Motivation, Achievement-Related Behaviours, and Educational Outcomes

Ingmar Jerome Rotgans

Printed by Ruby Printing Pte Ltd, Singapore

Motivation, Achievement-Related Behaviours, and Educational Outcomes

Motivatie, prestatiegerelateerde gedraging en onderwijsuitkomsten

Thesis

to obtain the degree of Doctor from the
Erasmus University Rotterdam
by command of the
rector magnificus

Prof. Dr. S.W.J. Lamberts

and in accordance with the decision of the Doctorate Board.

The public defence shall be held on
Tuesday, 2nd of June, 2009, at 16.00 hrs

By

Ingmar Jerome Rotgans

Born in Tübingen, Germany

DOCTORAL COMMITTEE

Promotor:	Prof. Dr. H. G. Schmidt
Other members:	Prof. Dr. H. T. van der Molen
	Prof. Dr. K. L. Lycke
	Dr. R. M. J. P. Rikers

For Priscilla

CONTENTS

ACKNOWLEDGEMENTS

It all started with a nightly walk along the Singapore River back in September 2006 where I met Professor Schmidt for dinner after a long day at a conference. In essence, the result of the discussion we had that night lies now in front of you. To me it was an honour and great pleasure to be able to do my doctoral study under the guidance of Professor Schmidt. He always had an open ear for my concerns, he was always optimistic, and every time after our frequent Skype conversations I had a feeling of invigoration and confidence that I can do it. I am truly thankful for your time, patience, and sharing your wisdom - I have learned a lot.

I am also highly thankful for the support of my academic institution, Republic Polytechnic, which enabled me to pursue my doctoral studies. In particular, I would like to express my gratitude to Dr. Alwis, for his full support during the various stages of my studies. Not only did he enable me to attend various international conferences to present my findings and learn from peers, he also showed a great deal of interest in the studies and provided essential support for the data collections. I am very grateful for your help.

Last, but certainly not least, I would like to thank Priscilla my dearest wife, for her continued support and belief in my capabilities to bring this work to a successful ending. She always listened to my ideas, did not complain about the long nightly hours working on the data analyses, and provided so much useful, critical yet constructive feedback on my manuscripts. Thank you for everything.

Jerome I. Rotgans, Singapore, 13 March 2009

CHAPTER 1
MOTIVATION AND ACHIEVEMENT – AN INTRODUCTION

Do students who are motivated behave differently in terms of their learning in the classroom and perform better than students who are less or not motivated? Understanding if and how motivational beliefs (e.g. self-efficacy judgments or task-value beliefs) are related to academic achievement measures (e.g. course grades or achievement-related behaviours) has significant implications for education. That is, if it is true that motivation is positively (and causally) related to achievement, it would suggest that when students are motivated they would perform better in school than students that are less motivated to study. However, an answer to the question of how motivation relates to achievement is more difficult to give than is commonly assumed. From a layman's perspective it is obvious that being motivated to achieve is a driving force to actually engage in learning-oriented behaviours, and that such behaviours should lead to a high level of achievement. However, as will be discussed below, this relationship is more complex than a layperson might expect. Testing the commonly accepted hypothesis of the motivation-achievement relationship is the major objective of this thesis.

This chapter provides an overview of the educational context the studies were conducted in, how motivation is defined, and how motivation theories developed, followed by how motivation is measured. Subsequently, it will be highlighted why the relationship between motivation and achievement can be considered a complex one. Finally, an overview of the chapters will be given.

EDUCATIONAL CONTEXT

The studies reported in this thesis were conducted at Republic Polytechnic. This polytechnic is the newest of the five polytechnics in Singapore. Although the objective of all polytechnics is to develop well-skilled young individuals to enter the work force and middle-management positions after 3 years of education, Republic Polytechnic stands out when it comes to its educational

approach. In this polytechnic, the instructional method is problem-based learning (PBL) for all its modules and programmes. In this approach five students work together in one team under the guidance of a tutor. One class is made up of four to five teams. Unique to this polytechnic's approach to PBL is that students work on one problem during the course of one day (Alwis & O'Grady, 2002). This means that students deal with one problem each day in all modules. A typical day starts with the presentation of a problem. Students discuss in their teams what they know, do not know, and what they need to find out. In other words, students activate their prior knowledge, come up with tentative explanations for the problem, and formulate their own learning goals (Barrows, 1988; Hmelo-Silver, 2004; Schmidt, 1993). Subsequently, a period of self-study follows in which students individually and collaboratively try to find information to address the learning goals (Schmidt, 1993). At the end of the day the five teams come together to present, elaborate, and synthesise their findings.

WHAT IS MOTIVATION?

Before going into detail about the relationship between motivation and achievement, it seems necessary to provide a definition of motivation first. According to Pintrich and Schunk (2002, p. 5): "*Motivation is the process whereby goal-directed activity is instigated and sustained*". This definition is made up of the variables that are typically used as operational indices in motivation research: (1) Task choice (i.e. selection of a task under free choice conditions), (2) Effort (i.e. high effort, particularly on difficult material), (3) Persistence (i.e. working for a longer time, particularly when one encounters obstacles), and (4) Achievement (i.e. increasing the above elements is expected to raise task achievement).

These four indices constitute central components in a variety of motivational theories and approaches. For instance, task choice is frequently used in experimental settings to determine students' topic interest (Ainley, Hidi, & Berndorff, 2002) and combined with sustained effort, both constructs form the central part of "control theories" and are often operationalised by control beliefs for learning, which refers to students' beliefs that educational

outcomes are contingent on one's own effort (Eccles & Wigfield, 2002; Pintrich, 1999). Persistence has been linked to students' self-efficacy judgments (Bandura, Freeman, & Lightsey, 1999) and constitutes an important factor is expectancy-value models of motivation (Wigfield, 1994; Wigfield & Eccles, 2000).

HISTORICAL DEVELOPMENTS

Many early motivation theories explained motivated behaviour in terms of drives, instincts, and internal traits, such as the basic need to succeed and to avoid failure (Weiner 1990). Atkinson (1957, 1964) and others proposed a theory in which motivation to achieve was seen as the result of an emotional conflict between striving for success and avoiding failure. In essence, it was this difference in emotional states (i.e. pride when succeeding vs. shame when failing) that was thought to explain differences in individuals' states of motivated behaviour.

Mainly due to the lack of considering cognitive factors in explaining achievement-related behaviour, the early drive theories were replaced by goal theory, where goals were introduced to explain how individuals interpret achievement outcomes, such as test scores. As Covington (2000, p.174) summarized it, in this goal-oriented approach to motivation "all actions are given meaning, direction, and purpose by the goals that individuals seek out, and that the quality and intensity of behaviour will change as these goals change". A broad distinction was made between "performance" versus "mastery" goals that individuals would pursue in learning situations. Research over the last three decades has repeatedly demonstrated that performance goals are associated with low ability attributions for failure, negative affect, the use of ineffective study strategies, and a decrease in performance. In contrast, when pursuing mastery goals, the lack of one's effort and not ability, is attributed to failure. Moreover, mastery goals are generally associated with positive affect, the use of effective study strategies, and increased levels of performance (Archer, 1994; Elliot & Harackiewicz, 1996; Elliot, McGregor, & Gable, 1999; Elliott & Dweck, 1988; Urdan & Maehr, 1995). Taken as a whole, the goal orientation (performance or mastery) an individual has for a learning

task is expected to influence the timing and quality of cognitive strategies used, which in turn influence an individual's academic achievements. As such, the most recent development is achievement goal theory which postulates that depending on individuals' subjective purposes, motivational goals differentially influence school achievement via variations in the degree of cognitive self-regulation (e.g. Ames, 1992; Covington, 2000; Harackiewicz, Barron, Pintrich, Elliot, & T. Thrash, 2002; Pintrich, 2000a; Urdan & Maehr, 1995; Wolters, 2004).

Cognitive self-regulation refers to students being actively and purposely engaged in their own learning. This includes analysing 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 (Pintrich, 1999; Zimmerman, 1990). In other words, positive motivational goals (e.g. mastery goals or intrinsic goal orientations) are expected to be responsible for activating appropriate and positive cognitive strategies, which are in turn deemed to result in deeper processing of information and eventually 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, 2000a, 2004; Zimmerman, 1989c, 1990). This model incorporates students' prior achievements, motivational constructs derived from both expectancy-value and goal theories (e.g. self-efficacy, intrinsic goal orientation, task value beliefs, and affect), and cognitive constructs (e.g. elaboration strategies, critical thinking, and meta-cognitive self-regulation strategies). Pintrich and colleagues hypothesised that motivation influences cognitive functioning and both are in turn assumed to be related to students' academic achievement.

In order to measure the motivational beliefs and learning strategies, Pintrich and his colleagues developed a measurement instrument that is based on this social-cognitive model of self-regulation and motivation: The *Motivated Strategies of Learning Questionnaire* (Pintrich, Smith, Garcia, & McKeachie, 1991). This instrument was used in the bulk of the studies reported in this thesis.

MEASURES OF STUDENT MOTIVATION AND SELF-REGULATED LEARNING

There are various instruments available to measure student motivation and the use of learning strategies. Although the measurement instruments that are available today are rather similar in the constructs they measure; all of them are anchored in one of two research traditions within educational psychology. On the one hand there is the "student approaches to learning" (SAL) and on the other the "self-regulated learning" (SRL) approach. A central point of debate between SAL and SRL researchers is the matter of appropriate "grain-size" or context-specificity of measurement (Pintrich, 2004). The SAL perspective favours a holistic approach to describe general conceptualisations of learning and motivation, whereas the SRL perspective focuses on course-specific and context-dependent constructs at a much smaller grain-size (Boekaerts, 1995, 1996; Lonka, Olkinuora, & Mäkinen, 2004). Both approaches have their advantages; the SAL approach has the capacity to provide useful information about student motivation and learning at the general curriculum level and the SRL approach is developed to measure a larger number of motivational and cognitive variables at the course-specific level.

The development of the SRL and SAL approaches to motivation and learning followed rather different paths in the early stages. SRL models have strong roots in mainstream educational and cognitive psychology and are derived from motivational, cognitive, and metacognitive theories. Thus, the resulting self-report instruments are based on a top-down approach and built on previous theories and empirical research findings (Boekaerts & Corno, 2005; Dyne, Taylor, & Boulton-Lewis, 1994; Entwistle & Waterston, 1988; Pintrich, 2000b). The SAL researchers, on the other hand, applied phenomenological studies that used in-depth qualitative interviews with students as a starting point to develop self-report instruments (Biggs, 1993; Dyne et al., 1994). As the various instruments were developed further, the distinction between the SRL and SAL conceptualisations has diminished insofar that SAL instruments now also include elements of the SRL scales, like metacognition and self-regulation (Biggs, 1993; Entwistle & McCune, 2004).

For the purpose of the studies reported in this thesis, we chose the widely-used *Motivated Strategies for Learning Questionnaire* (MSLQ; Pintrich et al.,

1991). The advantage of using this instrument, as compared to other available measures, is that it has a larger number of sub-scales, which allows for a broader measurement scope.

THE MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE

The MSLQ is an 81-item, self-report instrument consisting of six motivation scales and nine learning strategy scales. The motivational scales consist of three general motivational constructs: Expectancy, value, and affect (Pintrich, 1988a, 1988b, 1989). Expectancy components refer to students' beliefs that they can accomplish a given task. The MSLQ has two subscales that address this component: Self-efficacy and control beliefs for learning. The self-efficacy subscale incorporates expectancy for success, which is specific to task performance and judgments about one's ability to accomplish a task and be confident in one's skills to perform a task. Control beliefs for learning refer to students' beliefs that outcomes are contingent on one's own effort, rather than external factors like the teacher. The value component refers to the reasons students engage in an academic task. The values scales of the MSLQ are based on both achievement goal theory and expectancy-value theory. There are three subscales in the MSLQ that address this component: Intrinsic goal orientation (a focus on learning and mastery), extrinsic goal orientation (a focus on grades and approval from others) and task value beliefs (students' judgments of how interesting, useful and important a task is). The third component, affect, is operationalised by the subscale of test anxiety, which addresses students' concerns and worries of taking exams.

The learning strategies section consists of three scales: Cognitive processes, metacognitive processes, and resource management. The cognitive component comprises four subscales: Rehearsal, elaboration, organisation strategies, and critical thinking. The most basic cognitive subscale is rehearsal and refers to rehearsing materials over and over again to increase recall of information. The remaining subscales address more complex cognitive strategies like elaboration strategies (e.g. summarising and integrating information), organising strategies (e.g. outlining or creating tables or concept maps to better comprehend learning materials) and critical thinking, which

refers to students' strategies to apply prior knowledge to new contexts or critically evaluate ideas and concepts. The second general scale, metacognition, addresses students' use of strategies to monitor and regulate their cognition. This large scale includes planning (e.g. setting goals and task analysis), monitoring (e.g. tracking one's attention, self-testing and questioning) and regulating (i.e. fine-tuning and continuous adjustment of cognitive activities). The third general scale is resource management, which includes students' regulatory strategies to manage resources other than their cognition. These strategies include managing one's time and study environment (e.g. scheduling, planning and managing one's study time and setting realistic goals), regulating one's effort (e.g. willingness to try hard even when work is difficult), peer learning (e.g. working collaboratively with peers on a task), as well as help seeking (e.g. when facing difficulties to identify and approach someone who can provide assistance).

As mentioned above, due to the broad measurement scope of the MSLQ (i.e. 15 subscales) this instrument was deemed suited for our purposes to accurately measure students' motivational beliefs and their use of learning strategies.

THE COMPLEX RELATIONSHIP BETWEEN MOTIVATION AND ACHIEVEMENT

One of the implicit assumptions of motivation research is that there is a direct relationship between motivation and achievement (Pintrich & De Groot, 1990; Pintrich, Smith, Garcia, & McKeachie, 1993; Wolters & Pintrich, 1998; Zimmerman, 2008). This hypothesis makes theoretical sense, since more motivated students are expected to perform better in class than less motivated students. Being motivated to learn should correspond with the use of positive learning strategies, which should result in deeper processing of information and eventually better academic performance. It needs however to be mentioned that, despite the logic behind this thinking, the assumption that these causal relationships exist have possibly far outrun the available evidence. When looking at the evidence, existing studies repeatedly demonstrated that the correlation coefficients between these constructs are typically quite low.

For instance, Wolters and Pintrich (1998) found that student motivation was moderately related to students' use of cognitive and self-regulatory strategies (on average r = .33). Both motivation and learning strategies were in turn rather weakly related to students' academic achievements (on average r = .26 and r = .19 respectively). A similar outcome was found in a study by Wolters (1998), showing that motivation was moderately related (on average r = .22) to students' learning strategies. Both were in turn weakly related to students' grades (on average r = .19 and r = .20 respectively). Thus the variance in achievement explained in these studies by motivational measures ranges between 4 to 11%.

Overall, the findings of these studies (and others that will be discussed later in the various chapters) suggest that relationships exist between motivation and learning strategies on the one hand, and achievement on the other, are less straightforward and more complex than anticipated. It is however surprising that these disappointing findings are hardly articulated and addressed in the contemporary motivation literature. On the contrary, motivation is presented as a powerful predictor of students' academic achievements (e.g. Zimmerman, 2008). The key objective of this thesis is to re-examine the relationship between motivation and achievement, including the examination of potential mediator variables, such as cognitions, learning strategies, and achievement-related behaviours.

A second potential shortcoming of existing motivation studies is that they are restricted to the investigation of one or two specific motivational constructs. For instance, there is a relatively large body of research dedicated to the study of academic self-efficacy (e.g. Bong, 2004; Bong & Hocevar, 2002; Chen, Gully, & Eden, 2004; Schunk, 1991; Thelwell, Lane, & Weston, 2007; Walker, Greene, & Mansell, 2006; Zimmerman, 2000), but studies that include a larger number of constructs into the investigation are less than forthcoming. Research that extends the investigation from an individual construct, or a small number of specific motivational constructs, to more general perceptions of motivation, that is, the sum of various motivational constructs and how it is related to academic learning and achievement is lacking.

