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The Intricate Relationship Between Motivation and Achievement: Examining the Mediating Role of Self-Regulated Learning and Achievement-Related Classroom Behaviors

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The objective of the present study was to examine how motivation is related to academic achievement. The *Motivated Strategies for Learning Questionnaire* (MSLQ) was administered to 1,166 students at a polytechnic in Singapore as a measure for motivational beliefs and self-regulated learning strategies. In addition, students' prior knowledge, achievement-related classroom behaviors, and academic achievement were included in the analysis. Path analysis revealed that motivation is not directly related to achievement. Instead, the relationship was mediated by both learning strategies and achievement-related classroom behaviors. Prior achievement was a good predictor of subsequent achievement but had no influence on student motivation. Overall, the results suggest that motivation as operationalized by self-report seems to be a construct with limited predictive validity for academic achievement.

At the heart of all educational motivation theories is the explanation and prediction of achievement (Meece, Anderman, & Anderman, 2006). Despite the large body of research that motivation theories have generated, it is not entirely clear whether and how motivation is linked to achievement. In fact, studies investigating this relationship consistently revealed weak correlations between these two constructs. For instance, in a widely-cited validation and predictive validity study conducted by Pintrich, Simith, Garcia, and McKeachie (1993) for the *Motivated Strategies for Learning Questionnaire* (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991), the average correlation between the six motivational beliefs scales and academic achievement was .17. Subsequent studies by Wolters and Pintrich (1998) and Wolters (2004) showed similar results (average correlations between motivational beliefs and achievement: r = .17 and r = .19 respectively), suggesting that correlations between motivation and achievement, such as test scores or examination results, are fairly low. In view of these results, and considering that motivation generally explain less than 10% of the variance in achievement, it is surprising that these "disappointing" findings are hardly articulated and addressed in the contemporary motivation literature. On the contrary, motivation is still being presented as a powerful predictor of students' academic achievement (see Zimmerman, 2008). To re-examine the perhaps problematic relationship between motivation and achievement, the present study investigated which variables influence and possibly mediate this relationship.

There are reasons to believe that cognitive regulation factors play a significant mediating role between motivation and achievement. Support for this assumption can be found in the most recent manifestation of achievement goal theory (Ames, 1992; Covington, 2000; Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002; Pintrich, 2000; Urdan & Maehr, 1995; Wolters, 2004). The theory postulates that depending on individuals' subjective purposes, motivational goals differentially influence school achievement via variations in the degree of cognitive self-regulation (Covington, 2000). Cognitive self-regulation refers to students being actively and purposely engaged in their own learning. This includes analyzing the demands of a learning task, planning and allocating resources to meet the task demands, and monitoring one's progress towards completion of the task (see Pintrich, 1999; Zimmerman, 1990). In other words, positive motivational goals (e.g., mastery goals) are considered responsible for activating appropriate and positive cognitive strategies, which in turn are expected to result in deeper processing of information and eventually higher academic achievement (Pintrich & De Groot, 1990). Building on this theory, Pintrich and his colleagues proposed a social-cognitive model of self-regulation and motivation in which various motivational and cognitive theories are combined, such as achievement goal theory and expectancy-value models (Garcia & McKeachie, 2005; Pintrich, 2000, 2004). This model incorporates students' prior achievement, motivational constructs derived from both expectancy-value and goal theories (e.g., self-efficacy, intrinsic goal orientation, task value beliefs, and affect), and cognitive regulation constructs (e.g., elaboration strategies, critical thinking, and metacognitive self-regulation strategies). Pintrich and colleagues hypothesized that motivational beliefs influence cognitive constructs which are, in turn, both assumed to be related to students' involvement in the learning task and, consequently, to their achievement.

There is some evidence lending support for this hypothesis. For instance, Wolters and Pintrich (1998) found that students' motivational beliefs (i.e., task value, self-efficacy, and test anxiety) were moderately related to students' use of cognitive and self-regulatory strategies (on average r = .33). Both motivational beliefs and learning strategies were in turn moderately to weakly related to students' academic achievement (on average r = .26 and r = .19 respectively). These results were replicated in a study by Wolters (1998), showing that motivational orientations (i.e., intrinsic, extrinsic regulation, learning goal orientation and performance goal orientation) were moderately related (on average r = .22) to students' learning strategies (i.e., rehearsal, organization, elaboration, critical thinking, and metacognition). Both were in turn weakly related to students' grades (on average r = .19 and r = .20, respectively). A slightly higher average correlation of r = .38 between motivational beliefs (i.e., intrinsic value, self-efficacy, and test anxiety) and learning strategies (i.e., strategy use and self-regulation) was observed in yet another study conducted by Pintrich and De Groot (1990). However, the strength of correlation between motivation and achievement and learning strategies and achievement did not exceed .30.

