Revised Motivated Strategies for Learning Questionnaire for Secondary School Students

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Abstract

The purpose of the current study was to examine the psychometric properties of the MSLQ for junior high school students. The MSLQ for junior high students is a 44 item self-reported instrument consisting of three motivational beliefs subscales, one Cognitive Strategy subscale and one Self-regulation subscale. A total of 780 students from eight secondary schools in Singapore completed the MSLQ. In the first sample, there were 393 students who completed the junior high school version of the MSLQ. A second sample of 387 students completed the modified MSLQ. This study showed that the original junior high school version of the MSLQ measurement model needed to be revised. The modified MSLQ measurement model was confirmed via CFA with a second sample with two other competing models. Convergent and discriminant validity was supported. Multigroup analysis demonstrated invariance of the factor forms, factor loadings, factor variances and covariances, and error variances across gender. In summary, this current study contributes significantly to the validation of the MSLQ for junior high students in the Asian context.

Keywords: Confirmatory Factor Analysis (CFA), Motivated Strategies for Learning Questionnaire (MSLQ), psychometric, multigroup analysis

It is well established that in the area of educational psychology that motivation and cognition play a pivotal role in students' learning and academic performance (Pintrich, 1988, 1989; Printrich, Cross, Kozma, & McKeachie, 1986). Cognition refers to the cognitive and metacognitive strategies that the students engage in their learning. However, to enhance learning and achievement, students must be motivated to employ and regulate these cognitive and metacognitive strategies.

The Motivated Strategies for Learning Questionnaire (MSLQ) was developed using a social cognitive framework by Pintrich and his colleagues (Duncan & McKeachie, 2005; Pintrich, Smith, Gracia, & McKeachie, 1991, 1993). This social cognitive view of motivation and cognition postulates that cognitive strategies can be acquired and regulated by the students and that motivation is dynamic and contextually bounded (Duncan & McKeachie, 2005). Under this framework, motivation can be regulated through various motivational beliefs such as goal orientation, self-efficacy, perception of task difficulty, task value beliefs, and personal interest in the task. In addition, affect such as test anxiety is used as another general motivational construct. Based on a general cognitive model of learning and information processing, Pintrich includes specific cognitive learning strategies such as rehearsal, elaboration and organizational strategies, metacognitive and self-regulatory strategies (Pintrich, 1999). Taken together, the actual act of engaging in self-regulated learning involves use of various cognitive and self-regulatory strategies which demands more time and effort for students,

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and would need considerable motivation on the learner's part (Duncan & McKeachie, 2005).

The MSLQ measures two different components; motivation and learning strategies. In the motivation component, there are items to measure three key motivational constructs. These are: value beliefs, self-efficacy, and test anxiety. This is a typical expectancy-value model of motivation (Pintrich, 1988, 1989). In the learning strategies component, there are also three general types of scales: cognitive, metacognitive, and resource management. The full version of the MSLQ has a total of 81 items with 15 scales and was based on the conceptual model of college student motivation and self-regulated learning developed by Pintrich and his colleagues (Pintrich et al., 1993). There is also a shortened version of the MSLQ for junior high school students (Pintrich & De Groot, 1990). This version was developed as Pintrich and De Groot (1990) were aware of the need for a more manageable and simplified version for the younger participants. The original version was designed to assess college students. Factor analysis from the study indicated a three-factor structure for the motivational beliefs component and a two-factor structure for the component on self-regulated learning strategies. The self-report questionnaire consists of 44 items with five subscales under the two components namely, self-efficacy, intrinsic value, test anxiety, cognitive strategy use and self-regulation. Although the authors did exploratory factor analysis, the results were not presented.