The studies presented in this thesis cover four research areas to provide answers to the general question of how motivation is related to academic achievement and whether students who are motivated display different behaviours in the classroom as compared to students who are less or not motivated. The four research areas comprise: (1) the context-specific nature of motivation and self-regulated learning, (2) the cross-cultural validity of motivation and self-regulated learning (and potential differences) between cultural groups in a multicultural society (Singapore), (3) the causal relationships between prior achievement, motivation, self-regulated learning, achievement-related classroom behaviours, and academic achievement, and (4) students' situational interest in the active-learning classroom.

THE STUDIES

The MSLQ is based on the social-cognitive theory of motivation and self-regulated learning, in which the learner is represented as an active processor of information (Duncan & McKeachie, 2005; Pintrich, 2004; Pintrich et al., 1993). The social-cognitive framework assumes that motivation and learning are not stable traits of an individual, but that motivation and the use of learning strategies are dynamic and contextually bound, and can be learned and brought under the control of the learner. As such, the MSLQ is intended to be administered at the course-specific level, such as a particular subject domain or a particular course (Duncan & McKeachie, 2005; Pintrich et al., 1991). Contrary to the context-specificity assumption, the study reported in Chapter 2 was based on the hypothesis that students have fairly stable, dispositional motivational beliefs and learning strategies, which are invariant across subject domains and observable at the general curriculum level as well. The general curriculum level refers to "school in general" including all its courses.

In order to test the above hypothesis, a slightly modified version of the MSLQ was administered to a large cohort of polytechnic students in Singapore. Confirmatory factor analyses were conducted to assess whether the general version of the MSLQ bears psychometric characteristics similar to the course-specific version of the instrument. In addition, the instrument's

predictive validity was determined and compared with the findings of the course-specific MSLQ reported by Pintrich et al. (1993). Comparing the psychometric characteristics and the predictive validity of the instruments was expected to provide an initial answer to the question whether motivational beliefs and learning strategies are indeed context-dependent and should be measured at the more refined course or subject domain level rather than at the more general curriculum level.

Besides examining whether the MSLQ is a suitable instrument for the general curriculum level we were also interested to find out whether the underlying factorial structure of the MSLQ, as proposed by Pintrich and his colleagues, fulfils its theoretical assumptions of being able to determine context-dependent variations across subject domains. To that end, the course-specific MSLQ was administered on three subject domains, viz. mathematics, science, and English. The factorial structures of the MSLQ were then compared between the three subject domains using tests for invariant factorial structures and comparisons of latent mean structures for each of the underlying constructs over the different subject domains. Moreover, it was assessed if the MSLQ provides more accurate predictions of students' academic achievement at the course-specific level compared to the general curriculum level.

Besides the issues pertaining to the context-specificity of the MSLQ, it was further investigated how motivation is generally related to academic achievement and other educational variables, such as prior knowledge, learning strategies, classroom behaviours, and academic achievement. Chapter 4 reports the findings of a study, in which we combined all motivation subscales and all learning strategies subscales to represent only one mean value for motivation and learning strategies respectively. The data were interpreted in the form of a path model, in which we hypothesised that the relationship between motivation and achievement is mediated by both cognitive and achievement-related classroom behaviours. Achievement-related classroom behaviours in this study refer to an observational measure reflecting students' participation, teamwork, presentation skills, and self-directed learning. Moreover, in line with the literature, it was assumed that students' prior achievement has a positive influence on students' motivational beliefs. Prior achievement was also expected to be a good predictor of

students' subsequent achievement. In this study the MSLQ was administered to two large cohorts of first-year polytechnic students in Singapore.

After having dealt with the context-specificity of motivation and learning strategies and how they are related we conducted a series of studies to assess the cross-cultural validity of the MSLQ in the educational context of Singapore. The results of these studies are presented in Chapter 5. Within this chapter, three studies are discussed that investigated whether the MSLQ is a valid and reliable instrument for measuring student motivation and the use of self-regulatory learning strategies in the multicultural context of Singapore with Chinese, Indian, and Malay students. Moreover, it was investigated whether the dynamic relationships between students' prior achievements, motivation, learning strategies, and present academic outcomes vary as a function of different cultural backgrounds.

In the last study, presented in Chapter 6, it was investigated to what extent the motivational variable of situational interest could do a better job than conventional measures of motivation as a context-specific predictor of academic achievement. The literature suggests that situational interest has a phase in which it is triggered by characteristics of the learning phase, and a phase in which it is supposed to be maintained over time. Whether and how situational interest is maintained over time and how it is related to learning and academic achievement is however not fully understood. To determine how situational interest is triggered and maintained, measures of situational interest were administered on seven occasions during a one-day problem-based learning sequence at Republic Polytechnic. Each of the selected measurement occasions represented critical events that were supposed to foster situational interest and task engagement. Prior knowledge was also incorporated in the study to assess its influence on triggering situational interest. Potential causal relationships among the observed variables were analysed using path analysis. This study was supposed to provide more detailed insights into the complex correlational relationship between motivation and achievement from a microanalytical perspective.

CHAPTER 2
THE MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE: A MEASURE FOR STUDENTS' GENERAL MOTIVATIONAL BELIEFS AND LEARNING STRATEGIES?[1]

ABSTRACT

The *Motivated Strategies for Learning Questionnaire* (MSLQ) is a widely used self-report instrument to measure student motivation and learning strategies at the course-specific level (i.e. an individual course or subject domain). The present study sought to explore the utility of the MSLQ in measuring student motivation and learning strategies pertaining to the general curriculum level (i.e. all courses and subjects taken together) rather than to the course-specific level. To that end, the instrument was slightly modified and administered to recently graduated secondary school students (N = 1,166) in Singapore. The construct and predictive validity of the instrument were determined using confirmatory factor analysis and by correlating the individual scales of the instrument with the overall semester grades. Results showed that the modified MSLQ is a reliable and valid instrument to determine students' motivational beliefs and learning strategies at the general curriculum level.

INTRODUCTION

Within educational psychology there are two major approaches to study student motivation and learning. On the one hand there is the "student approaches to learning" (SAL) and on the other the "self-regulated learning" (SRL) approach. A central point of debate between SAL and SRL researchers is the matter of appropriate "grain-size" or context specificity of measurement (Pintrich, 2004). The SAL perspective favours a holistic approach to describe general conceptualisations of learning, whereas the SRL perspective focuses on course-specific and context-dependent constructs at a much smaller grain-size (Lonka, Olkinuora, & Mäkinen, 2004). Both approaches have their

[1] Paper presented at the 15th International Conference on Learning in Chicago.

advantages; the SAL approach has the capacity to provide useful information about student motivation and learning at the general curriculum level and the SRL approach is capable of measuring a large number of complex motivational and cognitive variables at the more detailed course-specific level. With this study we made an attempt to reconcile both approaches by investigating whether it is possible to use the *Motivated Strategies for Learning Questionnaire*, or MSLQ (Pintrich, Smith, Garcia, & McKeachie, 1991), to measure students' motivational beliefs and self-regulated learning strategies at the general curriculum level (i.e. the whole of studies for graduation, or "school in general").

The development of the SRL and SAL approaches to motivation and learning followed rather different paths in the early stages. SRL models have strong roots in mainstream educational and cognitive psychology and are derived from motivational, cognitive, and metacognitive theories. Thus, the resulting self-report instruments are based on a top-down approach and built on previous theories and empirical research findings (Biggs, 1993; Dyne, Taylor, & Boulton-Lewis, 1994; Entwistle & Waterston, 1988; Pintrich, 2000a). The SAL researchers, on the other hand, applied phenomenological studies that used in-depth qualitative interviews with students as a starting point to develop self-report instruments (Biggs, 1993; Dyne, Taylor, & Boulton-Lewis, 1994). As the various instruments were developed further, the distinction between the SRL and SAL conceptualisations has diminished insofar that SAL instruments now also include elements of the SRL scales, like metacognition and self-regulation (Biggs, 1993; Entwistle & McCune, 2004). Despite these developments the issue of adequate grain-size of the measurement instrument is still open to debate. The objective of the present study is therefore to investigate whether it is valid and practical to use a course-specific SRL measure, with the benefit of its small gain-size, to measure student motivation and learning at the general curriculum level, traditionally the territory of SAL.

Generally, grain-size refers to the number of constructs an instrument is able to measure (the more constructs, the smaller the grain size). Related to that, the context of measurement plays an equally important role when considering an instrument to determine student motivation and self-regulated

learning. According to Lonka et al. (2004) there are three basic levels of context: (1) the whole of studies for graduation (i.e. general curriculum level), (2) a particular course a student is participating in (i.e. domain- or course-specific level), and (3) a specific situation in which the student is dealing with the subject matter or a learning task (i.e. situational level). The choice of level of context is predominantly related to the research question one peruses. For instance, if the objective is to determine the effects of new pedagogical interventions on a particular course, the analysis should be conducted at a course-specific level (see Trigwell & Prosser, 2004). On the other hand, if the objective is to study general study behaviours at a particular school or college, the appropriate level of measurement is at the general curriculum level (e.g. Mäkinen, Olkinuora, & Lonka, 2002). This classification appears to be self-evident but the lack of distinction between the levels of context has caused many kinds of conceptual confusions and methodological difficulties in interpreting empirical data (see Lonka et al., 2004). The key issues of assessment revolve around the matter of construct validity of the instrument, which is not limited to the theoretical and conceptual definitions of the construct but should also include the level of context in which it is measured. For instance, a particular self-report instrument can be valid and reliable at one level of context (e.g. the course-specific level), but there are limitations in its use at another level of context (e.g. the general curriculum level). This aspect of validity is central to the SRL and SAL distinction; SRL models provide a larger number of constructs at a smaller grain-size that describe student motivation and cognition in all its complexity, whereas the SAL models focus on a much larger grain-size opting for much larger units of analysis such as general approaches to studying and learning. Pintrich was sceptical about the use of SRL models at the general curriculum level and stated that:

> "These differences in grain-size and domain-specificity assumptions make the SRL and SAL approaches somewhat incommensurable in terms of developing common construct lists or common instruments." (Pintrich, 2004, p.395).

In an attempt to reconcile both approaches we selected the MSLQ, a widely used SRL self-report instrument that was designed to measure a large number of motivational and self-regulated learning constructs, and tested whether it is valid to use for the purpose of measuring students' general

motivational beliefs and the use of self-regulated learning strategies. The MSLQ is an 81-item, self-report instrument consisting of six motivation scales and nine learning strategy scales (Pintrich et al., 1991). The motivational scales consist of three general motivational constructs: expectancy, value, and affect (Pintrich, 1988a, 1988b, 1989). Expectancy components refer to students' beliefs that they can accomplish a given task. The MSLQ has two subscales that address this component: self-efficacy and control beliefs for learning. The self-efficacy subscale incorporates expectancy for success, which is specific to task performance and judgments about one's ability to accomplish a task and be confident in one's skills to perform a task. Control beliefs for learning refer to students' beliefs that outcomes are contingent on one's own effort, rather than external factors like the teacher. The value component refers to the reasons students engage in an academic task. The value scales of the MSLQ are based on both achievement goal theory and expectancy-value theory. There are three subscales in the MSLQ that address this component: intrinsic goal orientation (a focus on learning and mastery), extrinsic goal orientation (a focus on grades and approval from others), and task value beliefs (students' judgments of how interesting, useful and important a task is). The third component, affect, is operationalised by the subscale of test anxiety, which addresses students' concerns and worries of taking exams.

The learning strategies section consists of three scales: cognitive processes, metacognitive processes, and resource management. The cognitive component comprises four subscales: rehearsal, elaboration, organisation strategies, and critical thinking. The most basic cognitive subscale is rehearsal and refers to rehearsing materials over and over again to increase recall of information. The remaining subscales address more complex cognitive strategies like elaboration strategies (e.g. summarising and integrating information), organising strategies (e.g. outlining or creating tables or concept maps to better comprehend learning materials), and critical thinking, which refers to students' strategies to apply prior knowledge to new contexts or critically evaluate ideas and concepts. The second general scale, metacognition, addresses students' use of strategies to monitor and regulate their cognition. This large scale includes planning (e.g. setting goals and task analysis), monitoring (e.g. tracking one's attention, self-testing and

questioning), and regulating (i.e. fine-tuning and continuous adjustment of cognitive activities). The third general scale is resource management, which includes students' regulatory strategies to manage resources other than their cognition. These strategies include managing one's time and study environment (e.g. scheduling, planning and managing one's study time and setting realistic goals), regulating one's effort (e.g. willingness to try hard even when work is difficult), peer learning (e.g. working collaboratively with peers on a task), as well as help seeking (e.g. when facing difficulties to identify and approach someone who can provide assistance).

The MSLQ has shown to be a reliable and valid instrument (Pintrich, Simith, Garcia, & McKeachie, 1993; Pintrich et al., 1991) that has been used in a variety of studies across various courses, content areas, and countries (Bandalos, Finney, & Geske, 2003; Brookhart & Durkin, 2003; Ommundsen, 2003; Seibert, 2002; Zusho, Pintrich, & Coppola, 2003). The MSLQ can be used either in its entirety or its subscales and has most frequently been applied to evaluate the motivational and cognitive effects educational programmes have on students (Bong, 2004; Bong & Hocevar, 2002). The MSLQ has however not yet been used at the general curriculum level to determine students' *general* motivational beliefs and self-regulated learning strategies. The advantage of using the MSLQ at the general curriculum level when compared to available SAL instruments is its smaller grain-size. This becomes apparent when comparing the MSLQ with another widely used SAL instrument, the *Study Process Questionnaire*, or SPQ (Biggs, 1987). Entwistle and McCune (2004, p.330) provided a conceptual comparison of both instruments by comparing the number of subscales they have in common when addressing several general constructs. For instance, when comparing the number of subscales that tap into students' meaning orientations (i.e. "indicating an orientation to understand for oneself") the SPQ uses two subscales (i.e. deep strategy and deep motive) whereas the MSLQ uses five subscales (i.e. elaboration, critical thinking, organisation, intrinsic goal orientation, and task value). The same is the case for the other self-report instruments that were used in the comparison.

Using the MSLQ at the general curriculum level would however only be justified if its course-specific constructs, like metacognitive self-regulation,

critical thinking, and elaboration, can also be measured at the general curriculum level. For instance, metacognitive self-regulation should not only be observable at the course-specific level, but also at the more general curriculum level. Several studies demonstrated that various motivation and learning related constructs were stable across subject domains. This implies that students may have stable dispositional learning behaviours. For instance, Wolters and Pintrich (1998) conducted a study where they investigated the contextual differences in student motivation and self-regulated learning in mathematics, English, and social studies. They used several scales of the MSLQ, like task value, self-efficacy, test anxiety, rehearsal, elaboration, and metacognitive self-regulation. Apart from their findings that there were some mean-level differences of motivational and cognitive variables between the subject areas, their results revealed that there were no differences in regulatory strategy use. In other words, the correlational relations between motivational and self-regulated learning construct did not significantly vary as a function of the subject area, indicating that students seem to have stable habitual or dispositional self-regulated learning strategies.

Vermetten, Lodewijks, and Vermunt (1999) conducted a similar study in which they investigated the consistency and variability of learning strategies in different university courses. They used the *Inventory of Learning Styles* (Vermunt, 1998), which includes four different domains of learning, namely cognitive processing, metacognitive regulation strategies, learning orientations, and mental models of learning. Their results are very similar to the findings of Wolters and Pintrich, suggesting that the learning context had only minor influence on the use of learning strategies. They concluded that students have a personal, habitual component in strategy used across domains.

