org/10.1016/j.stueduc.2006.10.003

Honicke, T., & Broadbent, J. (2016). The influence of academic self-efficacy on academic performance: A systematic review. *Educational Research Review*, *17*, 63-84. https://doi.org/10.1016/j.edurev.2015.11.002

Jossberger, H., Brand-Gruwel, S., Boshuizen, H., & Van de Wiel, M. (2010). The challenge of self-directed and self-regulated learning in vocational education: A theoretical analysis and synthesis of requirements. *Journal of Vocational Education and Training*, *62*, 415-440. https://doi.org/10.1080/13636820.2010.523479

Kaldi, S., Filippatou, D., & Govaris, C. (2011). Project-based learning in primary schools: Effects on pupils' learning and attitudes. *Education 3-13*, *39*(1), 35-47. https://doi.org/10.1080/03004270903179538

Kaya, S., & Kablan, Z. (2013). Assessing the relationship between learning strategies and science achievement at the primary school level. *Journal of Baltic Science Education*, *12*(4), 525-534.

Kitsantas, A., Steen, S., & Huie, F. (2009). The role of self-regulated strategies and goal orientation in predicting achievement of elementary school children. *International Electronic Journal of Elementary Education*, *2*(1), 65-81.

Law, Y. K., Chan, C. K., & Sachs, J. (2008). Beliefs about learning, self-regulated strategies and text comprehension among Chinese children. *British Journal of Educational Psychology*, *78*, 51-73. https://doi.org/10.1348/000709907X179812

Lee, J., & Stankov, L. (2013). Higher-order structure of noncognitive constructs and prediction of PISA 2003 mathematics achievement. *Learning and Individual Differences*, *26*, 119-130. https://doi.org/10.1016/j.lindif.2013.05.004

Lee, J. C. K., Zhang, Z., & Yin, H. (2010). Using multidimensional Rasch analysis to validate the Chinese version of the Motivated Strategies for Learning Questionnaire (MSLQ-CV). *European Journal of Psychology of Education*, *25*, 141-155. https://doi.org/10.1007/s10212-009-0009-6

Lindner, R., Harris, B., & Gordon, W. (1986). The design and development of the Self Regulated Learning Inventory: A status report. *American Educational Research Association*, *1*, 1-15.

Metallidou, P., & Vlachou, A. (2007). Motivational beliefs, cognitive engagement, and achievement in language and mathematics in elementary school children. *International Journal of Psychology*, *42*, 2-15. https://doi.org/10.1080/00207590500411179

Michalsky, T., Mevarech, Z. R., & Haibi, L. (2009). Elementary school children reading scientific texts: Effects of metacognitive instruction. *The Journal of Educational Research*, *102*, 363-376. https://doi.org/10.3200/JOER.102.5.363-376

Milner, A. R., Templin, M. A., & Czerniak, C. M. (2011). Elementary science students' motivation and learning strategy use: Constructivist classroom contextual factors in a life science laboratory and a traditional classroom. *Journal of Science Teacher Education*, *22*, 151-170. https://doi.org/10.1007/s10972-010-9200-5

Paris, S. G., & Newman, R. S. (1990). Development aspects of self-regulated learning. *Educational Psychologist*, *25*, 87-102. https://doi.org/10.1207/s15326985ep2501_7

Paris, S. G., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist*, *36*, 89-101. https://doi.org/10.1207/S15326985EP3602_4

Paris, S. G., & Winograd, P. (1990). How metacognition can promote academic learning and instruction. In B. F. Jones & L. Idol (Eds.), *Dimensions of thinking and cognitive instruction* (pp. 15-51). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Park, S. H. (1995). Learning strategy use of at-risk students. *Korean Journal of Thinking and Problem Solving*, *5*, 31-46.

Pastorelli, C., & Picconi, L. (2001). Scala di Autoefficacia Scolastica Percepita [Perceived Scholastic Self-efficacy Scale]. In G. V. Caprara (ed.), *La valutazione dell'autoefficacia.* Trento, Italy: Edizioni Erickson.

Perels, F., & Otto, B. (2009). Förderung selbstregulierten Lernens im Vor-und Grundschulalter [Promoting self-regulated learning in pre-school and primary school age]. In F. Hellmich & S. Wernke (Eds.), *Lernstrategien im Grundschulalter. Konzepte. Befunde und praktische Implikationen* (pp. 174-193). Stuttgart, Germany: W. Kohlhammer GmbH Stuttgart.