Overall, the findings of these studies suggest that the relationships between motivation and learning strategies on the one hand, and achievement on the other, are fairly weak. However, the relationship found between motivation and learning strategies seem to be relatively stronger, but not much stronger. This allows for the possibility that the relationship between motivation, learning strategies, and achievement is mediated by an additional factor.

Before we discuss this mediating factor, it needs to be clarified at this point that it is conceptually highly unlikely that motivation, as measured by a self-report instrument, directly "causes" students to achieve better grades. For instance, if students report that they hold favorable motivational beliefs, such as positive learning goals, it does not mean that they actually will be successful in terms of their grades. The same applies to learning strategies; responses to a self-report instrument may suggest that a person is likely to use elaboration or organization strategies. This however does not mean that this person will actually use such strategies to reach intended learning goals. In short, there may be a discrepancy between what is reported on a self-report instrument (e.g., ideal or typical motivational beliefs and learning strategies) and what students actually do in the classroom setting. For instance, students know that it is advisable to thoroughly understand mathematical formulae rather than rote-learning and blindly applying them, but whether this understanding can be observed in the actual classroom may be a different matter altogether. In the classroom, motivation and learning strategies manifest themselves by means of students' actual engagement with the learning task, their involvement in discussions, willingness to exert effort on the learning task, demonstration of interest in the task-at-hand, and so on. Data reflecting these achievement-related behaviors should be observational rather than self-reported since there is a possibility that students are not consciously aware of their learning-related actions in the classroom.

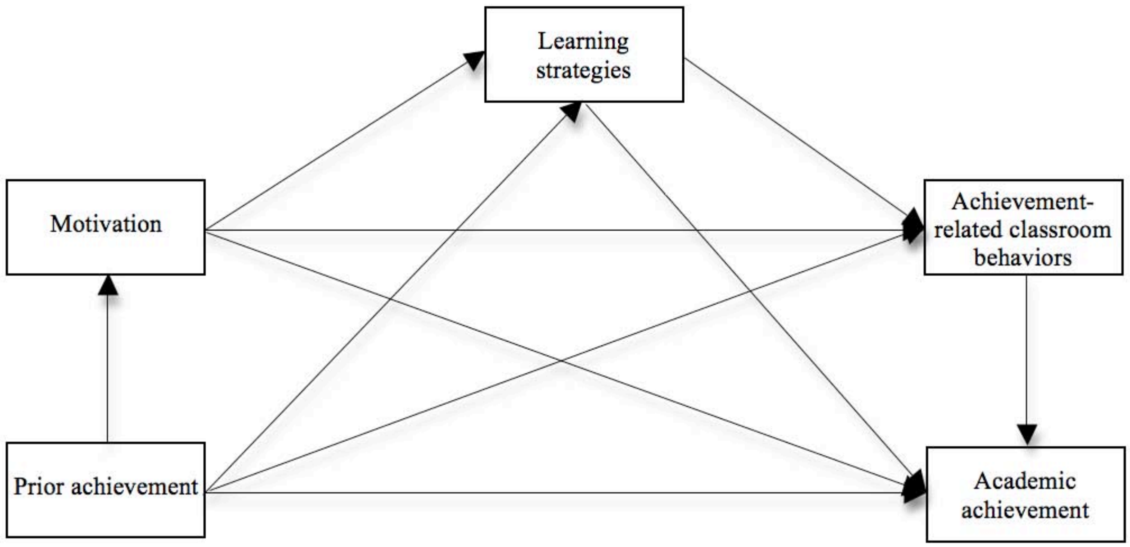
Considering the above, it is plausible that the relationship between motivation and achievement is not only mediated by cognitive factors, but also by students' achievement-related classroom behaviors. It is suggested that it may be insufficient to solely rely on self-reported measures of motivational beliefs and learning strategies, but that one should incorporate students' achievement-related classroom behaviors into the investigation as well.

The present study was conducted to find out whether actual learning behaviors in the classroom mediate between motivation and learning strategies on the one hand and achievement on the other. As a secondary issue, it was investigated whether, and to what extent, prior achievement influences students' motivational beliefs or the use of learning strategies. Self-efficacy theory (Bandura, 1977; Bandura, Freeman, & Lightsey, 1999) suggests that it is possible that students who have positive experiences related to their prior achievements may have more adaptive motivational beliefs or apply more effective learning strategies than students who did not perform well in their previous academic careers (Zimmerman, Bandura, & Martinez-Pons, 1992). Based on the findings in the literature, and on the arguments in favor of a mediating role of achievement-related behaviors discussed above, we developed a hypothetical model depicted in Figure 1.

This model states that prior achievement has a positive influence on students' motivation, which in turn influence corresponding learning strategies. These learning strategies need to be activated in the classroom first in order to be a good predictor of students' academic outcomes, hence the inclusion of achievement-related classroom behaviors as a mediator. The arrow between prior achievement and students' subsequent achievement represents a well-known finding that what people have learned before determines later achievement (e.g., Alexander, Kulikowich, & Schulze, 1994).