Based on the initial findings of the above studies we further tested the assumption that students display consistency in the use of learning strategies and motivational beliefs by investigating whether the factor structure of the MSLQ remains stable when students are asked to report on their general motivational beliefs and learning strategies. We hypothesised that this would provide more reliable insights to the existence of stable dispositional self-regulated learning strategies rather than comparing correlational structures

across courses. Moreover, we were interested to see whether a typical SRL-instrument, like the MSLQ, is capable of predicting course grades accurately in both situations; not only at the course-specific level, but also at the general curriculum level. To that end we calculated zero-order correlations between the MSLQ scores and the overall semester grade. In addition, we analysed the relationships between the MSLQ scores and course grades for English and mathematics to test for variability in domain contexts and to see whether the MSLQ is capable of identifying differences in strategy use. We selected English and mathematics since previous research suggests that the differences in motivational beliefs and learning strategies are most profound between these subject areas (cf. Eccles, 1983; Wigfield, 1994; Wigfield & Eccles, 1992). Previous research indicates that teachers from different subject areas have different views of the nature of their discipline and these views are related to different instructional beliefs and practices (Grossman & Stodolsky, 1995; Stodolsky & Grossman, 1995). Researchers found that the beliefs between mathematics and language teachers vary. Mathematics teachers believed that their subject domain is sequential and static, whereas English teachers believed that their subject domain is more open, less sequential, and more dynamic. These findings suggest that mathematics classrooms provide fewer opportunities for self-regulated learning. We assumed that the different course grades represent - to a certain degree - differences in the application of learning strategies. We therefore predicted that the strengths of correlations between the MSLQ scores and the course grades for English and mathematics would reveal differences that are due to context-specific variations in strategy use (i.e. correlations between the MSLQ scores and mathematics would be significantly weaker than the correlations between MSLQ scores and English since students' efficacy beliefs, task value, and interest are generally less positive and less adaptive in mathematics than in English). If this is indeed the case it would add to the overall validity of the instrument since it is capable of detecting not only student's general motivational beliefs and self-regulated learning strategies but is also sensitive to context-specific variations in their strategy use.

In sum, the objective of the present study was to investigate whether the MSLQ is a suitable instrument to determine students' motivational beliefs and

self-regulated learning strategies pertaining to the general curriculum level by determining its construct validity using a structural equation modelling approach. Moreover, the instrument's predictive validity was examined by calculating the correlations between the MSLQ scores and the overall semester scores as well as the English and mathematics scores to test for variability in context-specific motivations and self-regulated learning strategies.

METHOD

Participants

Newly graduated secondary school students from Singapore participated in the study. At the time the study was conducted, the participants were about to enrol in diploma programmes at a local polytechnic. The sample consisted of 1,166 participants (44% male and 56% female) with an average age of 17.40 years (*SD* = .93). The majority of the participants (96%) were Singaporean citizens, the remaining participants came from China, India, Indonesia, Japan, Malaysia, Myanmar, Philippines, Sri Lanka, and Thailand. During the freshmen orientation programme at the polytechnic all first-year students were administered the modified MSLQ.

Materials

For the purpose of this study we used the *Motivated Strategies for Learning Questionnaire* (Pintrich et al., 1991). Several of the original items were modified to enable measurement of motivation and 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*").

For the purpose of this study we incorporated all scales and subscales of the MSLQ except for "test anxiety" and "task value". We considered test

anxiety to have a scale too narrow to be an adequate measure of general affect (cf. Pintrich, 2004). Similarly, task value, was considered to be too course-specific to be a meaningful scale representing general motivational beliefs without significantly altering the items.

For the purpose of our analyses, we clustered the items of the modified MSLQ in groups of two based on semantic overlap. This technique is called "item parcelling" (Bandalos & Finney, 2001; Little, Cunningham, Shahar, & Widaman, 2002). Item Parcelling is a measurement practice that is commonly used for latent variable analysis. According to Little (2002), a parcel can be defined as an aggregate-level indicator, comprised of the sum or average of two or more items. For the modified MSLQ a total of 36 parcels were formed (10 for the motivation section and 26 for the learning strategies section).

In order to determine the predictive validity of the modified MSLQ we correlated the mean values of the MSLQ scales with the overall first semester grade, the English grade and the mathematics grade. The overall semester grade is the aggregated mean score, based on all five module grades of a common first semester at the polytechnic (i.e. English, Mathematics, Science, Enterprise skills, and Cognitive learning).

Procedure

Participants had 20 minutes to complete the questionnaire and had to rate the statements on a 5-point Likert-scale scale: 1 (*strongly disagree*), 2 (*disagree*), 3 (*neutral*), 4 (*agree*), and 5 (*strongly agree*). Participants were provided with an instruction to think of school in general when responding to the statements. No information was given about the underlying assumptions of the questionnaire.

Analysis

First, responses to negatively stated items (n = 8) were reversed so that for all items the highest score was indicative of a positive rating. Next, data were analysed using structural equation modelling. The analysis was done with AMOS 5 (Arbuckle, 2003). The analysis was conducted using three different

types of samples: one *exploration sample* (*N* = 583), to conduct an initial analysis of the hypothesised models, and a second *construct validation sample* (*N* = 583) to retest the models and cross-validate them with the first sample. Participants were randomly assigned to either one of the two samples until the entire population (*N* = 1,166) was equally distributed over both samples. After the analyses were completed for the first two samples we retested all models with the *main sample*. The two sections of the MSLQ were analysed separately as suggested by the developers (Pintrich et al., 1991). Thus, two confirmatory factor analyses were conducted: one for the set of motivation items and another for the set of learning strategies items. 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 the observed and 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 5 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 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 calculated. The CFI value ranges from zero to one and a value greater than .90 is conventionally considered a good model fit (Bentler, 1990). More recently however, cut-off values close to .95 were suggested (Byrne, 2001).

Finally, Hancock's coefficient *H* was calculated for each scale. The coefficient *H* is a construct reliability measure for latent variable systems that represents an adequate alternative to the conventional Cronbach's alpha. According to Hancock and Mueller (2001) the usefulness of Cronbach's alpha and related reliability measures is limited to assessing composite scales formed from a construct's indicators, rather than assessing the reliability of the latent construct itself as reflected by its indicators. The coefficient *H* is the squared correlation between a latent construct and the optimum linear

composite formed by its indicators. Unlike other reliability measures the coefficient *H* is never less than the best indicator's reliability. In other words, a factor inferred from multiple indicator variables should never be less reliable than the best single indicator alone. Hancock recommended a cut-off value for the coefficient *H* of .70.

RESULTS

Descriptive statistics were calculated for all items (n = 69) and parcels (36 parcels); no outliers or other abnormalities were found. The total scores of each of the 36 parcels were distributed normally.

As a next step we tested the measurement model to determine whether the data fitted the hypothesised factor structure of the MSLQ well. Confirmatory factor analysis was conducted to determine the adequacy of the model fit. All factor loading (i.e. regression weights) were statistically significant and ranged from .29 (time and study environment management) to .85 (self-efficacy for learning and performance). Correlation and covariance matrices were calculated for all input variables. Covariance matrices were used to perform maximum likelihood linear structural relations analyses. The motivation and learning strategies models were tested with all three samples. This was done first with the exploration sample, followed by the validation sample, and finally with the main sample. The model fit statistics for all three samples are summarized in Table 1.

The results demonstrate that the data fit the motivation and learning strategies models well. The Chi-square/df ratio for the motivation section (main sample, N = 1,166) was 3.79, $p < .01$, RMSEA = .05 and CFI = .98. Also, the learning strategies section fitted the data reasonably well: the Chi-square/df ratio (main sample, N = 1,166) was 4.63, $p < .01$, RMSEA = .06 and CFI = .91.

These findings are in agreement with the Pintrich et al. (1993) results at the course-specific level. In fact, when comparing the model fit statistics used in the Pintrich et al. "reliability and predictive validity study" (Pintrich et al., 1993) one can see that our data fitted the model even better.

Table 1: Chi-square/df ratio, p-value, RMSEA and CFI values for the motivation and learning strategies sections of the modified MSLQ

Samples	*N*	*P*-value	Chi-square/df ratio	RMSEA	CFI
Motivation Section					
Exploration Sample	583	*p<.01*	2.51	.05	.98
Construct Validation Sample	583	*p<.01*	2.43	.05	.98
Main Sample	1,166	*p<.01*	3.79	.05	.98
Learning Strategies Section					
Exploration Sample	583	*p<.01*	2.87	.06	.90
Construct Validation Sample	583	*p<.01*	3.02	.06	.90
Main Sample	1,166	*p<.0*	4.63	.06	.91

In the Pintrich et al. study the goodness-of-fit and adjusted goodness-of-fit indices (GFI and AGFI) as well as the root mean residual (RMR) were used as model fit indices. A GFI and AGFI of .90 or greater and an RMR of .05 or less are heuristic values that indicate an adequate model fit. Table 2 provides an overview of the comparison. It should be noted that for the purpose of this comparison the full model with all its observed items was used and not the parcelled item sets.

Overall, our results show a good model fit indicating that the MSLQ is a valid instrument to determine student motivation and self-regulated learning strategies at the general curriculum level.

Table 2: Comparison of the goodness-of-fit index, the adjusted fit goodness-of-fit index and root mean residual between the Pintrich et al. (1993, pp.807-809) study and the findings of the present study

Scale/Index	Pintrich et al. study	Present study
Motivation Section		
GFI	.77	.94
AGFI	.73	.92
RMR	.07	.03
Learning Strategies Section		
GFI	.78	.86
AGFI	.75	.84
RMR	.08	.04

Before testing the predictive validity of the modified MSLQ reliability analyses were carried out. The reliability of the 13 scales was assessed using the coefficient *H*, which represents the degree of replicability of a construct

based on its measured indicator variables. See Table 3 (third column) for details. Values ranged from .52 (peer learning) to .86 (self-efficacy for learning and performance), on average .70. The values are indicative of a moderate to good internal consistency of the motivation and learning strategies scales.

Table 3: Descriptive statistics, coefficient H, and correlations with final semester grades for the motivation and learning strategies scales

Scales	*M* (*SD*)	Coef. *H*	*r* with English Course Grade	*r* with Math Course Grade	*r* with Overall Semester Grade	*Pintrich et al. (1993, p.808)*
Self-efficacy for learning and performance	3.61 (.53)	.86	.11**	.04	.14**	.41**
Control of learning beliefs	3.78 (.55)	.64	.04	.04	.06	.13**
Intrinsic goal orientation	3.74 (.52)	.62	.14**	-.01	.16**	.25**
Extrinsic goal orientation	3.89 (.67)	.72	.05	.06*	.06*	.02
Rehearsal	3.65 (.58)	.69	.05	.08*	.07*	.05
Elaboration strategies	3.59 (.48)	.78	.11**	.05	.14**	.22**
Organisation strategies	3.58 (.55)	.70	.08**	.04	.10**	.17**
Critical thinking	3.51 (.50)	.73	.11**	.03	.12**	.15**
Metacognitive self-regulation	3.48 (.39)	.79	.13**	-.02	.17**	.30**
Time and study environment management	3.49 (.45)	.72	.11**	.01*	.16**	.28**
Effort regulation	3.57 (.58)	.61	.13**	-.01	.19**	.32**
Peer learning	3.51 (.50)	.52	.07*	-.02	.08**	-.06
Help seeking	3.65 (.50)	.65	.12**	.01	.14**	.02

Note: ** correlation is significant at the 1% level, * correlation is significant at the 5% level

After having tested the construct validity and reliability of the modified MSLQ, the instruments' predictive validity was assessed by computing Pearson's correlation coefficients for each scale and the overall semester grade as well as the course grades for English and mathematics. The overall semester grade is the accumulated average grade of five modules (i.e. English, Mathematics, Science, Enterprise skills, and Cognitive learning). The results of the correlation analyses are displayed in Table 3 (last four columns).

The results revealed that although the correlations between the MSLQ scales and the overall semester grade are moderate to weak they are all statistical significant except for the "control of learning beliefs" scale. Stronger correlations were found for variables that are considered to be indicative for a positive adaptation of self-regulated learning strategies and responsible for higher academic performance, like self-efficacy for learning and performance, intrinsic goal orientation, elaboration strategies, metacognitive self-regulation, time and study environment, and effort regulation. As expected, weaker correlations were found for less positive and less adaptive constructs like extrinsic goal orientation and rehearsal strategies. Similar results were found for the correlations between the MSLQ scales and the course-specific English grade. Comparable to the findings on the overall semester grade, stronger correlations were found for the adaptive constructs and weaker correlations for the less adaptive constructs. Overall, the correlations for the overall course grade and the English grade were non-significantly different. A different outcome could however be observed for the correlations with the mathematics grade. Most of the correlations were rather weak and not significant, expect for extrinsic goal orientation and rehearsal. These findings confirm our predictions and indicate the application of contextually dependent learning strategies; whereas for the English grade and the overall semester grade positive and more adaptive constructs seems to have a greater influence on academic performance, the opposite is the case for mathematics. Stronger correlations were found for less adaptive and more "surface" learning strategies. Considering the findings of the correlational analysis it seems that the MSLQ was not just able to predict the overall semester grade, but was also able to discriminate between the English and mathematics grade as a result of different strategy use.

DISCUSSION

The objective of this study was to investigate whether the MSLQ is capable of measuring students' motivational beliefs and self-regulated learning strategies pertaining to the general curriculum level. Until now, the MSLQ has exclusively been used at the course-specific level with a focus on situational factors that may influence student motivation and learning. Our study was based on the assumption that student motivation and learning strategies are not necessarily limited to situational contexts but that students may have fairly stable dispositional self-regulated learning strategies that can be observed at the general curriculum level as well. This assumption was based on findings from previous studies that were conducted at the course-specific level and suggest that students have stable patterns of learning strategies when comparing them across different subject areas (cf. Vermetten et al., 1999; Wolters & Pintrich, 1998). For the purpose of administering the MSLQ at the general curriculum level we slightly modified the wordings of several items and administered the modified MSLQ to 1,166 polytechnic students in Singapore. The data were analysed using confirmatory factor analysis to test whether the factor structure of the modified MSLQ remains stable when administering it at the general curriculum level. The results revealed a good fit of the motivation and learning strategy models with the data. All parcel loadings were significant and contributed to the latent constructs, which is indicative of a good construct validity of the 13 subscales of the instrument. The model fit indices and factor loadings we found in our study are quite similar to the ones found in an earlier study with the course-specific MSLQ (Pintrich et al., 1993). Considering our findings as a whole it seems reasonable to conclude that the slightly modified MSLQ is capable of measuring student motivation and learning strategies pertaining to the general curriculum level.

Concerning the predictive validity of the MSLQ for the general curriculum level, the results of the correlational analyses revealed that the instrument is capable of predicting the overall semester grade reasonably well. Although the correlations between MSLQ scores and the final overall semester grade were rather weak, they were all statistically significant (except for the extrinsic goal orientation subscale) and similar to the results found with the course-specific MSLQ (Pintrich et al., 1993). For instance, more positive and adaptive

constructs such as self-efficacy for learning and performance, intrinsic goal orientation, elaboration strategies, metacognitive self-regulation, time and study environment management, and effort regulation showed higher correlations with the overall semester grades as compared to negative and less adaptive constructs like extrinsic goal orientation and rehearsal. The majority of correlations we found in our study were non-significantly different from the course-specific findings in the Pintrich et al. study. Significant differences (at the 5% level) were found on the self-efficacy for learning and performance scale. This difference may be explained by the context-specific nature of the self-efficacy construct. As discussed elsewhere, self-efficacy is considered to be highly context-specific, eliciting students' judgments for a rather narrow and domain-specific filed of expertise (Bong & Skaalvik, 2003; Schunk, 1991). In our study it seems that students had difficulties making these context-specific judgments when asked to respond at the general curriculum level. Future research has to demonstrate whether the broader construct of academic self-concept may be a better construct than self-efficacy when measuring student motivation at the general curriculum level.