A number of studies have sought to examine the psychometric properties of the full version of the MSLQ. Pintrich and colleagues for instance, have reported on the reliability and validity of the college version (Pintrich et al., 1991, 1993). Other researchers have also examined the college version of the MSLQ with different populations (e. g., Cook, Thompson, & Thomas, 2011), or different languages and adaptations of the MSLQ such as the Turkish adaptation of the MSLQ-college version (e. g., Karadeniz et. al., 2008) and the Chinese version of the MSLQ-junior high school version (e. g., Rao & Sachs, 2001). But very few studies have examined the psychometric properties of the shortened version of the MSLQ meant for junior high school children. There is a need for equal attention to be paid to the junior high school version of the MSLQ if it is to be used for such a sample. In addition, it is very important to examine the issue of invariance in the development of a measurement tool (Byrne, 1994; Li, Harmer, Chi, & Vongjaturapat, 1996) because the items used in survey-type instruments may not convey the same meaning to students from different age or gender groups. The purpose of the current study was to examine the psychometric properties of the shortened version of the MSLQ for secondary school students (grade 7 to 10 in the US education system).

In previous studies, the MSLQ is frequently asserted to be a relatively useful, valid and reliable instrument (e. g., Pintrich et al., 1991, 1993). Nevertheless, findings regarding the factorial validity and reliability of the MSLQ vary widely. For instance, factor analyses of the MSLQ led Pintrich and his colleagues (1993) to conclude generally although somewhat tentatively that "the results suggest that the MSLQ has relatively good reliability in terms of internal consistency. The general

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theoretical framework and the scales that measure it seem to be valid given the results of the two confirmatory factor analyses" (p. 811-812). On the other hand, recent analyses by Dunn, Lo, Mulvenon, and Sutcliffe (2011) call the preceding conclusion into question when they demonstrated a lack of alignment with Pintrich and colleagues (1991, 1993) original model.

Credé and Phillips (2011) conducted a meta-analytic review of the MSLQ. These researchers concluded that "factor-analysis of the meta-analytic intercorrelations broadly support the theoretical structure of the MSLQ" (p.1). But recommend that "alternation or elimination of items with undesirable psychometric characteristics could potentially both augment empirical support for the theoretical structure of the MSLQ and strengthen its subscales' predictive utility…" (p. 1). A similar argument has been put forth by Rotgans and Schmidt (2010) who assert that "although the MSLQ has been portrayed as a reliable and valid instrument…and has been used in a variety of studies across various courses, content areas, and countries…closer examination of its psychometric properties suggest there is room for improvement…" (p. 360).

Thus despite the MSLQ having been widely used around the world in many different languages and countries with diverse samples and settings, different factor structures emerge from different research studies with junior high school and college students (Pintrich & De Groot, 1990; Pintrich et al., 1993) calling into question its factorial validity and reliability. The reason for this pattern of highly discrepant findings is unclear. However, it may be a result of issues associated with the statistical analyses and interpretations employed.

When using Exploratory Factor Analysis (EFA), items and factors in the MSLQ have been deleted due to a lack of correlation or stable factor structure (e.g., Pintrich & De Groot, 1990). And while Confirmatory Factor Analyses (CFAs) have largely superceded traditional applications of EFA in psychological and applied statistical research (e. g., Marsh et al., 2009; Asparouhov & Muthén, 2009), previous studies using CFAs have demonstrated that the MSLQ measurement model lacks satisfactory fit indexes (e. g., GFI = .78, AGFI = .75, $\chi^2/df = 2.26$, RMR = .08, in Pintrich et al., 1993), producing model fit statistics that are just on the edge of what is commonly considered acceptable (Rotgans & Schmidt, 2010).

Marsh and colleagues (e. g., Marsh, 2007; Marsh et. al., 2009) have asserted that many psychological instruments may have a well-defined EFA structure, but cannot be represented adequately within the CFA approach. Furthermore, with the broad definition of the MSLQ constructs, it is not surprising that the CFA results are poor in previous studies (Davenport, 2003; Pintrich et al., 1993; Sachs, Law, Chan, & Rao, 2001). In this study, we attempted to combine the EFA and CFA with two samples in order to search for a well-fitting measurement model.

To summarise, the purpose of the present study was to examine the psychometric properties of the junior high school version of the MSLQ. Specifically, we ought to examine the factor validity in terms of convergent validity and discriminant validity and the internal consistency of the measurement model. In addition, we aimed to test the measurement model against three alternative models

 ISSN 2094-1420

and to confirm the proposed measurement model with a separate sample. Finally, we sought to test the invariance of the measurement model across gender.