In the present study we administered the MSLQ (Pintrich et al., 1991) to a large cohort of first-year polytechnic students (N = 1,166) in Singapore. Students' overall motivational beliefs and learning strategies were determined and the relationship between motivation and academic achievement—as well as prior achievement, learning strategies, and achievement-related classroom behaviors—were examined using path analysis.

Figure 1
Path Model Depicting the Relationships Between Prior Achievement, Motivational Beliefs, Self-Regulated Learning Strategies, Classroom Performance, and Academic Achievement



Method

Participants

The sample consisted of 1,166 participants (55% female and 45% male) with an average age of 17 years (*SD* = 1.10). All participants were enrolled in a first year general curriculum at a polytechnic in Singapore. In the first-year general curriculum all participants—independent of their chosen diploma program—had to complete five general modules: English, mathematics, science, enterprise skills, and cognitive learning. The instructional mode for all programs was problem-based learning (PBL; Hmelo-Silver, 2004; Schmidt, 1983, 1993). In this PBL approach, the participants receive a problem every day that they were expected to discuss and learn from with a team of five during the course of one day (Alwis & O'Grady, 2002). There were five teams in one class. At the end of the day the teams had to consolidate their findings and give a presentation outlining how they dealt with the problem.

Measures

The *Motivated Strategies for Learning Questionnaire* (MSLQ). As a measure of motivation and self-regulated learning the MSLQ was administered (Pintrich et al., 1991). The MSLQ is an instrument initially designed to measure students' motivational beliefs and self-regulated learning strategies at the course level (i.e., at a single module or individual course). We were however interested in measuring students' general motivation and learning strategies to gain insights into the general relationships between these variable and achievement measures. Therefore, several of the original items were modified to enable measurement of motivational beliefs and the use of learning strategies at the general curriculum level. The modification was done with the intent to minimally alter the items to assure a close resemblance to the original MSLQ. For instance, all items referring to a "course" were altered to fit the more general context of a "School" or "Polytechnic"' (e.g., "I'm confident I can learn the basic concepts taught in this course" was altered to "I'm confident I can learn the basic concepts taught at the Polytechnic"). The construct validity and reliability of the modified MSLQ was established and reported elsewhere (see Rotgans & Schmidt, 2009, 2010). The MSLQ has six motivational beliefs scales and nine learning strategy scales and consists of 81 items. The motivational beliefs scales consist of self-efficacy, control of learning beliefs, intrinsic goal orientation, extrinsic goal orientation, task value beliefs and test anxiety. The learning strategies scales incorporate rehearsal, elaboration, organization strategies, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, and help seeking (see Pintrich et al., 1991 for a more detailed description of the scales). All items were assessed on a 5-point Likert scale: 1 (*strongly disagree*), 2 (*disagree*), 3 (*neutral*), 4 (*agree*), and 5 (*strongly agree*). The reliability of the

MSLQ was determined by calculating Hancock's coefficient *H* (Hancock & Mueller, 2001). The coefficient *H* is a construct reliability measure for latent variable systems that represents a relevant alternative to the conventional Cronbach's alpha. For the motivational beliefs scales, the coefficient *H* ranged from .48 to .85 (average = .67) and for the learning strategies scales from .56 to .69 (average = .66).

Prior achievement measure. As a measure of students' prior achievement, Singapore-Cambridge general certificate of education ordinary level examination results (GCE "O" level results) were used (Lim, 1999). All students in the sample passed the GCE "O" level exam before enrolling at the polytechnic. Students' aggregated scores for English, mathematics, and science subjects were used in the analysis.

Achievement-related classroom behavior measure. This measure was based on teacher observations representing students' achievement-related behaviors. In this measure teachers rated (1) the extent to which students participated in group discussions, (2) the extent to which they engaged and persisted in self-directed learning, and (3) the quality of their presentations in the classroom. A grade was assigned to each student based on the teacher observations for the day. The grade was reflected on a 5-point performance scale: 0 (*fail*), 1 (*conditional pass*), 2 (*acceptable*), 3 (*good*), and 4 (*excellent*). The reliability of this measure was established by means of Cronbach's alpha, which was .87. In addition, a study by Chua and Schmidt (2007) demonstrated the validity and reliability of this measure. Their findings were based on 1,059 student observations by 230 teachers, which resulted in generalizability coefficients ranging from .55 to .94 (average = .83). In their study the measure correlated .47 with the results of a written achievement test. These values are indicative of an overall high reliability and good predictive validity of this measure.