Furthermore, the differences in the strengths of correlations between the MSLQ scores and the English and mathematics course grades suggest that the modified MSLQ is capable of distinguishing between subject domains that may put different constraints on the application of learning strategies. This context sensitivity seems to be related to the grain-size of the instrument; despite administering the MSLQ at the general curriculum level we were able to pick up variations in correlations between different courses. Although this explanation needs to be tested in further studies, the results presented so far do add to the overall validity of the MSLQ.

Considering the practical implications of our findings, the modified MSLQ can be considered as an alternative instrument to existing SAL-based self-report instruments like the *Approaches to Studying Inventory* (Entwistle & Ramsden, 1983) or the *Study Processes Questionnaire* (Biggs, Kember, & Leung, 2001) in measuring student motivation and learning strategies at the general curriculum level. The advantage of using the modified MSLQ may be its smaller grain-size. As Entwistle and McCune (2004) pointed out in their comparison of SRL and SAL instruments, the scales of the MSLQ cover a larger

number of motivational, cognitive, and study resource management related constructs than most of the SAL instruments. This difference in grain-size may prove beneficial in providing educational researchers with more detailed information about students' self-regulatory capabilities as compared to other SAL instruments.

Finally, it should be noted that some of our explanations need to be explored further with additional research. Whereas our main concern was to determine the construct and predictive validity of the modified MSLQ, further studies should be directed towards a clear identification of what constitute *contextual* and *dispositional* self-regulated learning strategies. Most studies that explored dispositional self-regulatory strategies were limited to research at the course-specific level and used comparisons between correlational variable structures in different subject areas. Our study added to the existing body of research by signifying that dispositional self-regulatory learning strategies can also be observed at the general curriculum level. In order to identify however what accounts for contextual and what for the dispositional factors that influence learning, future studies should consider a combined research approach by simultaneously administering the modified MSLQ and the original, course-specific MSLQ in multiple subject domains. Comparing the results of both questionnaires would enable verification of which of the constructs remain constant in both contexts and thus represent the stable, dispositional aspect of learning. Observed variability in scores would indicate more ad hoc and context-dependent utilizations of self-regulated learning components.

CHAPTER 3
EXAMINATION OF THE CONTEXT-SPECIFIC NATURE OF SELF-REGULATED LEARNING[2]

ABSTRACT

The purpose of the present study was to investigate to what extent self-regulated learning (SRL) is context-dependent. The *Motivated Strategies for Learning Questionnaire* (MSLQ) was repeatedly administered to 155 first-year students at a polytechnic in Singapore - a general version of the MSLQ before students entered the polytechnic and a course-specific version at the end of the first semester for mathematics, science, and English courses. Data were analysed using structural equation modelling. The analyses included: (1) tests for invariance of factorial structures, (2) tests for invariance among latent means, and (3) a comparison of the predictive validity of the general and the course-specific versions of the MSLQ. The results showed that no significant differences could be found in the underlying structure of SRL between subject domains. In addition, average subscale responses were rather invariant across domains. Finally, course-specific measures of SRL were generally not more accurate in predicting academic achievements than the general version. These findings taken together do not support the notion that SRL is context-dependent. Rather, SRL as measured by the MSLQ appears to be a stable disposition of the learner.

INTRODUCTION

Over the past three decades, the study of self-regulated learning, or SRL, has gained considerable ground in educational psychology (Paris & Paris, 2001). A major reason for this is that SRL research is not limited to the cognitive aspects of learning alone - as it was traditionally the case in learning research - but that it also incorporates metacognitive, motivational, affective, and

[2] Rotgans & Schmidt (in press*). Examination of the Context-Specific Nature of Self-Regulated Learning.* Educational Studies.

social-behavioural factors, which provide a more detailed picture of students' motives, goals and actual classroom performances. Although there are various definitions of the SRL construct, there seems to be general agreement about three integrated components that describe self-regulated learners.

According to Zimmerman (1990), the first component refers to students' metacognitive strategies for planning, self-monitoring, and controlling one's learning during various stages of the learning process. A second component refers to students' motivational and affective processes to engage with and persist on the learning task (Pintrich, 1999; Zimmerman, 1989b, 1990). Self-efficacy, task value, intrinsic goal orientation, and test anxiety are some of the key variables here. The third component refers to students' behavioural processes, such as how students create and structure their learning environment (Henderson, 1986; Zimmerman, 1989a, 1989b). In addition, many SRL models include students' use of cognitive strategies such as rehearsal, elaboration, and organisation strategies under this component (Pintrich & De Groot, 1990). To date, most SRL approaches incorporate these three general components into comprehensive models of students' academic learning and classroom performance. There is however less agreement on whether SRL components are context-dependent or fairly generalisable across subject domains and disciplines. In other words, are motivational beliefs, cognitive, and metacognitive self-regulative strategies dependent on the learning context or are they transferable and rather stable dispositions of the learner?

A number of answers have been proposed to the above question. A dominant and broadly accepted perspective postulates that SRL is highly dependent on the learning context and should therefore be studied at the course level, that is, for an individual discipline or study subject (Anderman et al., 2001; Bong, 1996; Pintrich, 2004). Many motivational processes, such as self-efficacy judgments and task value beliefs, are thought to be highly sensitive to the features of a learning task (Schunk, 1989, 1991). Bong (2001, 2004), for instance, reported that motivational beliefs, such as academic self-efficacy and task value beliefs are subject matter specific. She found that students' task value beliefs for mathematics were different from task value beliefs in English and Korean. The same seems to apply to the cognitive component of SRL, such as cognitive strategy use, which often seems to

depend on cues of the learning task and environment (Brown, Bransford, Ferrara, & Campione, 1983; Schneider & Pressley, 1989). Stodolsky (1988) found that mathematics classes were more structured, sequential and less engaging than was the case for social study classes. Mathematics tasks were often cognitively less engaging than the more open-ended and diverse tasks found in social studies. The findings indicate that the context in which the learning task is embedded in largely determines which cognitive strategy needs to be activated.

In contrast to the above position, there is also research suggesting that students who are aware of and are able to control their learning strategies and motivational beliefs (i.e. being self-regulated) should be able to overcome contextual differences (Siegler, 1988; Sternberg, 1988). One could argue that SRL strategies are psychological skills that can be activated in a similar fashion for different learning contexts. For instance, the metacognitive component of SRL may apply equally well to an English class as it does to mathematics; it entails planning one's learning steps, monitoring one's progress and taking corrective actions to optimise one's learning (see also Kaldeway & Korthagen, 1995). In short, this view about SRL postulates that student motivation and the use of learning strategies are rather consistent across school subjects (Bandura, 1997; Pokay & Blumenfeld, 1990; Zimmerman & Martinez-Pons, 1990).

A third position suggests that the underlying structure of SRL (i.e. the relationships between the variables involved) is fairly stable and does not significantly change as a function of the subject domain or discipline. At the same time however, it is assumed that despite this stable underlying structure, the measured variables can take different values depending on the subject domain. For instance, a student may experience more task value for mathematics than for English, but despite these differences in task value, it does not affect the underlying relationships between task value beliefs and the use of learning strategies in general. If task value is high, the student is more likely to use positive and adaptive learning strategies, which are expected to result in higher levels of academic achievement. Consequently, the opposite is the case for low levels of task value (cf. Pintrich, Simith, Garcia, & McKeachie, 1993). Empirical evidence that supports this view about SRL can

be found in a study conducted by Wolters and Pintrich (1998). They investigated whether seventh and eighth grade students' motivational beliefs and learning strategies vary as a function of mathematics, social studies, and English. The results showed that the directions and strengths of the correlations between the measured variables were similar for all three subjects. However, despite these stable correlational patterns, they also found mean level differences between the measured variables, which suggest that the levels of students' motivational beliefs and cognitive strategy use were sensitive to contextual differences. Overall, Wolters and Pintrich concluded that "…the general models of self-regulated learning that are being developed are applicable to different academic domains and can be fruitfully used to understand student learning in different classroom contexts" (p.45).

Similar results were reported by Vermetten, Lodewijks, and Vermunt (1999) in a study investigating students' consistency and variability of learning strategies among four university law courses (i.e. Private Law, Criminal Law, Introduction to Law, Administrative Law). They also found mean level differences in reported learning strategies between the four law subjects, but, generally, correlations between the measured variables showed that students displayed consistency in their use of learning strategies. For instance, the correlations between critical processing, memorizing, and analysing were quite similar for all four courses. Analogous to Wolters and Pintrich's conclusion, Vermetten et al. noted that their results point towards a personal, dispositional component in the use of learning strategies. At this point, it is important to emphasise that the mean level differences between the law subjects may have been due to possible differences in teaching methods and assessment practices rather than to differences in nature of the subject matter itself. Although Vermetten et al. report that they interviewed several teachers and reviewed course materials to see whether there are any instructional differences, they do not mention if and how they controlled these possible sources of variation. Wolters and Pintrich also stressed this point by adding to their conclusions that it is important to differentiate between subject area differences and general instructional differences.

Overall, the findings of both studies demonstrated that while there were mean level differences between the measured SRL subscales, the pattern of

correlations between the subscales were similar across the various subject domains. This suggests that the underlying structure of the SRL construct is generally invariant for different educational contexts. The reader should however bear in mind that this conclusion is based solely on the presence of raw correlations between the scores of the various subscales of the SRL-measures used. However, "raw" correlations between measured variables are usually insufficiently informative if one wishes to understand the nature of the structure underlying a set of psychological constructs. Correlations between any two variables may be subject to moderation or suppression by other variables and, therefore, cannot be trusted as the foundation for theoretical claims about the nature of underlying cognitive and motivational structures. We therefore suggest that the analysis concerning the context-specific nature of SRL should be conducted with the latent constructs that define the underlying structure of SRL, rather than with the mean values of the subscales. Assessing whether the factorial structure of the subscales holds across various subject domains and disciplines is a more powerful analysis than correlating the mean values of these subscales, since it takes into account the relationships between all measured variables instead of the correlations between the aggregated mean scores. "Factorial structure" refers to the relationships between the observed variables (i.e. measured items) and the underlying latent, unobserved factor (the construct being estimated), which is commonly referred to as confirmatory factor analysis (CFA). If the factorial structure of the subscales (i.e. the CFA model) for different subject domains turns out to be non-significantly different, it would provide strong empirical evidence in favour of the notion that SRL is a rather stable disposition of the learner and against the claim that SRL is highly context dependent.

In addition to the above discussion, which is mainly related to the construct and external validity of the SRL construct, matters pertaining to its *predictive* validity should not be overlooked. One of the key objectives of SRL research is to make predictions about students' academic achievements, and if necessary initiate interventions to improve learning outcomes. As mentioned earlier, a dominant research perspective, which reflects the current zeitgeist of SRL is based on the assumption that SRL is highly context-dependent and should be analysed at the course-specific level. As such, an implicit

assumption guiding this line of research is that predictions about students' academic achievements are more accurate at this level of analysis as compared with the more general curriculum level (e.g. Boekaerts, 1997). It remains however to be seen if this is indeed the case. It may be possible that general measures of SRL are able to reach similar levels of accuracy in predicting learning outcomes. A straightforward approach to test this possibility is to compare the predictive validity of a general measure of SRL with a course-specific one.

In summary, an examination of the context-specific nature of SRL includes first, scrutiny of the variability or invariance of the underlying constructs between subject domains. This would make it possible to test whether the underlying structures are general motivational processes and cognitive skills or context-specific behaviours that emerge in response to the particular learning task at hand. Second, the examination should incorporate comparisons of latent mean values for each of these underlying constructs over the different subject domains. Such analysis would incorporate tests for invariant latent mean structures of relevant CFA models to examine if individual subscales differ as a function of the subject domain. Third, the examination of the context-specificity nature of SRL should also include a comparison of the predictive validity of a course-specific measure of SRL with a general measure. This comparison would help clarify whether predictions with a course-specific SRL measure are more accurate than predictions with a general measure.

In order to test the above hypotheses we administered a SRL self-report instrument, the *Motivated Strategies for Learning Questionnaire*, or MSLQ (Pintrich, Smith, Garcia, & McKeachie, 1991) for mathematics, science, and English at a polytechnic in Singapore. We chose a within-subjects design in which all students responded to the MSLQ for all three courses. The instructional method and assessment procedures were identical in format for all three courses. This setup enabled us to assign potential differences between subjects to differences in content rather than to the instructional approach or assessment practices. Prior to this study, at the beginning of the academic year, a general version of the MSLQ was administered to the same

group of students. This enabled us to compare the predictive validity of the course-specific instrument with the general version of the same instrument.

METHOD

Participants

The sample consisted of 155 first-year students enrolled at a polytechnic in Singapore. The average age of the participants was 17.65 years (*SD* = 1.29). The majority of the participants were Singaporeans (89%); the remaining students (11%) came from China, Indonesia, Malaysia, and the Philippines. All students were enrolled in a general first year curriculum.

Materials

As a measure for SRL we used the *Motivated Strategies for Learning Questionnaire,* MSLQ (Pintrich et al., 1991). The MSLQ has two sections, one section taps into students' motivational beliefs and the second section measures students' use of learning strategies as well as study management related aspects. Overall, the MSLQ has six motivation scales and nine learning strategy scales and consists of 81-items. The motivation 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, organisation 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*).

Students' general motivational beliefs and the use of SRL strategies were measured by administering a slightly modified version of the MSLQ. Several of the original items of the MSLQ were modified to enable measurement at the general curriculum level. The modification was made 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 slightly modified MSLQ was demonstrated to be sufficiently high and similar to the context-specific versions of the same questionnaire.

As an outcome measure of students' academic achievement in mathematics, science, and English, final course grades were used in the analyses. For all three courses, the assessment practices were identical. The final course grade was based on two assessment measures. The first measure is referred to as a "classroom performance measure". The classroom performance measure was based on teacher observations of students' participation, teamwork, presentation skills, and self-directed learning. A 5-point performance scale was used: 0 (*fail*), 1 (*conditional pass*), 2 (*acceptable*), 3 (*good*), and 4 (*excellent*). Since students were rated every day and a course covered 16 days of work for each student 16 judgments were obtained per module. The reliability of the classroom performance measures was determined by means of Cronbach's coefficient alpha. The alpha values were equal to .86, .88 and .89 for mathematics, science, and English respectively. The second assessment measure was based on students' performances in written achievement tests. The written achievement test is a 30 minutes test, consisting of a combination of open-ended questions and multiple-choice questions, where students' subject-specific understanding was tested. Four written achievement tests were conducted per semester for all modules. 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 coefficient alpha was .61, .84, and .66 for mathematics, science, and English respectively. The average of both the classroom performance measures and the written achievement tests was calculated for each of the three courses. In addition, students' general performance at the end of the first semester was determined by taking the average of all three-course grades.

Procedure

The general version of the MSLQ was administered during matriculation period (2007) before the students commenced their studies at the polytechnic. The instrument measured students' general motivational beliefs and learning strategies based on their prior educational experiences. Students had 20 minutes to complete the questionnaire. The course-specific MSLQ was administered three weeks before the first semester ended for mathematics, science, and English courses in the same fashion as the general version. These three courses were conducted in parallel during the first semester. The questionnaires appeared in the students' regular electronic learning environment where the participants were instructed to complete the questionnaire on the same day the particular course was conducted. For instance, on the day they had a mathematics session, they were asked to respond to the MSLQ for the same subject mathematics. The same applied to science and English courses. This procedure was conducted with the intent to reduce response interference effects that may occur when students respond to all three questionnaires in a relatively short period of time. The written achievement test was conducted every four weeks, whereas the classroom performance measure was determined after every class over a period of 16 weeks. The achievement measures were stored electronically and compiled at the end of the first semester.