Method

Participants

A total of 780 students from eight secondary schools in Singapore completed the MSLQ. In the first sample, there were 393 students who completed the junior high school version of the MSLQ. A second sample of 387 students completed the modified MSLQ. There were 425 boys and 351 girls (4 did not state gender) ranging in age from 13-16 years old (M = 13.29, SD = .94).

Procedure

The MSLQ was administered with reference to specific subjects – in this case, either Mathematics or Science. Participants were assured of the confidentiality of their responses and informed that there were no right or wrong answers. They were encouraged to ask questions if necessary. Completion of the questionnaires took about ten minutes. The procedure for conducting this study was cleared by the university's ethical review committee.

Measures

Motivated Strategies for Learning Questionnaire (MSLQ). The junior high school version of the MSLQ (Pintrich & De Groot, 1990), includes 44 items on student motivation, cognitive strategy use, metacognitive strategy use, and management of effort. Students respond to items on a 7-point Likert scale (1= not at all true of me to 7 = very true of me) in terms of their behavior in a specific class. There were scales to measure students' self-efficacy (9 items), intrinsic value (9 items), test anxiety (4 items), cognitive strategy use (13 items), and self-regulation (9 items). Within the subscale of cognitive strategy use, there were items measuring rehearsal (5 items) and elaboration (6 items) and organization (2 items).

Data Analysis

Principal components factor analyses were conducted on the responses to the 44-items MSLQ of Sample 1. Varimax and oblique rotations were both used in the factor analysis. Eigenvalues of greater than 1.00 were used to guide factor extraction. The loadings of each item were examined closely with the wording of the items and item deletion was carried out if necessary.

In a second sample, we conducted Confirmatory Factor Analysis (CFA) to confirm the factor structure of the modified MSLQ measurement model (Model A), followed by a comparison between two other competing models. Model A is the five

 ISSN 2094-1420

factor model derived from the EFA based on sample 1. Model B is a model with seven-factor model in which the cognitive strategy was split into rehearsal and elaboration subscales, and self-regulation split into two subscales. Model C is a model is based on the five subscales proposed by Pintrich and De Groot (1990). The three constant factors in these three models were intrinsic value, self-efficacy, and test anxiety.

We computed the rho's coefficients as the reliability coefficients for each subscale. According to Bagozzi and Yi (1988), a composite reliability coefficient (rho) of greater than 0.60 is considered as acceptable. To assess convergent validity, we calculated the average variance extracted (AVE), which is a measure of the amount of variance that is captured by the latent variable in relation to the amount of variance due to measurement error (Dillion & Goldstein, 1984). A value of close to 0.50 is considered as acceptable (Fornell & Larcker, 1981). To test for discriminant validity, the confidence intervals of the latent factor correlation between each pair of factors were examined (ϕ-coefficients). If the correlations are significantly less than unity, the discriminant validity of the measure is supported (Bagozzi, 1981).

Finally, we determine the invariance of the measurement model of the MSLQ across gender by conducting a series of CFA. First we tested the unrestrictive model, followed by adding restriction on factor loadings, factor covariances and variances, and error variances and disturbances sequentially.

Various criteria were used to assess model fit. They were: Satorra-Bentler scaled Chi-square statistics, and the associated fit indices such as the robust non-normed fit index (NNFI), robust comparative fit index (CFI), and root mean square error of approximation (RMSEA). Yu and Muthen (2002) suggest that a good fit is achieved when the robust RMSEA is 0.05 or less, and when robust CFI is close to .95. When testing for invariance, we examined the difference between the robust goodness-of-fit indexes (robust CFI). Cheung and Rensvold (2002) suggest that change in CFI is trustworthy in testing the between-group invariance of CFA models. If the difference in the CFI between the two models is smaller than or equal to -.01, the null hypothesis of invariance should not be rejected.

Results

Initial EFA with sample 1 found eight factors with eignevalues more than 1.00 with 59.17% of the variance explained. There were 16 items that did not load on the intended factors or cross-loaded on another factor (see Table 1). After careful consideration and close examination of the wording, it was decided that these items should be deleted from further analyses. A second factor analysis on the remaining 28 items found that these items loaded on five factors accounting for 58.71% of the variance and had eigenvalues above 1.00.