Academic achievement measure. As an academic achievement measure, written tests of 30 minutes duration, were conducted every four weeks over the first semester for all five subjects to measure students' understanding of the concepts learned. Most of the tests were a combination of open-ended questions and multiple-choice questions. Overall 20 test scores per student were collected. Scores were distributed on a scale ranging from 0 to 4 with .5 increments: 0 (*full fail*), 0.5 (*fail*), 1.0 (*conditional pass I*), 1.5 (*conditional pass II*), 2.0 (*acceptable*), 2.5 (*satisfactory*), 3.0 (*good*), 3.5 (*very good*), and 4.0 (*excellent*). The Cronbach's alpha for this measure was moderate (.62).

Procedure

The MSLQ was administered during a three-day orientation program at the beginning of the first semester to 1,166 students. Students had 30 minutes to complete the questionnaire. They were instructed to think of school in general when completing the questionnaire. The written achievement test was conducted every four weeks, whereas the classroom performance measure was recorded after every class over a period of 16 weeks. Both achievement measures were stored electronically and compiled at the end of the first semester.

Analysis

Overall mean scores were calculated for the prior achievement measure, the written achievement tests, and the classroom performance measures. Responses to negatively stated items (n = 8) in the MSLQ were reversed so that for all items the highest score was indicative of a positive rating. Mean scores for all 15 scales of the MSLQ were calculated, as well as the overall mean scores of all items belonging to the motivation and learning strategies sections of the MSLQ.

The data were analyzed by means of structural equation modeling using AMOS 5 (Arbuckle, 2003). In our analysis we followed the two-step approach recommended by Byrne (2001) through which we first tested a measurement model before conducting a path analysis. According to Byrne it is essential to first assess whether the measurement of each latent variable is psychometrically sound. Accordingly, Confirmatory Factor Analysis (CFA) procedures were used in testing the validity of the indicator variables. Once the validity of the measurement model was established, we proceeded with testing the structural path relationships. In the path model we used accumulated mean values of the MSLQ scales representing a summary of students' general motivational beliefs and learning strategies respectively. A potential reservation against this approach may be that when combining various scales, representing different constructs, some of the construct-specific information may get lost. On the other hand, one could argue that combining a number of scales is justified to the extent that it represents a broader and more generalizable underlying factor. We speculated that this was the case for the present study since we were interested in the relationships between students' general motivation, cognitions and academic achievement. We tested this assumption by devising a model with only one underlying factor (or latent variable) for the general scales motivation and learning strategies, and compared it with the initial solution. In the discussion section we will further elaborate on this decision to combine the six motivational beliefs scales of the MSLQ into one measure and the nine cognitive scales into one measure.

For both steps in the analysis, parameter estimates were generated using maximum likelihood and tests of goodness of fit. Chi-square accompanied by degrees of freedom, sample size, *p*-value and the root mean square error of approximation (RMSEA) were used as indices of absolute fit between the models and the data. The Chi-square is a statistical measure to test the closeness of fit between an observed and a predicted covariance matrix. A small Chi-square value, relative to the degrees of freedom, indicates a good fit (Byrne, 2001). A Chi-square/*df* ratio of less than three is considered to be indicative of a good fit. RMSEA is sensitive to model specification and is minimally influenced by sample size and not overly affected by the estimation method (Fan, Thompson, & Wang, 1999). The lower the RMSEA value, the better the fit. A commonly reported cut-off value is .06 (Hu & Bentler, 1999). In addition to these absolute fit indices, the comparative fit index (CFI) was generated. The CFI value ranges from zero to one and a value greater than .95 is conventionally considered a good model fit (Hu & Bentler, 1999).

In order to evaluate the robustness of the general path model, we conducted a cross-validation study in which we replaced the current sample with a large-scale sample collected one year earlier (N = 1,164). Assessing potential differences between the two samples was done by means of a test for invariant patterns in causal structures (Byrne, 2001). In this test, the researcher constrains the factor loadings between the variables in the path model. Significant differences in Chi-square value between the constrained and unconstrained models in relation to the difference in degrees of freedom provide an indication whether the models are invariant across the tested samples.

Results

Descriptive statistics were calculated for all items (n = 81) of the MSLQ. No outliers or other abnormalities were found. See Table 1 for a summary or the descriptive statistics, the values of the coefficient H, and the intercorrelations between all scales of the MSLQ.

The average correlation among the motivation scales was equal to .30; the average correlation among the cognitive strategies scales was equal to .41. Testing of the measurement models showed that the models fitted the data well. The model fit statistics for the motivation section of the MSLQ was: Chi-square/*df* = 2.63, $p < .01$, CFI = .97 and RMSEA = .04. The fit statistics for the learning strategies section was: Chi-square/*df* = 3.45, $p < .01$, CFI = .93 and RMSEA = .05. Overall, the results demonstrate that the psychometric properties of the MSLQ are within acceptable range. These findings are in-line with earlier validations studies conducted with the modified MSLQ (Rotgans & Schmidt, 2009, 2010). To simplify further analyses, we computed one average score for all motivation items and one for all learning strategies items. Of course, this is only an admissible approach if such one-factor solution for both constructs fits the data equally well, or better than, the initial multifactor solution. Only in the latter case the simplification we propose would make sense.