Analysis

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. The subsequent analyses were conducted in AMOS 5.0 (Arbuckle, 2003). Items of the MSLQ were clustered into groups of two based on semantic overlap. This technique is called "item parcelling" (Bandalos & Finney, 2001; Little, Cunningham, Shahar, & Widaman, 2002). Item Parcelling is a measurement practice that is commonly used in latent variable analyses. According to (Little et al., 2002), a parcel can be defined as an aggregate-level indicator, comprised of the sum or average of two or more items. For the MSLQ a total

of 41 parcels were formed, with 16 for the motivation section and 25 for the learning strategies section.

Confirmatory factor analysis was conducted for both the motivation and learning strategies measurement models. 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 the observed and 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 3 is deemed 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 the absolute fit indices, the comparative fit index (CFI) was calculated. The CFI value ranges from 0 to 1 and a value greater than .95 is conventionally considered a good model fit (Byrne, 2001).

A first test to examine if SRL strategies are similar between subject domains was conducted by assessing whether the motivational model and the learning strategies model, as proposed by Pintrich et al. (1991) for the MSLQ, produces acceptable model fits for mathematics, science, and English. If they do, it would be considered a first indicator that the factorial structure of SRL is invariant across all three subjects. Models were then tested with both unconstrained and constrained factor loadings. Significant differences in Chi-square value between the constrained and unconstrained models in relation to the difference in degrees of freedom reveals the extent to which the SRL construct is considered invariant for the three subject domains. Subsequently, tests for invariant latent mean structures were conducted by testing for the equivalence of latent means related to each underlying construct. In the analysis of invariant factorial structures it is implicitly assumed that all observed variables are measured as deviations from their means; the means are set equal to zero. As a consequence, the intercept terms associated with the equations are irrelevant to the analysis. With the analysis of invariant mean

structures however, the means take non-zero values, which means that intercept parameters must be taken into account (Byrne, 2001). Since observed variable means are functions of the other parameters in the model, the intercept terms must be estimated jointly with all other model parameters. In this case, the analysis was based on the mean structures of the underlying measurement models.

Finally, it was examined whether the scales of the course-specific MSLQ provide better predictions of the course grades than the general version of the MSLQ. To that end, the mean scores of the motivation scales and the learning strategies scales of the course-specific MSLQ for mathematics, science, and English were correlated with the respective course grades. The same was done with the general version of the MSLQ. Differences between the correlation coefficients of the course-specific MSLQ and the general version of the MSLQ were statistically analysed for significance.

RESULTS

Descriptive statistics for each item and parcel were calculated. No outliers or abnormalities were found. The reliability of the subscales was assessed using Hancock's coefficient *H* (Hancock & Mueller, 2001). The coefficient *H* is a reliability measure for latent variable systems which reflects the degree of replicability of a construct based on its measured indicators. The coefficient *H* for the motivation subscales ranged from .70 to .91 (average .81) and the learning strategies subscales ranged from .62 to .85 (average .75). These values are indicative of adequate construct reliability. See Table 1 for a summary of the descriptive statistics for the mathematics, science, and English subjects.

In the next step it was tested whether the data for mathematics, science, and English fitted the motivation and learning strategies models as proposed by Pintrich et al. (1991) equally well. The results for all three subjects showed an acceptable model fit for both the motivation and the learning strategies model. See Table 2 for an overview of the model fits for all three subjects as well as the overall model fit.

Table 1: Descriptive statistics of the MSLQ for the mathematics, science and English subjects

Subscales of the MSLQ	Mean (*SD*) Mathematics	Mean (*SD*) Science	Mean (*SD*) English
Intrinsic Goal Orientation	3.72 (.78)	3.58 (.68)	3.91 (.70)
Extrinsic Goal Orientation	3.88 (.73)	3.88 (.77)	4.17 (.72)
Task value beliefs	3.44 (.79)	3.42 (.72)	4.13 (.75)
Self-efficacy beliefs	3.19 (.78)	3.15 (.79)	3.71 (.66)
Test anxiety	3.06 (.80)	3.02 (.84)	2.99 (.89)
Control of learning	3.74 (.74)	3.62 (.72)	3.80 (.68)
Rehearsal	3.27 (.75)	3.19 (.73)	3.33 (.74)
Elaboration	3.47 (.69)	3.45 (.68)	3.72 (.71)
Organisation	3.24 (.78)	3.27 (.77)	3.42 (.79)
Critical thinking	3.39 (.70)	3.34 (.68)	3.65 (.74)
Metacognitive self-regulation	3.35 (.57)	3.35 (.56)	3.58 (.57)
Time and study environment	3.33 (.61)	3.32 (.61)	3.47 (.61)
Effort regulation	3.58 (.78)	3.50 (.77)	3.88 (.71)
Peer learning	3.53 (.79)	3.53 (.69)	3.64 (.79)
Help seeking	3.75 (.67)	3.83 (.65)	3.67 (.69)

Table 2: Summary of model fit statistic for mathematics, science and English

Model fit statistics	Mathematics	Science	English	Overall
Motivation Section of the MSLQ				
Chi-square/df	1.84	2.26	1.76	2.07
p-value	< .01	< .01	< .01	< .01
CFI	.95	.92	.95	.94
RMSEA	.07	.08	.07	.05
Learning Strategies Section of the MSLQ				
Chi-square/df	1.75	1.98	2.36	2.03
p-value	< .01	< .01	< .01	< .01
CFI	.93	.91	.89	.90
RMSEA	.06	.07	.08	.05

None of the modification indices suggested that any of the parcels cross-loaded on other latent variables. Since the generated model fits for all three subjects were similar and within acceptable range, the findings can be

considered as a first indicator that SRL, as defined by the MSLQ, does not significantly vary between the subject domains.

Consistent with these initial findings, the test for invariant factorial structures confirmed that no significant differences could be observed between mathematics, science, and English in the underlying factor structures for motivation and learning strategies. The results of the differences in Chi-square test for the motivation model are summarized in Table 3.

Table 3: Motivation section of the MSLQ, test for invariant factorial structures between mathematics, science and English

Model	χ^2	df	$\Delta\chi^2$	Δdf	Statistical Significance
Unconstrained model	540.33	261	-	-	
Constrained model	540.34	263	0.01	2	ns

The value for $\Delta\chi^2$ (df = 2) was .01, which is statistically non-significant (p = .99). The test of invariance between the constrained and unconstrained models showed that the underlying factor structure of the motivational component of SRL does not significantly differ between the subjects. The findings suggest that intrinsic/extrinsic goal orientations, control of learning beliefs, task value, self-efficacy, and test anxiety are invariant for mathematics, science, and English. Similar results were obtained for the learning strategies model, as depicted in Table 4.

Table 4: Learning strategies section of the MSLQ, test for invariant factorial structures between mathematics, science and English

Model	χ^2	df	$\Delta\chi^2$	Δdf	Statistical Significance
Unconstrained model	1617.94	717	-	-	
Constrained model	1659.93	749	41.99	32	ns

The $\Delta\chi^2$ (df = 32) value was 41.99, which is statistically non-significant (p = .11). The findings demonstrate that the underlying factor structure for both the motivation and learning strategies models was non-significantly different between the subject domains. Due to this equality in factor loadings, latent

mean values could be estimated for the motivation and learning strategies models. The results of the motivation model are presented in Table 5.

Table 5: Motivation section of the MSLQ, test for invariant latent mean structures between mathematics, science and English

Scales	Estimate	S.E.	C.R.	Statistical Significance
Intrinsic goal orientation	-.04	.08	-.48	.63
Extrinsic goal orientation	-.12	.07	-1.68	.09
Control of learning beliefs	.02	.07	.26	.79
Task value	-.35	.09	-3.73	.00
Test anxiety	.10	.07	1.49	.14
Self-efficacy judgments	-.31	.08	-3.77	.00

The results show that significant latent mean differences between the three subject domains could be observed with respect to task value beliefs and self-efficacy judgments. Closer examination of the results revealed that task value beliefs were significantly higher for mathematics and science than for English. The opposite was the case for self-efficacy; students felt less self-efficacious for mathematics and science than for English. In contrast to the test of invariant factorial structures, the analysis of mean level differences for the motivation model revealed that task value beliefs and self-efficacy seem to be rather context dependent. This is not entirely surprising, since task value, as defined by Pintrich et al. (1991) for the MSLQ, refers to students' perceptions of particular course material in terms of interest, importance, and utility. Similarly, self-efficacy is related to a student's specific expectations and confidence to perform a particular task. The operational definitions themselves imply a close context dependency as compared to other more generally defined motivational variables such as intrinsic goal orientation. Significant latent mean differences were also observed for the learning strategies model. As Table 6 depicts, significant differences could be observed for metacognitive self-regulation, time and study management, and elaboration.

Table 6: Learning strategies section of the MSLQ, test for invariant latent mean structures between mathematics, science and English

Scales	Estimate	S.E.	C.R.	Statistical Significance
Rehearsal	-.05	.07	-.69	.49
Effort regulation	-.12	.07	-1.57	.12
Organisation	-.12	.07	-1.73	.08
Peer learning	-.09	.06	-1.55	.12
Help seeking	.02	.06	.29	.77
Critical thinking	-.11	.07	-1.61	.11
Time and study environment	-.10	.05	-2.01	.04
Metacognitive self-regulation	-.10	.05	-2.06	.04
Elaboration	-.13	.07	-1.95	.05

Analogous to the findings for the motivation model, closer examination of the results revealed that the latent mean differences were most evident between English on the one hand and mathematics and science on the other. Time and study management, metacognitive self-regulation, and elaboration were significantly lower for English than for mathematics and science. Taken together, these findings suggest that although the underlying factorial structure of SRL seems to be rather context-independent, latent mean score differences of the subscales point towards context-specific variations in strategy use.

In the last step of the analysis, it was tested whether course-specific measures of SRL provide more accurate predictions in students' academic achievements as compared with more general measures. The results of the statistical comparisons between the correlation coefficients for the course-specific version of the MSLQ and the general version of the MSLQ are summarized in Table 7.

Superscripts in column "Average Grade" indicate the level of significance between the correlation coefficients of the course-specific predictions (correlation coefficients math[1], science[2], English[3]) and the general predictions (correlation coefficient Average Grade).

Columns 2 to 4 ("Math", "Science", and "English") of Table 7 represent the correlation coefficients between the subscales of the course-specific MSLQ and the respective course grades.

Table 7: Comparison of the predictive power between the course-specific and the general version of the MSLQ and course grades

Scale	Math	Science	English	G-Math	G-Science	G-English	Average Grade
Intrinsic goal orientation	.23	.39	.22	.31	.11*	.07	.21
Extrinsic goal orientation	.20	.17	.12	.21	-.01*	.03	.10
Task value	.29	.36	.23	.21	.09	.04	.14
Control of learning beliefs	.12	.11	.05	.13	.01	-.02	.05
Self-efficacy judgments	.45	.48	.33	.34	.15**	.06*	.23[1*2*]
Test anxiety	-.17	-.22	-.10	-.10	-.21	-.09	-.17
Rehearsal	.17	.15	-.03	.07	-.01	-.04	.01
Elaboration	.31	.35	.21	.23	.06	.01	.13
Organisation	.24	.31	.11	.21	.05	.00	.11
Critical thinking	.28	.30	.21	.32	.22	.07	.26
Metacognitive self-regulation	.39	.36	.30	.32	.18	.07	.24
Time and study environment	.31	.28	.19	.15	.10	.10	.15
Effort regulation	.35	.29	.29	.02**	.08*	.09	.08[1*]
Peer learning	.20	.33	.16	.24	.10	.08	.16
Help seeking	.11	.11	.17	.17	.04	.06	.12

Note: ** correlation is significant at the 1% level, * correlation is significant at the 5% level.

The results are within the expected directions and strengths. For instance, test anxiety correlated negatively with the module grades and positive motivational beliefs such as self-efficacy was a rather strong predictor for the course grades (cf. Pintrich, Smith, Garcia, & McKeachie, 1993). Columns 5 to 7 ("G-Math", "G-Science", and "G-English") represent the corresponding correlation coefficients between the general version of the MSLQ and the course grades for mathematics, science, and English. Significance tests between the correlation coefficients revealed that only 4 out of 15 comparisons were statistically significantly different. For instance, the correlation between the course-specific self-efficacy subscale and the course grades for science and English were significantly different from the correlations with the general version of the MSLQ. The same was the case for effort regulation and the course grades for mathematics and science. Overall however, grade predictions based on the general MSLQ turned out to be very similar to the course-specific ones. This outcome was supported by the

findings concerning the correlations between the general version of the MSLQ and the average of all course grades (last column), which showed only minor deviations from the course-specific predictions. Statistically significant differences could only be observed for self-efficacy ("Math" and "Science") and effort regulation ("Math") indicated in Table 7 by "1*, 2*" in the last column. Self-efficacy, as mentioned earlier, seems to depend chiefly on students' prior experiences with the subject matter. Similarly, the amount of effort that students are willing to spend on studying for a particular subject seems to be dependent on the subject in question. Overall however, the findings demonstrate that a general measure of SRL predicts students' academic achievements surprisingly well when compared with the course-specific predictions. These results suggest that SRL as measured by the MSLQ is not that context specific after all; it seems likely that most of the SRL variables are stable dispositions of the learner rather than dependents of the learning context - with the exception of explicitly context-specific variables such as self-efficacy and effort regulation.

DISCUSSION

The purpose of the present study was to investigate whether SRL is dependent on the learning context or whether it is generalisable across subject domains and disciplines. A general version of the *Motivated Strategies for Learning Questionnaire* was administered to first-year polytechnic students before they enrolled at a polytechnic in Singapore. Subsequently, a course-specific version of the same instrument was administered at the end of the first semester for mathematics, science, and English. For all study subjects, the configuration of the instructional methods, learning resources, and assessment practices were highly similar to ensure that any measured effects represent potential differences in the nature of the subjects rather than differences in the instructional settings. The examination of the context-specific nature of SRL was conducted (1) by scrutinising whether the underlying structure of the motivation and learning strategies constructs were invariant across subject domains, (2) by comparing the latent mean values for each of these underlying constructs between the subject domains, and (3) by assessing

whether the predictions of academic performance made with the course-specific and the general measure of SRL yielded different results.

To begin, the results of the confirmatory factor analysis showed that the data fitted the motivation and learning strategies models equally well for all three subject domains. This outcome in itself can be considered a first piece of evidence that the underlying structure of SRL is consistent across learning contexts for our samples. Support for this preliminary conclusion came from the results of the more stringent tests for invariant factorial structures. As such, restrictions were imposed on the factor loadings and the Chi-square values were compared between the constrained and unconstrained models. The difference in Chi-square tests for both the motivation and the learning strategies models confirmed that the factorial structures do not significantly differ between mathematics, science, and English. Our results are consistent with the findings of Vermetten et al. (1999) and Wolters and Pintrich (1998) who also reported stable correlational configurations among the measured SRL variables. Taken as a whole, the first part of our examination suggests that students' motivational beliefs and the use of learning strategies are rather stable across subject domains and disciplines.

The results for the second part of the analysis revealed that some latent mean values were significantly different between the three subject domains. For the motivation model, differences were observed in students' self-efficacy judgments and task value beliefs across domains. For the learning strategies model latent mean differences emerged between mathematics/science and English for metacognitive self-regulation, effort regulation and elaboration. These findings parallel the earlier findings reported in the studies by Vermetten et al. (1999) and Wolters and Pintrich (1998). Overall it seems that despite the stable underlying structure of SRL some mean level differences do emerge. It should however be emphasised that most latent means did not significantly differ, suggesting that the majority of SRL variables are not influenced by variations in subject domains.