 ISSN 2094-1420

Table 1
Factor Loadings of the 8-Factors Solution on the 44 MSLQ Items

Factors	Factor Loadings							
Items	1	2	3	4	5	6	7	8
Intrinsic Value								
IV1	**.55**							
IV2	.61				.42			
IV3	**.70**							
IV4	**.72**							
IV5			.63					
IV6	**.54**							
IV7	**.70**							
IV8	.68		.45					
IV9	.56		.41					
Self-efficacy								
SE1	**.68**							
SE2	.61							
SE3	.49	.58						
SE4	**.76**							
SE5	**.59**							
SE6	**.71**							
SE7	**.75**							
SE8	**.66**							
SE9	.62				.40			
Anxiety								
Anxiety1						**.71**		
Anxiety2						**.68**		
Anxiety3						**.76**		
Anxiety4						**.66**		
Cognitive Strategies								
CS1					.42			
CS2	.48				.41			
CS3								
CS4							.59	
CS5					.67			
CS6					.64			
CS7							.46	
CS8		**.78**						
CS9		**.41**					.47	
CS10		**.47**						
CS11		**.81**						
CS12		**.41**						
CS13		**.43**						
Self-regulation								
SR1		**.54**						
SR2								**.64**
SR3			.70					
SR4		**.43**						
SR5		**.53**						
SR6								**.74**
SR7								**.73**
SR8		**.46**						
SR9					.50			

Table 2 shows the factor loadings of the EFA produced by SPSS for a five-factor solution. The first factor consisted of five items related to cognitive strategy (a mix of rehearsal and elaboration items) and four items on self-regulation (metacognition strategies). This factor, named as *learning strategies*, accounted for 29.87% of the variance. The internal consistency was satisfactory (α = .89). The second factor was made up of six items related to self-efficacy with loadings ranging from .61 to .80. This factor, named as *self-efficacy*, accounted for 11.93% of the variance and has a Cronbach's alpha of .85. The third factor comprised a subscale with five items assessing *intrinsic value*, accounting for 6.80% of the variance with loadings between .56 to .78. The alpha coefficient was .82. The fourth factor accounted for 4.93% of the variance and consisted of the four items pertaining to *test anxiety* (α = .72). Finally, three negatively worded items for self-regulation loaded on a final factor and accounted for 4.80% of the variance, with an alpha coefficient of .71. These three items were related to lack of understanding or difficulty of task, we named the factor as *lack of learning self-regulation.*

In the second stage of the data analysis, we conducted a series of CFA with sample 2. Model A, which is a five-factor measurement model derived from the EFA with sample 1, fits the data well (χ^2= 549.70, df = 336, NNFI = .931, CFI = .939, RMSEA = .042, 90% CI of RMSEA = .036, .048). The results of the CFA confirmed the measurement model established with sample 1.

Table 3 shows the fit indices for the three competing models. Results from the CFA showed that Model A derived from sample 1 is a better fit model compared to the Model B (the cognitive strategy was split into rehearsal and elaboration subscales, and self-regulation split into two subscales and Model C (based on the five original MSLQ subscales).

Table 4 shows the composite reliability coefficients (rho), average variance extracted (AVE), and latent factor correlation matrix with confidence intervals. From the results, it is shown that the rho coefficients were all above .70, indicating acceptable reliability. Support for convergent validity for the modified MSLQ was provided by the AVE indexes. In terms of discriminant validity, the latent factor correlations among the subscales were significantly less than unity, thus, the discriminant validity of the modified MSLQ was supported.