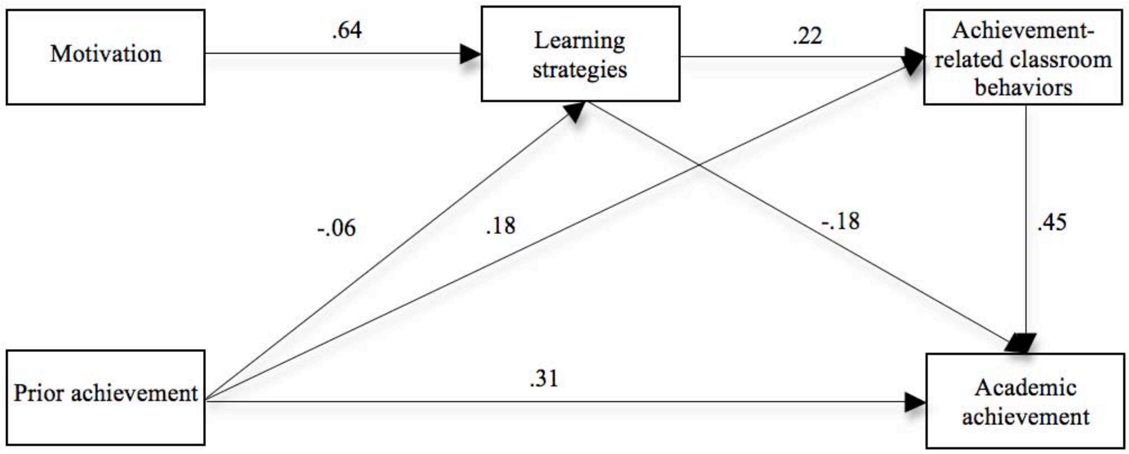
Thus, before we proceeded with the path model, we tested whether a one-factor solution for the motivation and learning strategies sections resulted in better fitting models than the initial solutions. Statistical comparison of a one-factor solution and the original factor models as proposed for the MSLQ by Pintrich et al. (1993) showed that the one-factor solution resulted in significantly better model fits both for the motivation model: $\Delta\chi^2$ (df = 13) = 54.21, $p < .01$, and for the learning strategies model: $\Delta\chi^2$ (df = 4) = 123.16, $p < .01$. These outcomes suggest that one underlying factor may indeed be hypothesized, describing students' general motivation and one factor describing learning strategies. This outcome lent support for using the two mean values representing motivation and learning strategies in the general path model, which was used in the subsequent analyses.

Testing of the hypothesized path model revealed a good model fit: Chi-square/*df* = 1.07, p = .36, CFI = 1.00 and RMSEA = .01. Figure 2 depicts the significant path coefficients (i.e., standardized regression weights) between the observed variables.

The path analysis revealed that motivation was neither directly related to achievement-related classroom behaviors nor to academic achievement. In other words, motivation was not directly related to any of the achievement measures. However, motivation was strongly related to the use of learning strategies (β = .64, $p < .01$). Learning strategies in turn showed a negative relationship to academic achievement (β = -.18, $p < .01$). On the other hand, learning strategies were positively related to students' achievement-related classroom behaviors (β = .22, $p < .01$), which, in turn, was a relatively strong predictor of academic achievement (β = .45, $p < .01$). In addition, prior achievement played a significant role in predicting subsequent academic achievement. In fact, it was a relatively good predictor of both, achievement-related classroom behaviors (β = .18, $p < .01$) and academic achievement (β = .31, $p < .01$). A weak, but statistically significant, negative relationship was also observed between prior achievement and learning strategies (β = -.06, p = .01).

As a last step, we conducted a cross-validation study in which we used an earlier collected sample and statistically compared whether the hypothesized path model holds for the two samples. The data (N = 1,164) were collected a year earlier also during the first-year orientation program at the polytechnic. The results of the multi-group comparison are summarized in Table 2.

Figure 2
Path Model Depicting Significant Relationships Between Prior Achievement, Motivational Beliefs, Self-Regulated Learning Strategies, Classroom Performance, and Academic Achievement



Note. Numbers above the arrows represent standardized regression weights. All regression weights are statistically significant at the 1% level.