The final part of the analysis revolved around the predictive validity of the SRL measures used in this study. It was tested whether the correlations between the course-specific version of the MSLQ and course grades were

significantly higher than those derived from the general version of the instrument. The results revealed that only a small number of correlation coefficients showed significant differences. Differences were observed for self-efficacy, effort regulation and to a certain degree for intrinsic and extrinsic goal orientation. For these scales, the context-specific predictions were more accurate. Considering only a small number of variables were affected, our overall findings suggest that the course-specific MSLQ did not predict students' academic achievements more accurately than the general version of the instrument. Taking into account the above findings and that the general version of the MSLQ was administered before students entered the polytechnic (i.e. directly after they completed secondary school), it is quite likely that SRL is a stable disposition of the learner rather than a situational response triggered by contextual clues in the learning context.

When considering our findings as a whole, what kind of larger picture are we able to draw about the context-specific nature of SRL? First of all, our data did not support the general notion that SRL is highly context-dependent and manifest itself as a situation-specific behavioural response to the learning task at hand - at least not for the cognitive component. Instead, it seems much more likely that the cognitive architecture students develop throughout the years of educational experiences is built-up by general schemata that can be uniformly applied to various learning contexts. When it comes to the motivational component of SRL the picture seems to allow for more colourful variations. For instance, self-efficacy judgments and task value beliefs showed consistent variability between learning contexts. This was not merely the case for the analysis of latent mean differences but also for the predictive validity analysis of the SRL instruments.

As a final remark it should not go unnoticed that the predictions of students' academic achievements based on the MSLQ subscales were overall weak. Both measures - the course-specific MSLQ and the general version of the instrument - produced at best medium-strong correlations. In this respect, our findings are not dissimilar from earlier research conducted with the MSLQ by Pintrich, Simith et al. (1993) and Wolters (1998). These authors also report low to medium strong correlations between the subscales of the MSLQ and course grades. Considering the poor qualities of the scales in predicting

students' academic achievements it seems plausible that the grain-size of the MSLQ, even as a context-specific measure, may still be too large to detect context-dependent variations of motivational beliefs and learning strategies. It is not unlikely that the scope of motivational and learning strategy-related measures should be narrowed down to much smaller units of analysis, which go beyond the curriculum and course level. It may be required to focus on the individual learning task to gather more information about the contextual variations in SRL. For instance, a range of recent studies demonstrated that *interest* has a powerful positive effect on cognitive performance and affective experiences of the learner (Hidi & Baird, 1988; Hidi, Renninger, & Krapp, 2004; Renninger & Wozniak, 1985; Schiefele, 1991). In particular, situational interest may play a significant role in exploring the true contexts-specific nature of SRL since it seems to be generated by situational conditions, or stimuli in the learning environment, which cause a relatively immediate affective reaction that focuses the attention on the learning task (Hidi, 1990; Mitchell, 1993). It seems that these immediate affective reactions to a particular learning task are difficult to detect with self-report instruments like the MSLQ, which draws on students' overall perceptions for a subject domain or a study course. On-line, or "event" measures may prove to be more effective in assessing how situational interest mediates cognitive, motivational and affective learning processes in the case of SRL. Naturally, this explanation needs to be tested in future studies using on-line measures and experimental approaches to verify and, if necessary, to amend our theories about the context-specific nature of self-regulated learning.

CHAPTER 4
THE COMPLEX RELATIONSHIP BETWEEN MOTIVATION AND ACHIEVEMENT: EXAMINING THE MEDIATING ROLE OF SELF-REGULATED LEARNING AND ACHIEVEMENT-RELATED CLASSROOM BEHAVIOURS[3]

ABSTRACT

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

INTRODUCTION

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* (Pintrich, Smith,

[3] This study was presented at the 2008 Annual Meeting of the American Educational Research Association in New York City.

Garcia, & McKeachie, 1991), the average correlation between the six motivation scales and academic achievement was .17. Subsequent studies by Wolters and Pintrich (1998) and Wolters (2004) showed similar results (average correlations between motivation and achievement: r = .17 and r =.19 respectively), confirming that correlations between motivation and achievement, such as test scores or examination results, are quite low. In view of these results, and considering that motivation generally explains 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, for a recent discussion). 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, 2000a; 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 analysing 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, 2000a, 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 hypothesised that motivation influences 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 motivation and learning strategies were in turn moderately to weakly related to students' academic achievements (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, organisation, 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 relationships found between motivational beliefs 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 hypothesizing what this factor may be, 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 favourable 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 organisation 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 a formula rather than blindly applying it, 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 behaviours 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 behaviours. 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 behaviours into the investigation as well.

The present study was conducted to find out whether actual learning behaviours 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 favour of a mediating role of achievement-related behaviours discussed above, we developed a hypothetical model depicted in Figure 1.

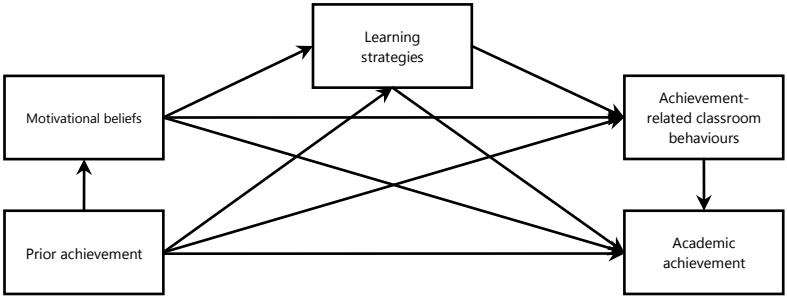


Figure 1: Path model depicting the relationships between prior achievement, motivational beliefs, self-regulated learning strategies, classroom performance, and academic achievement

This model states that prior achievement has a positive influence on students' motivational beliefs, 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 behaviours 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 (Alexander, Kulikowich, & Schulze, 1994).

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

METHOD

Participants

The sample consisted of 1,166 participants (55% female and 45% male) with an average age of 17.22 years (*SD* = 1.10). The majority of the participants (96%) were Singaporean citizens; the remaining (4%) came from China, Indonesia, Malaysia, Hong Kong, Philippines, and Taiwan. 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 programme - had to complete five general modules viz. English, mathematics, science, enterprise skills, and cognitive learning. The instructional mode for all programmes was problem-based learning, or 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

Motivated Strategies for Learning Questionnaire. As a measure of motivation and self-regulated learning the *Motivated Strategies for Learning Questionnaire* (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 motivational beliefs 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 MSLQ has six motivation scales and nine learning strategy scales and consists of 81-items. The motivation 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, organisation 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*).

Prior knowledge 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 behaviour measure. This measure was based on teacher observations representing students' achievement-related behaviours. 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 generalisability 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 programme 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 subscales 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 analysed by means of structural equation modelling using AMOS 5 (Arbuckle, 2003). In our analysis we followed the two-step approach recommended by Byrne (2001, pp. 145-147) 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 subscales representing a summary of students' general motivational beliefs and learning strategies respectively. A potential reservation against this approach may be that when combining various subscales, representing different constructs, some of the construct-specific information may get lost. On the other hand, one could argue that combining a number of subscales is justified to the extent that it represents a broader and more generalisable underlying factor. We speculated that this was the case for the present study since we were interested in the relationships between students' general motivational beliefs, 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 motivation 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 3 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).

As a reliability measure we calculated Hancock's coefficient *H* for each scale of the MSLQ. The coefficient *H* is a construct reliability measure for latent variable systems that represents an adequate alternative to the conventional Cronbach's alpha. According to Hancock and Mueller (2001) the usefulness of Cronbach's alpha and related reliability measures is limited to assessing composite scales formed from a construct's indicators, rather than assessing the reliability of the latent construct itself as reflected by its indicators. The coefficient *H* is the squared correlation between a latent construct and the optimum linear composite formed by its indicators. Unlike other reliability measures the coefficient *H* is never less than the best indicator's reliability. In other words, a factor inferred from multiple indicator variables is never less reliable than the best single indicator alone.

In order to evaluate the robustness of the general path model, we conducted a cross-validation study in which we tested the path model with an earlier collected data set (matriculation period 2006) and investigated whether it was significantly different from the first model. 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 groups.

RESULTS

Descriptive statistics were calculated for all items (n = 81) of the MSLQ. No outliers or other abnormalities were found. The reliability of the 15 scales was assessed using the coefficient *H*, which represents the degree of replicability of a construct based on its measured indicator variables. For the motivation subscales, the coefficient *H* ranged from .48 to .85 and for the learning strategies subscales from .56 to .69. See Table 1 for a summary or the descriptive statistics, the values of the coefficient *H*, and the intercorrelations between all subscales of the MSLQ.

Table 1: Intercorrelations between the subscales, as well as the mean values, standard deviations, and coefficient H for each subscale of the MSLQ

Subscales	(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				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) Organisation									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: ** correlation is significant at the 1% level, * correlation is significant at the 5% level.

The average correlation among the motivation subscales was equal to .30; the average correlation among the cognitive strategies subscales was equal to .41. Testing of the measurement models showed that the data fitted the models 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. 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 hypothesised, describing students' general motivational beliefs and one factor describing learning strategies. This outcome lent support for using the two mean values representing motivational beliefs and learning strategies in the general path model, which was used in the subsequent analyses.

Testing of the hypothesised 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. standardised regression weights) between the observed variables.

The path analysis revealed that students' motivational beliefs were neither directly related to their achievement-related classroom behaviours nor to their academic achievement. In other words, motivation was not directly related to any of the achievement measures.

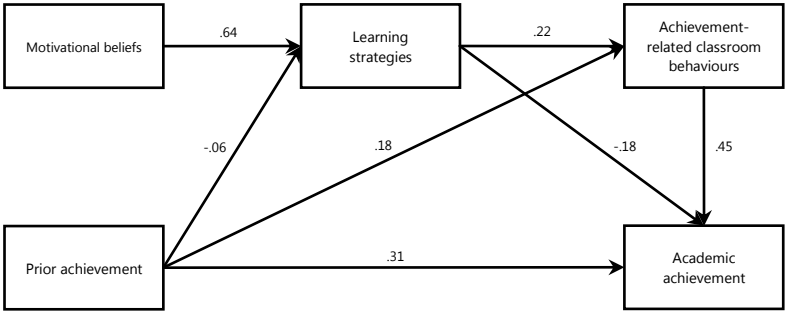


Figure 2: Path model depicting significant relationships between prior achievement, motivational beliefs, self-regulated learning strategies, classroom performance, and academic achievement
Note: Numbers above the arrows represent standardised regression weights. All regression weights are statistically significant at the 1% level.

However, motivational beliefs were strongly related to the use of learning strategies (standardised regression weight = .64, $p < .01$). Learning strategies in turn showed a negative relationship to academic achievement (standardised regression weight = -.18, $p < .01$). On the other hand, learning strategies were positively related to students' achievement-related classroom behaviours (standardised regression weight = .22, $p < .01$), which, in turn, was a relatively strong predictor of academic achievement (standardised regression weight = .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 behaviours (standardised regression weight = .18, $p < .01$) and academic achievement (standardised regression weight = .31, $p < .01$). A weak, but statistically significant, negative relationship was also observed between prior achievement and learning strategies (standardised regression weight = -.06, $p = .01$).

As a last step, we conducted a cross-validation study in which we used an earlier sample of the MSLQ and statistically compared whether the hypothesised path model holds for the two samples. The data (N = 1,164) were collected a year earlier during matriculation period 2006. The results of the multi-group comparison are summarized in Table 2.

Table 2: Multi-group comparison; test for invariant factorial structures between the 2006 and 2007 MSLQ data

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 no significant differences between the constraint and unconstraint models, which suggest that not only the relationships between the variables involved are consistent for both years, but also that the size of regression weights relating the variables in the path models for the 2006 and 2007 samples are invariant. Overall, these findings add 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 hypothesised 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 behaviours. The latter was based on the assumption that motivation without engagement cannot influence performance. In our study, these achievement-related classroom behaviours, 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 hypothesised that students' prior achievement is related to their motivational beliefs, as well as to their subsequent academic achievements.

To test the above hypotheses the MSLQ was administered to a large cohort of 1,166 first-years 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, students' general motivational beliefs were strongly related to the use of learning strategies, which were in turn moderately related to students' achievement-related classroom behaviours. Achievement-related classroom behaviours were a relatively strong predictor of students' academic achievement. Finally, prior achievement was not related to motivational beliefs, but was related to learning strategies, achievement-related classroom behaviours, 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 behaviours 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 raise concerns about the observed low correlations between motivation and academic achievement. The question is then: why is motivation such a poor predictor for academic achievement? Wolters and Pintrich (1998) argued that motivation should be seen as the starting point (or "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 does not seem to be a coincidental finding which is specific to our two samples. Pintrich and De Groot (1990) also found a negative correlation between cognitive strategy use and academic achievement. They labelled this phenomenon as a "negative suppressor effect of cognitive strategy use on academic performance" (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 behaviours are included as an additional mediator, a relatively strong correlation is observed between learning strategies and achievement-related classroom behaviours 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 involvement 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 behave optimally, but there seems room for other, yet unknown, factors that may trigger these achievement-related classroom behaviours. One can think of efforts of the teacher to involve students in their own learning, or characteristics of the learning task triggering appropriate behaviours. In short, we suggest that the nature of achievement-related classroom behaviours and their antecedent conditions may be a more fruitful area of motivation research than seeking relations between responses on self-report instruments and performance.

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 behaviours. 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 motivational beliefs.

A critical point that needs to be addressed is that overall mean scores were used to represent the average of all subscales 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 subscales 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 motivational beliefs and general learning strategies respectively. To ensure that no information was lost by computing overall scores for both constructs (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 motivation subscales with nine learning strategies subscales). For an overview of these tests, see Appendix. The tests revealed that *none* of the individual combinations of the subscale resulted in statistically 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' motivational beliefs and learning strategies rather than using individual subscales. 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 (in press) 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 as operationalised through self-report 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 analysed 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. 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 behaviours and learning, but also in predicting academic achievement.

CHAPTER 5
CROSS-CULTURAL VALIDATION OF SELF-REGULATED LEARNING IN SINGAPORE[4]

ABSTRACT

Over the past three decades, the study of self-regulated learning has gained considerable ground in educational psychology. A major reason for this is that self-regulated learning research is not limited to the cognitive aspects of learning alone but it also incorporates metacognitive, motivational, affective, and social-behavioural factors, which provide a more detailed picture of students' motives, goals, and actual classroom performances. Little is known whether self-regulated learning instruments, which are mainly based on Western theorising and research, are generally applicable to other cultures and contexts. Within this chapter we present three studies where we examined whether the *Motivated Strategies for Learning Questionnaire* is a valid and reliable instrument for measuring student motivation and the use of self-regulatory learning strategies in the multicultural context of Singapore. Moreover, we investigated whether the dynamic relationships between students' prior achievements, motivation, learning strategies, and present academic outcomes vary as a function of different cultural backgrounds.