Table 2
Factor Loadings of the 5-Factors Solution on the 28 MSLQ Items

Factors / Items	Factor Loadings 1	2	3	4	5
F1 Learning Strategies					
When I study for a test I practice saying the important facts over and over to myself	**.77**				
I use what I have learned from old homework assignments and the textbook to do new assignments	**.59**				
When I am studying a topic, I try to make everything fit together	**.56**				
When I read materials for this class, I say the words over and over to myself to help me remember	**.81**				
I outline the chapters in my book to help me study	**.68**				
When reading I try to connect the things I am reading about with what I already know	**.56**				
I ask myself questions to make sure I know the material I have been studying	**.71**				
Even when study materials are dull and uninteresting, I keep working until I finish	**.65**				
Before I begin studying I think about the things I will need to do to learn	**.66**				
When I'm reading I stop once in a while and go over what I have read	**.64**				
F2 Self-efficacy					
Compared with other students in this class I expect to do well		**.64**			
Compared with others in this class, I think I'm a good student		**.76**			
I am sure I can do an excellent job on the problems and tasks assigned for this class		**.61**			
I think I will receive a good grade in this class		**.69**			
My study skills are excellent compared with others in this class		**.80**			
Compared with other students in this class I think I know a great deal about the subject		**.72**			
F3 Intrinsic Value					
I prefer class work that is challenging so I can learn new things.			**.59**		
I like what I am learning in this class			**.61**		
I think I will be able to use what I learn in this class in other classes			**.73**		
Even when I do poorly on a test I try to learn from my mistakes			**.65**		
I think that what I am learning in this class is useful for me to know			**.76**		
F4 Anxiety					
I am so nervous during a test that I cannot remember facts I have learned				**.72**	
I have an uneasy, upset feeling when I take a test				**.73**	
I worry a great deal about tests				**.73**	
When I take a test I think about how poorly I am doing				**.66**	
F5 Lack of Learning Strategies					
When work is hard I either give up or study only the easy parts					**.69**
I often find that I have been reading for class but don't know what it is all about					**.69**
I find that when the teacher is talking I think of other things and don't really listen to what is being said					**.81**

 ISSN 2094-1420

Table 3
The Fit Indices for the Three Alternative CFA Models

Fit Index	Model A (5-factor model derived from Sample 1)	Model B (7-factor)	Model C (5-factor proposed by Pintrich & De Groot, 1990)
Scaled χ^2	549.70	598.73	783.83
Df	336	329	336
χ^2/ df	1.63	1.83	2.33
Robust NNFI	.931	.911	.856
Robust CFI	.939	.923	.872
RMSEA	.042	.048	.061
(Confidence Intervals)	(.036, .048)	(.042, .054)	(.055, .061)

Note. NNFI = Non-normed Fit Index; CFI = Robust Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation.

Table 4
Reliability, Validity, and Latent Factor Correlations for the MSLQ subscales formation

Scale	Composite Reliability (Rho)	AVE	1	2	3	4
Intrinsic Value	.85	.53				
Self-efficacy	.89	.57	.72* (.10) .52, .92			
Test Anxiety	.76	.44	.02 (.08) -.14, .18	-.09* (.07) -.23, .05	.	
Learning Strategies	.90	.47	.70* (.10) .50, .90	.58* (.08) .42, .74	.29* (.08) .13, .45	
Lack of self-regulation	.70	.44	.16* (.07) .02, .30	.04 (.06) -.08, .16	-.68* (.12) -.92, -.44	-.12 (.07) -.26, .02

Note. * $p < .05$. In each cell, first row = latent factor correlation, second row = SE of latent correlation coefficient, last row = correlation confidence intervals within plus/minus 2 SE.

Finally, we tested the invariance of the modified MSLQ measurement model across gender. The results are shown in Table 5 supported the invariance of the

modified MSLQ in factor loadings, factor covariances and variances, and error variances and disturbances.

Table 5
Testing for Invariance of the Modified MSLQ across Gender

Model	Scaled χ^2	df	$\Delta\chi^2$	Δdf	Robust CFI	ΔCFI	RMSEA (CI)
M_A Free Model	924.84	672	---	---	.931	---	.046 (.038, .046)
M_B Equality of factor loading	949.00	695	24.16	23	.931	.000	.045 (.038, .046)
M_C Equality of factor loading, factor var/cov	961.08	705	36.24	33	.930	-.001	.045 (.038, .052)
M_D Equality of error variance	1014.44	733	89.30	61	.924	-.007	.046 (.039, .053)

Note. CFI = Comparative Fit index; RMSEA = Root Mean Square Error of Approximation.