Table 1
Intercorrelations Between the Scales, as Well as the Mean Values, Standard Deviations, and Coefficient H for Each Subscale of the MSLQ

Scales	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	Mean (*SD*)	*H*
(1) Intrinsic	1	.23**	.54**	.37**	.44**	-.01	.24**	.37**	.33**	.43**	.43**	.28**	.26**	.31**	.25**	3.09 (.36)	.48
(2) Extrinsic		1	.37**	.34**	.39**	.21	.33**	.28**	.26**	.26**	.23**	.26**	.17**	.21**	.15**	3.14 (.51)	.74
(3) Task Value			1	.50**	.52**	.02	.32**	.42**	.38**	.46**	.50**	.45**	.39**	.36**	.35**	3.22 (.34)	.69
(4) Control of Learning				1	.36**	.10**	.28**	.29**	.25**	.30**	.30**	.30**	.27**	.23**	.20**	3.08 (.39)	.54
(5) Self-Efficacy					1	-.15**	.33**	.42**	.37**	.49**	.52**	.41**	.42**	.38**	.26**	2.98 (.39)	.85
(6) Test Anxiety						1	.16**	.11**	.05	.04	-.08**	-.10**	-.18**	.01	-.01	2.65 (.48)	.67
(7) Rehearsal							1	.40**	.55**	.36**	.46**	.43**	.32**	.30**	.24**	2.99 (.42)	.67
(8) Elaboration								1	.51**	.57**	.57**	.38**	.29**	.40**	.34**	2.95 (.30)	.62
(9) Organization									1	.45**	.58**	.45**	.35**	.40**	.31**	2.95 (.38)	.67
(10) Critical Thinking										1	.59**	.34**	.31**	.41**	.31**	3.02 (.32)	.68
(11) Metacognition											1	.56**	.56**	.45**	.40**	2.90 (.29)	.76
(12) Time and Study												1	.59**	.34**	.35**	2.83 (.31)	.69
(13) Effort Regulation													1	.33**	.31**	2.91 (.44)	.66
(14) Peer Learning														1	.42**	2.98 (.38)	.58
(15) Help Seeking															1	3.02 (.38)	.56

Note. ** Statistically significant at the 1% level.

Table 2

Multi-Group Comparison; Test for Invariant Factorial Structures Between Two Samples of the MSLQ

Model	Chi-Square	*df*	Difference in chi-square	Difference in *df*	Statistical Significance
Unconstrained model	7.46	4	-	-	
Constrained model	15.12	10	7.66	6	ns

The test of invariant patterns in causal structures revealed that there are non-significant differences between the constraint and unconstraint models. This outcome demonstrates that the strengths of regression weights relating the variables in the path models for the two samples are invariant; in other words, there are no differences of the model between the two samples. Overall, this finding adds to the validity of the model.

Discussion

The objective of the present study was to investigate how motivation is related to students' academic achievement. It was hypothesized that the relationship between motivation and achievement is mediated not only by cognitive factors, as has been proposed in the literature (e.g., Linnenbrink & Pintrich, 2002; Pintrich & De Groot, 1990; Wolters, Yu, & Pintrich, 1996), but also by students' achievement-related classroom behaviors. The latter was based on the assumption that motivation without engagement cannot influence performance. In our study, these achievement-related classroom behaviors, as observed by the teacher, consisted of three elements: (1) the extent to which students participated in group discussions, (2) the extent to which they engaged and persisted in self-directed learning, and (3) the quality of their presentations in the classroom. Finally, it was hypothesized that students' prior achievement is related to motivation, as well as to subsequent academic achievement.

To test the above hypotheses the MSLQ was administered to a large cohort of 1,166 first-year students at a polytechnic in Singapore. In order to test the validity and stability of our proposed model, we re-tested and thus cross-validated our findings with an additional large-scale sample of 1,164 students. The results of the path analyses revealed that motivation as measured by the MSLQ was not directly related to any of the achievement measures. Instead, motivation was strongly related to the use of learning strategies, which were in turn moderately related to students' achievement-related classroom behaviors. Achievement-related classroom behaviors were a relatively strong predictor of students' academic achievement. Finally, prior achievement was not related to motivation but to learning strategies, achievement-related classroom behaviors, and academic achievement.