Perry, N., Phillips, L., & Dowler, J. (2004). Examining features of tasks and their potential to promote self-regulated learning. *Teachers College Record*, *106*, 1854-1878. https://doi.org/10.1111/j.1467-9620.2004.00408.x

Pintrich, P. R. (1989). The dynamic interplay of student motivation and cognition in the college classroom. In C. Ames & M. L. Machr (Eds.), *Advances in Motivation and Achievement*: Motivation enhancing environments (Vol. 6, pp. 117-160). Greenwich, CT: JAI Press.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451-502). San Diego, CA: Academic.

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review*, *16*, 385-407. https://doi.org/10.1007/s10648-004-0006-x

Pintrich, P. R., & DeGroot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, *82*, 33-40. https://doi.org/10.1037/0022-0663.82.1.33

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). *A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ).* Ann Arbor, MI: National Centre for Research to Improve Postsecondary Teaching and Learning.

Pintrich, P. R., Smith, D. A., García, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and Psychological Measurement, 53,* 801-813. https://doi.org/10.1177/0013164493053003024

Poliandri, D., Cardone, M., Muzzioli, P., & Romiti, S. (2011). *A rating scale model for a scale of Test Anxiety in Italy* (Working Paper No. 11/2011). National Institute for the Educational Evaluation of Instruction and Training (INVALSI). http://dx.doi.org/10.2139/ssrn.1856110

Pressley, M., Levin, J. R., & Ghatala, E. S. (1984). Memory strategy monitoring in adults and children. *Journal of Verbal Learning and Verbal Behavior, 23,* 270-288. https://doi.org/10.1016/S0022-5371(84)90181-6

Rao, N., & Sachs, J. (1999). Confirmatory factor analysis of the Chinese version of the motivated strategies for learning questionnaire. *Educational and Psychological Measurement, 59,* 1016-1029. https://doi.org/10.1177/00131649921970206

Robitzsch A., Kiefer T., & Wu M. (2020). *TAM: Test Analysis Modules* [R package version 3.5-2]. https://CRAN.R-project.org/package=TAM

Rost, J., & Carstensen, C. H. (2002). Multidimensional Rasch measurement via item component models and faceted designs. *Applied Psychological Measurement, 26*(1), 42-56. https://doi.org/10.1177/0146621602026001003

Roth, A., Ogrin, S., & Schmitz, B. (2016). Assessing self-regulated learning in higher education: a systematic literature review of self-report instruments. *Educational Assessment, Evaluation and Accountability, 28,* 225-250. https://doi.org/10.1007/s11092-015-9229-2

Schneider, W., & Lockl, K. (2002). The development of metacognitive knowledge in children and adolescents. In T. J. Perfect & B. L. Schwartz (Eds.), *Applied metacognition* (pp. 224-257). Cambridge, UK: Cambridge University Press.

Schunk, D. H., & Ertmer, P. A. (2000). *Self-regulation and academic learning: Self-efficacy enhancing interventions.* In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 631-649). San Diego, CA: Academic Press. https://doi.org/10.1016/B978-012109890-2/50048-2

Shores, M. L., & Shannon, D. M. (2007). The effects of self-regulation, motivation, anxiety, and attributions on mathematics achievement for fifth and sixth grade students. *School Science and Mathematics, 107,* 225-236. https://doi.org/10.1111/j.1949-8594.2007.tb18284.x

Sink, C. A., Barnett, J. E., & Hixon, J. E. (1991). Self-regulated learning and achievement by middle-school children. *Psychological Reports, 69*(3), 979-989.

Veenman, M. V., & Spaans, M. A. (2005). Relation between intellectual and metacognitive skills: Age and task differences. *Learning and Individual Differences, 15,* 159-176. https://doi.org/10.1016/j.lindif.2004.12.001

Wang, M. C., Haertel, G. D., & Walberg, H. J. (1993). Toward a knowledge base for school learning. *Review of Educational Research, 63,* 249-294. https://doi.org/10.3102/00346543063003249

White, R. T., & Mitchell, I. J. (1994). Metacognition and the quality of learning. *Studies in Science Education, 23*(1), 21-37. https://doi.org/10.1080/03057269408560028

Wright, B. D., Linacre, J. M., Gustafson, J. E., & Martin-Lof, P. (1994). Reasonable mean-square fit values. *Rasch Measurement Transactions, 8*(3), 370-371.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81*(3), 329-339.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25,* 3-17. https://doi.org/10.1207/s15326985ep2501_2

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into practice, 41,* 64-70. https://doi.org/10.1207/s15430421tip4102_2

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal, 45,* 166-183. https://doi.org/10.3102/0002831207312909

Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal, 23,* 614-628. https://doi.org/10.3102/00028312023004614

Zimmerman, B. J., & Schunk, D. H. (Eds.) (2001). *Self-regulated learning and academic achievement: Theoretical perspectives* (2nd ed.). Mahwah, NJ: Erlbaum.