Discussion

MSLQ is one of the most popular questionnaires since its development. It has been translated into more than 20 different languages and resulted in more than 50 different research studies (Duncan & McKeachie, 2005). However, it is surprising that there were not many psychometric assessment papers on the MSLQ. It was also suggested that there were problems with the factorial validity of the MSLQ (Credé & Phillips, 2011; Duncan & McKeachie, 2005; Rotgans & Schmidt, 2010). In all research, it is pivotal that the validity and reliability of the MSLQ is examined before its usage for the interpretation of results.

The aim of the present study was to examine the psychometric properties of the junior high school version of the MSLQ using two Asian samples. We examined the factor structure of the MSLQ with EFA and follow up with CFA approach to validate the modified measurement model with a separate sample. We also examined the internal consistency, convergent validity, discriminant validity and invariance of the measurement models across gender.

The present study has presented a vigorous approach to psychometric testing of the junior high school version of the MSLQ with a combination of EFA and CFA. In the initial EFA analysis, this study found that 16 items out of the 44 items of the MSLQ (junior high version) did not load on the intended factors or cross-loaded on another factor. These were the items that which may hinder the validity of the measure. Another problem with the 44-item junior high school version of the MSLQ

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is that the items in the scales cover broad constructs that result in lack of convergent validity. For example, the self-efficacy scale includes expectancy for success, judgment of ability to complete the task (both in normative and self-referenced terms), and self-confidence (Duncan & McKeachie, 2005). In addition, the results also showed that the junior high version of the MSLQ consisted of more than the proposed five constructs (intrinsic value, self-efficacy, anxiety, cognitive strategies used, and metacognition self-regulation) with the original 44 items. A comparison with the full version of the MSLQ provided the evidence. Within the scale of cognitive strategies used, there were items measuring rehearsal, elaboration, and organization. The results of the EFA showed that secondary school students are not able to differentiate the items measuring cognitive strategies and self-regulation, as well as certain items within intrinsic task value (e.g., "I often choose paper topics I will learn something from even if they require more work"). Although the participants could not differentiate items assessing self-regulation and cognitive strategies, they could identify with the items measuring lack of self-regulation, thus, it is justifiable to have a separate factor on lack of self-regulation. The item deletion strategy is sound based on the results of the EFA and CFA.

In a recent study, Marsh and his colleagues (Marsh et al., 2009) showed that the CFA approach is based on highly restrictive ICM (independent cluster model) in which each item is hypothesized to load on only one factor and has zero loadings on other non target factors. Therefore, even with a well-defined EFA structure, a CFA approach may not work for psychological instruments. With the broad definition of the MSLQ constructs, it is not surprising that the CFA results are poor in previous studies (Davenport, 2003; Pintrich et al., 1993; Sachs et al., 2001). Therefore, there is a need to reduce the number of item per subscale. The original MSLQ (junior high school version) had 13 items in use of cognitive strategies, 9 items each in self-regulation, intrinsic value, and self-efficacy. The modified MSLQ with 28 items was validated with a separate sample in a follow up CFA and it was confirmed that there are five factors: intrinsic value (5 items), self-efficacy (6 items), anxiety (4 items), learning strategies (10 items, include 6 items on cognitive strategies and 4 items on self-regulation), and lack of self-regulation (3 items). Two other alternative models were used to compare with the modified MSLQ. The results of the CFA confirmed the modified measurement model was a good fit.

In terms of the convergent validity of the modified MSLQ, the results supported the convergent validity using the AVE, which was close to .50. However, the AVE for anxiety and lack of self-regulation subscales were slightly lower than .50, probably because of fewer items. The composite reliability coefficients (rho) indicated adequate internal reliability of the all the scales. In terms of discriminant validity, the latent factor correlation and the confidence intervals provide evidence of independence of constructs among the five subscale of the modified MSLQ.

The current study contributes to the literature of testing the psychometric properties of the MSLQ. This study shows the logical steps in the approach of psychometric testing which can be modelled for future studies. Future studies should use the current approach to test the full version of the MSLQ.

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In conclusion, the present study provides evidence of a five-factor measurement model of the junior high school version of the MSLQ. The measurement models are similar for males and females in terms of its factor forms and structures. There are currently only three items for lack of self-regulation, which may not be ideal. Future studies can add a few items to this scale or consider removing this scale altogether.

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