The results of this study demonstrate that motivation is not directly related to any of the academic outcome measures (i.e., neither to achievement-related classroom behaviors nor to academic achievement). Although various studies in the motivation literature appear to have produced similar results (e.g., Pintrich & De Groot, 1990; Wolters, 2004; Wolters & Pintrich, 1998), the primary focus of these studies was not to directly investigate (or report on) the relationship between motivation and academic achievement. In addition, none of the authors of these studies raised concerns about the observed low correlations between motivation and academic achievement. The question is then: why is motivation such a poor predictor of academic achievement? Wolters and Pintrich (1998) argued that motivation should be seen as the starting point (i.e., "starter") of the learning process. Once initiated, other cognitive and self-regulatory processes take over that steer the learner towards the desired learning goal (see also: Pintrich & De Groot, 1990). This theory would explain why we found a relatively strong correlation between motivation and learning strategies. Although the relationship between learning strategies and achievement seems in some studies slightly higher than the relationship between motivation and achievement, we found a negative correlation between learning strategies and achievement. This negative correlation does not seem to be a coincidental finding that is specific to our two samples. Pintrich and De Groot (1990) also found a negative correlation between cognitive strategy use and academic achievement. They labeled this fining a "negative suppressor effect of cognitive strategy use on academic performance" (Pintrich & De Groot, 1990, p. 38). Why cognitive strategy use in their study, and learning strategies in the present study, has a negative suppressor effect on academic achievement is presently unexplained. Nonetheless, our data demonstrated that if achievement-related classroom behaviors are included as an additional mediator, a relatively strong correlation is observed between learning strategies and achievement-related classroom behaviors and between the latter and academic achievement. This finding suggests that motivation only has an indirect effect on academic achievement. In line with Pintrich's hypothesis, motivation seems to be a starter of the learning process; it does not directly control or regulate it, nor is this the case with learning strategies (which are directly controlled by motivation). The role of actual learning behaviors in the classroom setting seems crucial since it directly and strongly predicts achievement. The availability of appropriate learning strategies (as reported through responses to the questionnaire) play a moderate role in getting the students to perform optimally, but there seems room for other, yet unknown, factors that may trigger these achievement-related classroom behaviors. One can think of efforts of the teacher to involve students in their own learning, or characteristics of the learning task triggering appropriate behaviors. In essence, we suggest that the nature of achievement-related classroom behaviors and their antecedent conditions may be a more fruitful area of motivation research than seeking relations between responses on self-report instruments and performance.

This suggestion has direct implications for educational practice since it implies that teachers should focus less on determining (and labeling) how motivated students are and what kind of dispositional learning strategies they apply generally. Think of all the questionnaires and tests that are administered in schools to determine student motivation, appropriate use of learning strategies and subsequently categorize them according to deep, surface, rote learners, etc. Our results suggest that students' achievement can substantially be improved by encouraging students to engage actively in the classroom (i.e., improve their achievement-related classroom behaviors). To improve their achievement-related classroom behaviors one can think of setting clear goals that need to be achieved within a specified timeframe, encouraging students to actively participate in group work, initiate independent self-study, and provide opportunities to present their findings and elaborate on their learning. As our data suggest, if teachers succeed in providing opportunities for students to engage in these positive learning behaviors they will perform well in terms of their academic outcomes measured by the written tests.

Concerning the role of prior achievement in the path model, the results revealed that students' prior levels of achievement contributed significantly in predicting subsequent achievement. This was more strongly the case for academic achievement than for achievement-related classroom behaviors. It is, however, surprising that students' prior achievement was unrelated to their motivational beliefs. We expected that students' achievement-related experiences (e.g., having performed well on previous examinations) would be an influencing factor in shaping their motivational beliefs (Pintrich & Schunk, 2002). This was however not the case—students' prior achievements, as represented in this study by the General Certificate Examination (GCE) "O" level examination results, do not have a direct impact on their overall motivation.

A critical point that needs to be addressed is that overall mean scores were used to represent the average of all scales concerning students' motivational beliefs and the use of self-regulated learning strategies. Using overall mean scores has never been attempted before. This is most likely due to the concern that important information about the relationships between individual scales and performance could get lost. This may be a major point of concern against our approach of using overall mean scores. One possible approach to address this issue is, as we did in this study, to test whether a one-factor solution results in significantly better fitting models as compared to Pintrich's original six- and nine-factor solutions. Our findings demonstrated that the one-factor models generated significantly better measurement model fit statistics than the six- and nine-factor models, suggesting that there is indeed a common underlying factor that represents general motivation and general learning strategies respectively. To ensure that no information was lost by computing overall scores for both constructs (i.e., motivation and learning strategies), we also tested all possible model combinations using the subscale means rather than the overall means (i.e., 54 models, combining six motivational beliefs scales with nine learning strategies scales). For an overview of results of these tests see Appendix. The tests revealed that none of the individual combinations of the subscale resulted in significantly better models than the general model based on overall mean scores. These outcomes lend additional support to our approach of using overall mean scores to represent students' motivation and learning strategies rather than using individual scales. Interestingly, some of the model combinations resulted in similarly good fitting models as the general model. For instance, the combination of control of learning beliefs (as motivational component in the model) with effort regulation, or time and study environment, or critical thinking (as learning strategies component in the model) resulted in rather well-fitting models. However, none of these models produced significantly better model fits than the general model as depicted in Figure 2. This suggests that the approach chosen in this study was appropriate.