INTRODUCTION

When the first author moved to Singapore some four years ago to take up a teaching and research position he was exhilarated by the cultural diversity of this island state (75% Chinese, 14% Malay, 9% Indian, and 2% Others (Chuan, Chow, Tyng, Ching, & Wing, 2006). In his multi-cultural classes he learned quickly about the cultural practices and mentalities surrounding key cultural events such as Chinese Lunar New Year, Hari Raya, and Deepavali. During that

[4] Rotgans & Schmidt (2008). Cross-Cultural Validation of Self-Regulated Learning in Singapore. In O.S. Tan, D.M. McInerney, A.D. Liem, & A. Tan (Eds.) *What the West Can Learn From the East: Asian Perspectives on the Psychology of Learning and Motivation*, pp. 245–266.

period we started to conduct research on self-regulated learning at a local polytechnic. As our studies progressed it was not surprising that we were eventually confronted with questions about cultural differences. One of our questions was whether it is valid to use Western-based instruments to measure students' motivational beliefs and the use of learning strategies in the Singapore context. Aware of the reservations cross-cultural researchers have with respect to the use of instruments that originated from a different cultural context, we initiated a number of studies to find an answer to the question whether students of different cultural heritage entertain different ideas and convictions about motivation and learning. We were particularly endeavoured with finding a suitable methodological approach to validate our instrument. In addition, we intended our research to comply with the current notions about a process-oriented approach to culture that focuses on the investigation of the underlying psychological phenomena rather than applying a simplistic analysis of mean-level differences.

In this chapter we present three studies in which we applied a confirmatory factor analysis approach to establish the cross-cultural construct validity of the *Motivated Strategies for Learning Questionnaire* (Pintrich, Smith, Garcia, & McKeachie, 1991). Before we present the outcomes of these studies we briefly discuss what self-regulated learning is and review methodological approaches that have been used in current studies on cross-cultural differences.

SELF-REGULATED LEARNING (SRL)

Over the past three decades, the study of self-regulated learning, or SRL, has gained considerable ground in educational psychology (Paris & Paris, 2001). A major reason for this is that SRL research is not limited to the cognitive aspects of learning alone - as it was traditionally the case in learning research - but it also incorporates metacognitive, motivational, affective, and social-behavioural factors, which provide a more detailed picture of students' motives, goals, and actual classroom performances. Although there are various definitions of the SRL construct, there seems to be general agreement about three integrated components that describe self-regulated learners. According to Zimmerman (1990), the first component refers to students'

metacognitive strategies for planning, self-monitoring, and controlling one's learning during various stages of the learning process. A second component refers to students' motivational and affective processes to engage with and persist on the learning task (Pintrich, 1999; Zimmerman, 1989a, 1990). Self-efficacy, task value, intrinsic goal orientation, and test anxiety are some of the key variables here. The third component refers to students' behavioural processes, such as how students create and structure their learning environment (Henderson, 1986; Zimmerman, 1989a, 1989b). In addition, many SRL models include students' use of cognitive strategies such as rehearsal, elaboration, and organisation strategies under this component (e.g. Pintrich & De Groot, 1990).

To date, most SRL models incorporate these three general components into comprehensive models of students' academic learning and classroom performance (Garcia & Pintrich, 1994; Zimmerman, 1994). However little is known on whether the SRL components, which are based on Western theorising and research, are generally applicable to other cultures and contexts. Of late, researches have raised concerns about the cross-cultural validity of Western conceptions of SRL. The main objection is that Western models of SRL, which reflect the cultural and educational values of the West, are not necessarily transferable to other cultures; instruments measuring SRL may therefore lack cross-cultural validity. Hence, cross-cultural validation studies are needed to find out whether the SRL construct is transferable across cultures. In the next section we review a selection of studies that used different approaches and methodologies to cross-cultural validation.

RESEARCH ON THE CROSS-CULTURAL VALIDATION OF SRL

The purpose of this section is to present findings of several cross-cultural studies that each from its own perspective contributed to providing evidence for the cross-cultural construct validity of SRL. To begin, Purdie, Pillay, and Boulton-Lewis (2000) conducted a study with Australian and Malaysian students investigating cross-cultural variation in conceptions of learning and the use of learning strategies. The *Conceptions of Learning Inventory* (COLI) (Purdie, 1998) and the *Motivated Strategies for Learning Questionnaire* (MSLQ)

(Pintrich et al., 1991) were used as measurement instruments. Exploratory factor analysis was used to extract common factors from the items of the COLI. Besides the "surface-processing" and "deep-processing" factors that are commonly found, a third and new factor was extracted, which was labelled "learning as duty." Multivariate analysis of variance (MANOVA) was used to examine differences between the Australian and Malaysian samples on the three extracted factors and the subscales of the MSLQ. The results revealed that only the third factor "learning as duty" showed a significant difference between the Australian and Malaysian students ($F(1, 382) = 10.01$, $p < .01$); the Malaysian students rated themselves higher on this factor than their Australian counterparts. Pillay and colleagues hypothesised that this difference can be explained by the collectivist nature of Malaysian society and the Asian phenomenon of "loss of face." Loss of face, they argue, may translate to "duty to learn" for the students and the obligation towards those around them, like parents and teachers. Analysis of the MSLQ revealed that the Malaysian students had significantly higher mean scores for most of the motivational beliefs and learning strategies. Pillay and colleagues concluded that their findings provide evidence against the much-cited conceptions of Asian students as being passive and transmissive in their learning. Further, a closer examination of the relationship between the scales of the COLI and the MSLQ revealed that "deep learning" is not the only positive factor that sets the condition for adaptive and desired learning behaviour. It seems that a student's sense of responsibility for their learning, the responsibility to acquire, remember, use and understand information, is an equally important factor.

A similar study was conducted by Purdie, Hattie, and Douglas (1996) with Australian and Japanese students about their conceptions of learning and the use of self-regulated learning strategies. Although the objectives of this study were very similar to the Pillay et al. (2000) study, the methodological approach was different. A more phenomenological approach was chosen, using a slightly modified version of the *Student Learning Survey* (Zimmerman & Martinez-Pons, 1990). The Student Learning Survey consists of 10 open-ended questions, which students responded to in written format. After translation of the Japanese responses into English, they were coded and scored. Students'

responses concerning strategy use were coded according to the 14 categories of self-regulated learning strategies proposed by Zimmerman and Martinez-Pons (1986) (e.g. goal setting and planning, self-evaluation, keeping records, and monitoring and reviewing tests, notes and texts). A strategy consistency measure was used (see Zimmerman & Martinez-Pons, 1986 for a detailed description). As such, each time students referred to a SRL strategy on the Student Learning Survey, they were asked to estimate how often they would use such a strategy in similar situations. Responses were rated on a 4-point scale, ranging from 1 (*seldom*) to 4 (*most of the time*). The average score was determined for each student, indicating the typical importance of that strategy. After the coding procedure was completed, nine categories of learning conceptions were identified (e.g. memorizing and reproducing, understanding, personal fulfilment, duty, and developing social competence). In order to compare Australian and Japanese students' conceptions of learning and the use of SRL strategies multivariate analysis of variance (MANOVA) was used. The findings of the study suggest that contrary to the stereotypical views about Asian students being "rote learners" who mainly use memorisation strategies for learning, the Japanese students in this study viewed learning from a much broader perspective than their Australian counterparts. For Japanese students, learning goes beyond the classroom; it is seen as a lifelong, experiential process leading to personal fulfilment. Another major finding of the study is that despite the above differences, the SRL strategies used by Australian students are very similar to the strategies used by Japanese students. Overall, the results showed that if students' conceptions of learning are related to "understanding" it is associated with a greater total use of SRL strategies for both Australian and Japanese students. In other words, if a student's objective is to understand a topic thoroughly, it is not sufficient to use one isolated strategy – instead, a variety of (interacting) SRL strategies are needed to master the learning task at hand.

McInerney and Ali (2006) conducted a study assessing the multi-dimensional and hierarchical structure of school motivation. Although the study's focus is limited to the motivational component of SRL, it provides an adequate example of establishing cross-cultural validity evidence of a newly devised measurement instrument. The first objective of the study was to

examine the multi-dimensional structure of 43 motivation items of the *Inventory of School Motivation* (McInerney & Sinclair, 1991, 1992). Using a confirmatory factor analysis approach, it was tested whether the 43 items could be explained by eight first-order factors (i.e. task, effort, competition, social power, affiliations, social concern, praise, and token). The results demonstrated that the data fitted the model well, which supported the hypothesis of multi-dimensionality. The second objective of the study was to explore whether there is a hierarchical structure of the eight constructs that can be explained by higher-order factors. To that end it was investigated if the eight first-order factors can be explained by four second-order factors (i.e. mastery, performance, social, and extrinsic) and if in turn these four second-order factors could be explained by one higher-order factor referred to as "general motivation". The results of the confirmatory factor analysis suggest that there is a hierarchical structure. Although the model fit indices suggested that the first-order factor model fitted the data best, the other model combinations also resulted in acceptable model fits. As a third objective, and most relevant for this chapter, it was tested whether the multi-dimensional model was invariant in terms of factor pattern matrix across cultural groups. The sample consisted of 8,963 participants with diverse cultural backgrounds, stemming from Australia, Hong Kong, United States, and Africa. If the factor structure between groups is invariant it is a good indication that the instrument can be used in a variety of cultural settings. The cross-cultural comparison showed that each of the eight scale of the instrument was invariant across the cultural groups.

COMMON VALIDATION PROCEDURES IN CROSS-CULTURAL RESEARCH

The above-mentioned studies provide some insights into several approaches to cross-cultural validation of SRL measures. In general, construct validation research can be broadly classified as *between-construct* and *within-construct* studies (Kong, Hau, & Marsh, 2003). The first category deals with the investigation of a construct's theoretical relationships with other constructs. The first part of the Purdie et al. (2000) study is an example of such an approach. They correlated the mean values of the scales of the COLI with the

MSLQ to see whether the hypothesised relations could be observed. The fact that strength and the direction of correlations fulfilled the theoretical expectations provided evidence for the validity of the instruments. The second category focuses on the cohesiveness of various components/scales within the construct of interest. An example that falls under this category can also be found in the Purdie et al. (2000) study. Exploratory factor analysis was used to examine whether the factor structure for the COLI could be replicated for the Malaysian sample. In this case, a third and new factor was found which exemplifies one of the major problems related to this technique. In many cases, new factors are found, and items from a scale, or scales, dissolve into other factors. The use of exploratory factor analysis has therefore its limitation in model testing since one cannot compare an *a priori* model against other alternative models. Such problems can be overcome by the use of confirmatory factor analysis. McInerney and Ali (2006) applied such an approach in their study, where the *a priori* model was tested against several alternative models. Subsequent testing of the models' invariance across cultural groups provided information about the model's cross-cultural validity.

In addition to the above considerations, several researchers in cultural psychology have recently raised concerns about treating culture as a too simplistic concept. For instance, Zusho and Pintrich (2003) made a compelling argument for a process-oriented approach to culture. Rather than treating culture as an independent variable – an antecedent of psychological phenomena – they advocate considering culture as a dynamic process that consists of both *cultural practices* and *cultural mentalities* (Shweder et al., 1998). In short, cultural practices represent the macro-level of a cultural system, such as the educational system, religious beliefs and language. Cultural mentalities on the other hand represent the psychological side of the system and can broadly be defined in terms of what an individual knows, thinks, desires, and values. Both components are closely interconnected; the psychological state and behavioural responses are synchronised with the environmental, contextual cultural conditions and practices (see Zusho & Pintrich, 2003 for a more detailed description). A process-oriented approach to culture demands a reconsideration of the research methodology. As Zusho and Pintrich argue, it would be too simplistic to view culture as an "entity", a

static causal antecedence of a psychological or behavioural process. Thus, analysing mean-level differences between cultures may not be generally that informative as to what processes cause the differences. Emphasis should be placed not on whether there are mean-level differences between cultural groups but rather on the processes that underlie those differences.

Considering the above, what kind of general picture are we able to draw about the cross-cultural validation of the SRL construct? First of all, it seems that the analysis of mean-level differences does not tell us the full story about the processes that may underlie different cultural contexts. If one wishes to investigate whether SRL varies as a function of culture, one has to conduct the analysis at the latent construct level. At this level of analysis, one can investigate whether the factorial structures of the variables used to measure SRL are invariant across cultural groups. This would help clarify the issue whether Western conceptions of SRL are indeed transferable to different cultural learning contexts. If the factor structure remains intact, it would be strong empirical evidence for the cross-cultural validity of the instrument. Once this condition is met, one can proceed with the analysis by testing for differences in the latent mean structures. This test would reveal – by simultaneously taking all measured variables into account - whether there are indeed score differences between cultural groups. Finally, to come closer to a process-oriented approach to cultural research it would be most informative to test whether dynamic interactive structural patterns in SRL vary between cultural groups. For instance, one could test if the structural relationships between students' motivational beliefs, the use of learning strategies, and academic achievements differ as a function of the cultural background of the students.

CROSS-CULTURAL VALIDATION OF SRL IN THE SINGAPORE CONTEXT

In order to test the above-mentioned suggestions we conducted three studies in the multi-cultural learning context of Singapore. In the remainder of this chapter we present the findings of these studies. For all three studies we used the *Motivated Strategies for Learning Questionnaire*, or MSLQ (Pintrich et al., 1991) as a measure of SRL.

The MSLQ has two sections, one section that taps into students' motivational beliefs and one section that measures students' use of learning strategies as well as study management related aspects. Overall, the MSLQ has six motivation scales and nine learning strategy scales and consists of 81-items. The motivation 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, organisation 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). For the purpose of our analyses we used all scales of the instrument except test anxiety and task value beliefs. All items were assessed on a 5-point Likert scale: 1 (*strongly disagree*), 2 (*disagree*), 3 (*neutral*), 4 (*agree*), and 5 (*strongly agree*). Since we were mainly interested in students' general motivational beliefs and use of SRL strategies, we administered a slightly modified version of the MSLQ (see Rotgans & Schmidt, 2007 for more details). Several of the original items were modified to enable measurement 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 version of the 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".

Before presenting the findings of the three studies we provide a brief overview of the key objectives of the studies. The objective of the first study was to examine whether the MSLQ is a valid instrument to determine students' motivational beliefs and the use of learning strategies in the multi-cultural context of Singapore. The construct validity of the instrument was determined using confirmatory factor analysis. The results of this study were then compared with the findings of an earlier study in the United States.

Whereas the first study was mainly concerned with the overall external validity of the MSLQ, the second study was conducted at the underlying construct level. As such, we were interested in finding answers to whether the underlying factorial structures differ as a function of students' cultural

backgrounds. "Factorial structure" refers to the relationships between the observed variables (i.e. measured items) and the underlying latent, unobserved factor (the construct being estimated), which is commonly referred to as confirmatory factor analysis (CFA). Differences in CFA models between the Chinese, Malaysian, and Indian student populations were statistically compared using tests for invariant factorial structures and latent mean structures. This approach enabled us to assess if (1) the underlying structure of the MSLQ holds across various cultural groups and if (2) latent mean differences in the use of SRL strategies exist between students with different cultural backgrounds.

After having dealt with the construct validity of the MSLQ the third study explored structural relationships between prior achievement, motivation, learning strategies, and students' present academic achievements. We investigated whether the relationships between these variables significantly differ between the three cultural groups in Singapore. Tests for invariant patterns of causal structures were used in the analysis.

STUDY 1: CROSS-CULTURAL VALIDATION OF THE MSLQ

Method

Newly graduated secondary school students participated in the study. At the time the study was conducted, the participants were about to enrol in diploma programmes at a local polytechnic. The sample consisted of 1,166 participants (44% male and 56% female) with an average age of 17.40 years (*SD* = .93). The majority of the participants (96%) were Singapore citizens; the remaining participants came from China, India, Indonesia, Japan, Malaysia, Myanmar, Philippines, Sri Lanka, and Thailand. During the freshmen orientation programme at the polytechnic all first-year students were administered the modified MSLQ.

For the purpose of our analyses, we clustered the items of the MSLQ in groups of two based on semantic overlap. This technique is called "item parcelling" (Bandalos & Finney, 2001; Little, Cunningham, Shahar, & Widaman, 2002). Item Parcelling is a measurement practice that is commonly used for latent variable analysis. According to Little et al. (2002), a parcel can be

defined as an aggregate-level indicator, comprised of the sum or average of two or more items. For the MSLQ a total of 36 parcels were formed.