Another issue that needs to be addressed is the fact that we used a general version of the original course-specific MSLQ to measure students' motivational beliefs and learning strategies at the general school level (i.e., school in general; all courses and experiences taken together). The original MSLQ was however designed to measure motivational beliefs and learning strategies at the course level—that is, for a study course or subject domain. Administering this instrument at the general school level may thus be a point for concern. An earlier study by Rotgans and Schmidt (2009) shed light on this issue. They administered a course-specific version (for three subject domains) and a general version of the MSLQ and statistically compared whether there are differences between the two versions in terms of construct validity and predictive validity. Their results demonstrate that there are generally no significant differences between a course-specific and a general version of the MSLQ. They did not find significant differences when comparing the underlying factorial structure or the predictive validity. For instance, the accuracy of the general version in predicting students' course grades was as accurate as the predictions made by the course-specific MSLQ. Considering this outcome and the fact that the factorial structures of both versions are highly similar lent support for using the general version of the MSLQ in this study.

Finally, it needs to be stressed that our results revealed that motivation as measured through self-report appears to be a relatively "isolated" construct since it was neither influenced by prior achievement, nor did it relate to any other constructs except for learning strategies. Given this outcome, and considering that the correlations between motivation and achievement of previous studies at the course-specific and individual construct level (e.g., Pintrich & De Groot, 1990; Wolters, 2004; Wolters & Pintrich, 1998) were also rather weak, one is tempted to question the overall validity of the motivation construct (measured through self-reports) as a significant predictive variable for education—both, at the general curriculum level and the course-specific level.

Besides questioning matters related to the validity of the motivation construct it seems possible that there are limitations in how motivation is measured. Motivational self-report measures are typically administered at the end (or the beginning) of a semester or course. As such, students are asked to respond to general statements about motivational beliefs and learning strategies that are related to the course, or as in the present study, to school in general. If one accepts the notion of social-cognitive theory that motivation and self-regulated learning strategies are highly dependent on the learning context (Pintrich, 2004; Zimmerman, 1990) it seems possible that the measurement should also be more context-specific. In other words, measurement and analysis should be narrowed down to the actual learning event, rather than measuring the collective experiences of a course, or a curriculum. A trend towards such a narrowed-down (micro-analytical) measurement approach can be found in the field of interest research. A range of recent studies in this domain analyzed students' interest development during text-processing tasks at hand. The studies demonstrate that interest has a powerful positive effect on cognitive performance and affective experiences of the learner (e.g., Hidi & Baird, 1988; Hidi, Renninger, & Krapp, 2004; Renninger & Wozniak, 1985; Schiefele, 1991). In particular, situational interest seems to play a significant role in student learning and achievement (Hidi, 1990; Hidi & Renninger, 2006; Schraw, Flowerday, & Lehman, 2001; Schraw & Lehman, 2001). Measures of situational interest are typically administered during the task at hand that means in real time. It seems possible that motivational beliefs should also be studied at this very detailed and context-specific level of analysis. As such, future studies should investigate if microanalytical measures of motivation and learning are indeed more appropriate, not only in determining students' motivated behaviors and learning, but also in predicting academic achievement.

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Appendix
Matrix of Model Combinations Between the Motivation Beliefs Scales and Learning Strategies Scales of the MSLQ

Motivation Subscales	Intrinsic motivation			Extrinsic motivation			Task value			Self efficacy			Control of learning			Test Anxiety		
	χ^2/df	CFI	RMSEA	χ^2/df	CFI	RMSEA	χ^2/df	CFI	RMSEA	χ^2/df	CFI	RMSEA	χ^2/df	CFI	RMSEA	χ^2/df	CFI	RMSEA
Critical thinking	2.51	.98	.04	4.23	.98	.05	5.27	.98	.06	5.52	.98	.06	.66	1.00	.00	2.33	.99	.03
Elaboration	2.81	.99	.04	3.60	.99	.05	4.66	.99	.06	4.65	.99	.07	.92	1.00	.00	5.21	.98	.03
Help seeking	2.99	.99	.05	5.64	.97	.06	5.29	.98	.07	6.29	.98	.08	1.04	1.00	.01	1.87	1.00	.04
Effort regulation	3.37	.99	.04	4.82	.98	.06	6.96	.97	.06	8.69	.96	.06	.41	1.00	.00	2.65	.99	.06
Metacognition	3.30	.99	.04	3.24	.99	.04	2.19	1.00	.03	3.64	.99	.05	1.03	1.00	.01	3.89	.99	.05
Organization	3.95	.99	.05	3.30	.99	.04	5.65	.98	.06	7.44	.97	.07	1.58	1.00	.02	2.19	.99	.03
Peer leering	3.01	.99	.04	4.44	.98	.05	5.98	.98	.07	6.47	.98	.07	.99	1.00	.00	2.55	.99	.04
Rehearsal	4.37	.98	.05	2.85	.99	.04	7.35	.97	.07	8.68	.97	.08	1.86	1.00	.03	1.57	1.00	.02
Time and study	2.99	.99	.04	3.46	.99	.05	3.64	.99	.05	5.19	.98	.06	.67	1.00	.00	3.92	.98	.05