Data were analysed using structural equation modelling. The analysis was done with AMOS 5 (Arbuckle, 2003). The two sections of the MSLQ were analysed separately. Thus, two confirmatory factor analyses were conducted: one for the set of motivation items and another for the set of learning strategies items. 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 the observed and 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 5 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 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 calculated. The CFI value ranges from zero to one and a value greater than .95 (Byrne, 2001). Hancock's coefficient *H* was calculated for each scale. The coefficient *H* is a construct reliability measure for latent variable systems that represents an adequate alternative to the conventional Cronbach's alpha. According to Hancock and Mueller (2001) the usefulness of Cronbach's alpha and related reliability measures is limited to assessing composite scales formed from a construct's indicators, rather than assessing the reliability of the latent construct itself as reflected by its indicators. The coefficient *H* is the squared correlation between a latent construct and the optimum linear composite formed by its indicators. Unlike other reliability measures the coefficient *H* is never less than the best indicator's reliability. In other words, a factor inferred from multiple indicator variables should never be less reliable than the best single indicator alone.

Results and discussion

Confirmatory factor analysis revealed that all factor loading (i.e. standardised regression weights) were statistically significant and ranged from .29 (Time and Study Environment Management) to .85 (Self-Efficacy for Learning and Performance). The results demonstrate that the data fit the motivation and learning strategies models well. The Chi-square/df ratio for the motivation section was 3.79, $p < .01$, RMSEA = .05, and CFI = .98. Also, the learning strategies section fitted the data reasonably well: the Chi-square/df ratio was 4.63, $p < .01$, RMSEA = .06, and CFI = .91. These findings are very similar to the results of the validation study conducted by Pintrich et al. (1993) in the United States. In fact, when comparing the model fit statistics used in the Pintrich et al. "reliability and predictive validity study" (Pintrich et al., 1993) one can see that our data with the Singaporean sample fitted the model even better. In the Pintrich et al. (1993) study the goodness-of-fit and adjusted goodness-of-fit indices (GFI and AGFI) as well as the root mean residual (RMR) were used as model fit indices. A GFI and AGFI of .90 or greater and an RMR of .05 or less are heuristic values that indicate an adequate model fit. Table 1 provides an overview of the comparison between the U.S. and the Singapore study. The model fit statistics of both studies are based on the full MSLQ (i.e. all items, without item parcelling).

Table 1: Comparison of the goodness-of-fit Index, the adjusted goodness-of-fit index and root mean residual between the Pintrich et al. (1993, pp.807-809) study and the findings of the Study 1 in Singapore

Scale/Index	Pintrich et al. study	Study 1; Singapore
Motivation Section		
GFI	.77	.94
AGFI	.73	.92
RMR	.07	.03
Learning Strategies Section		
GFI	.78	.86
AGFI	.75	.84
RMR	.08	.04

Note: The above model fit indices for Study 1 (Singapore) were generated without item parcelling (i.e. all individual items were included as in the U.S. study).

The reliability of the MSLQ was assessed using the coefficient *H*, which represents the degree of replicability of a construct based on its measured indicator variables. Values ranged from .52 (Peer learning) to .86 (Self-efficacy for learning and performance). The values are indicative of a reasonable internal consistency of the motivation and learning strategies scales. These findings are very similar to the reliability values in the Pintrich et al. study with the U.S. students. Overall, the results of this study demonstrate that the data fitted the models well. The similarities in model fit as well as the reliability between the Singapore and U.S. version suggest that there are no cultural influences that would make the instrument less valid in the Singapore context. In other words, the MSLQ is a valid and reliable instrument that is capable of measuring motivational beliefs and self-regulatory strategies in the multi-cultural learning context of Singapore.

STUDY 2: CROSS-CULTURAL DIFFERENCES IN THE FACTORIAL STRUCTURE UNDERLYING SRL

Method

The general version of the MSLQ was administered during matriculation period (2006/2007) before the students commenced their studies at the polytechnic. The sample consisted of 582 participants (59% female and 41% male) of which 210 were Chinese, 212 Malay, and 160 Indian students. The average age of the participants was 17.35 years (SD = 1.02). Like the first study, the analyses were conducted in AMOS 5 (Arbuckle, 2003). Items of the MSLQ were clustered in groups of two based on semantic overlap. A total of 36 parcels were formed. Confirmatory factor analysis models for the motivation section and the learning strategies section of the MSLQ were devised and tested in AMOS. 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.

A first test to examine if SRL strategies vary as a function of the cultural background was conducted by assessing whether the motivational model and

the learning strategies model, as proposed by Pintrich et al. (1991), produces acceptable model fits for the Chinese, the Malay, and the Indian populations. If they do, it can be considered a first indication that the factorial structure of SRL is invariant for three cultural groups. Models were then tested with both unconstrained and constrained factor loadings. Significant differences in Chi-square value between the constrained and unconstrained models in relation to the difference in degrees of freedom revealed the extent to which the SRL construct is considered invariant for the three cultural groups. Subsequently, tests for invariant latent mean structures were conducted by testing for the equivalence of latent means related to each underlying construct. In the analysis of invariant factorial structures it is implicitly assumed that all observed variables are measured as deviations from their means; the means are set equal to zero. As a consequence, the intercept terms associated with the equations are irrelevant to the analysis. With the analysis of invariant mean structures however, the means take non-zero values, which means that intercept parameters must be taken into account (Byrne, 2001). Since observed variable means are functions of the other parameters in the model, the intercept terms must be estimated jointly with all other model parameters. In this case, the analysis was based on the mean structures of the underlying measurement models to see whether there are differences in the latent mean values between the three groups.

Results and discussion

Descriptive statistics for each item and parcel were calculated. No outliers or abnormalities were found. The reliability of the subscales was assessed using Hancock's coefficient *H* (Hancock & Mueller, 2001). The coefficient *H* for the motivation subscales ranged from .71 to .90 (average .79), and the learning strategies subscales ranged from .66 to .87 (average .78). These values are indicative of adequate construct reliability. Next, it was tested whether the data for the Chinese, Malay, and Indian samples fitted the motivation and learning strategies models equally well. All factor loadings were statistically significant and ranged from .55 (help seeking) to .86 (self-efficacy).

The results for the confirmatory factor analysis showed a good overall model fit for both the motivation model (Chi-square/df = 2.46, $p < .01$, CFI = .96, and RMSEA = .05) and the learning strategies model (Chi-square/df = 1.86, $p < .01$, CFI = .91, and RMSEA = .04). None of the modification indices suggested that any of the parcels cross-loaded on other latent variables. Since the generated model fits were within acceptable range, these findings can be considered as a first indication that SRL, as defined by the MSLQ, does not vary between Chinese, Malay, and Indian learners.

Consistent with these initial findings, the test for invariant factorial structures confirmed that no significant differences could be observed between the three groups in the underlying factorial structures for motivation and learning strategies. The value for $\Delta\chi^2$ (df = 12) was 8.53, which is statistically non-significant ($p = .74$). The test of invariance between the constrained and unconstrained models showed that the underlying factor structure of the measured motivational component of SRL does not significantly differ between the three groups. Similar results were obtained for the learning strategies model. The $\Delta\chi^2$ (df = 32) value was 36.88, which is statistically non-significant ($p = .25$). Since the factorial structure of the MSLQ is invariant across cultural groups we were able to establish the cross-cultural construct validity of the instrument for the Singapore cultural context. Due to the equality in factor loadings, latent mean values could be estimated for the motivation and learning strategies models to assess whether there are latent mean differences between the three cultural groups. The results for the motivation model are presented in Table 2.

Table 2: Motivation section of the MSLQ, test for invariant latent mean structures between Chinese, Indian, and Malay students

Scales	Estimate	S.E.	C.R.	Statistical Significance
Intrinsic goal orientation	-.12	.05	-2.34	.02
Extrinsic goal orientation	-.26	.06	-4.13	<.01
Control of learning beliefs	-.14	.05	-2.82	.01
Self-efficacy judgments	-.19	.04	-4.38	<.00

The results revealed that significant latent mean differences could be observed between Chinese, Malay, and Indian learners for all motivational

variables. Closer examination of the results revealed that the largest differences occurred between the Chinese, and Malay student population. The estimated latent mean differences for all motivational variables were significantly lower for the Chinese group. Comparison between the Chinese and Indian population showed a similar trend; the latent mean values for extrinsic goal orientation and self-efficacy judgments were significantly lower for the Chinese group. Significant differences in latent mean values for intrinsic/extrinsic goal orientation and control beliefs for learning could also be observed between Malay and Indian students. The findings suggest that the latent mean values for most motivational variables were highest for the Malay students, followed by the Indian students and lowest for the Chinese students. As a next step we tested whether differences between the cultural groups could also be observed when it comes to the use of self-regulatory learning strategies. The results of the analysis are displayed in Table 3.

Table 3: Learning strategies section of the MSLQ, test for invariant latent mean structures between Chinese, Indian, and Malay students

Scales	Estimate	S.E.	C.R.	Statistical Significance
Rehearsal	-.10	.05	-1.91	.06
Effort regulation	-.10	.05	-1.96	.06
Organisation	-.09	.05	.26	.80
Peer learning	-.04	.03	-.94	.35
Help seeking	.01	.06	.29	.77
Critical thinking	-.04	.04	-1.19	.24
Time and study environment	-.07	.05	-1.50	.13
Metacognitive self-regulation	-.04	.03	-1.37	.17
Elaboration	-.07	.05	-1.42	.16

The results revealed that no significant differences could be observed for the use of learning strategies between the Chinese, Malay and Indian student populations. It seems that only the motivational component is subject to cultural influences. Overall, the findings of Study 2 suggest that the factorial structure of the MSLQ did not significantly differ between the three cultural groups in Singapore. This contributes to the cross-cultural validity of the instrument. Further analysis by testing for invariant latent structures showed that there are cultural differences in the motivational beliefs about learning. Considering the use of learning strategies, no significant differences between

the cultural groups could be found. Besides the motivational aspects, it seems that the use of cognitive, metacognitive and study management related aspects are rather stable across the cultural groups.

STUDY 3: STRUCTURAL MODEL OF SELF-REGULATED LEARNING AND ACADEMIC PERFORMANCE

Method

Data were collected during matriculation period 2006/2007 (*N* = 2,224). The sample consisted of 1,618 Chinese students, 454 Malay students, and 152 Indian students. The average age of the participants was 17.30 (*SD* = 1.01) years, 56% were female and 44% male. Despite the uneven distribution of the sample sizes, the demographic characteristics such as average age, academic performance and gender distribution, of the three groups were very similar. The MSLQ served as a measure of students' motivational beliefs and the use of SRL strategies. Aggregated mean scores of the motivation and learning strategies subscales were generated to reflect students' overall motivational beliefs and SRL strategies. Rotgans and Schmidt (2008) conducted a similar study where they used aggregated mean scores in a general path model of SRL. The results of their study demonstrated that using aggregated mean scores was an equally valid approach as using the individual subscales in a model, such as self-efficacy or metacognitive self-regulation.

Besides the MSLQ, three achievement measures were taken. Singapore-Cambridge GCE 'O' Level examination results (Lim, 1999) served as a prior achievement measure. Two additional performance measures were selected to reflect students' present academic achievement. The first of these two measures was a classroom performance measure, which was based on teacher observations where students' participation, teamwork, presentation skills and self-directed learning were evaluated and graded. Performance grades were given to each student at the end of every class. The distribution of grades for all classes followed an individualistic, criterion-referenced system. A 5-point performance scale was used: 0 (*fail*), 1 (*conditional pass*), 2 (*acceptable*), 3 (*good*), and 4 (*excellent*). Overall, 80 scores were obtained and the average value was calculated at the end of the first semester. The second measure

reflected the scores of written achievement tests. Most of the tests were a combination of open-ended questions and multiple-choice questions. The average score of 20 tests was calculated to generate an overall semester grade. 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 analysis was conducted with AMOS 5 (Arbuckle. 2003).

A general path model was tested. See Figure 1 for an overview of the model and all the hypothesised relationships between the variables.

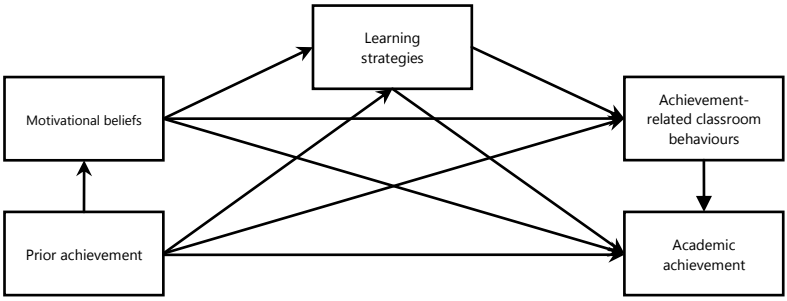


Figure 1: General path model of the relationships between prior achievement, motivation, learning strategies, classroom performance measures and written achievement tests

Within the model we assumed that students' prior achievements ('O' level examination results) have a direct influence on their motivational beliefs, learning strategies and their subsequent achievements. Moreover, we hypothesised that students' motivational beliefs have a direct impact on the use of learning strategies. For instance, if students have positive motivational beliefs (e.g. feel self-efficacious) they are likely to employ positive and adaptive learning strategies (see also Pintrich, Simith, Garcia, & McKeachie, 1993). Consequently, the use of effective learning strategies was expected to result in better classroom performance and subsequently higher scores on the written achievement tests. We first tested this general model with the entire population, indiscriminate of their cultural background. Model fit indices were used to evaluate how well the data fitted the general model. We then

assessed if there are differences in the structural model between the three groups. Similar to the approach used in Study 2 on the tests of invariant factorial structures, the Chi-square in combination with the degrees of freedom was first generated in an unrestricted model. As such the factor loadings between the observed variables are allowed to vary between the three groups. Then, restrictions were imposed on the factor loadings (i.e. they are assumed to be invariant across groups). A statistical test of the difference between Chi-square relative to the difference in degrees of freedom between the unrestricted and restricted model indicates if the models significantly differ between Chinese, Malay and Indian students.

Results and discussion

Testing the general structural model revealed that the relationships between motivation and students' present academic achievements were statistically non-significant. Moreover, the relationship between prior achievement and the use of learning strategies failed statistical significance. Non-significant relationships were removed, which resulted in a slightly simplified model. The model is depicted in Figure 2. The data fitted this model very well: Chi-square/df = .21, p = .89, CFI = 1.00, and RMSEA = .00.

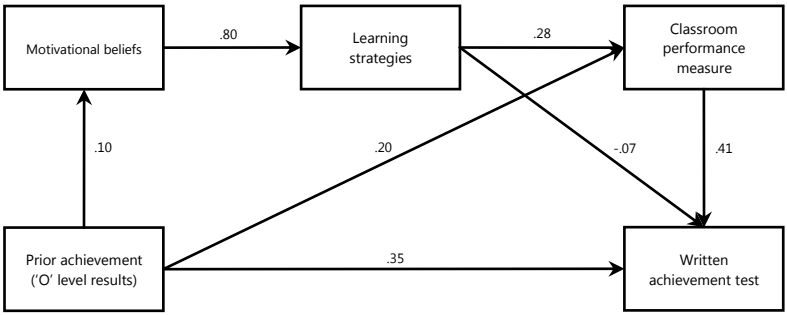


Figure 2: Simplified path model of the relationships between prior achievement, motivation, learning strategies, classroom performance measures, and written achievement tests

Note: Values above the arrows represent standardised regression weights. All values are statistically significant at the 1% level.

The simplified model was used to test whether there are differences between the Chinese, Indian, and Malay students. The results of the difference in Chi-square test revealed that the relationships between the variables in the structural model do not significantly differ between the three groups. See Table 4 for details.

Table 4: Test for invariant patterns of causal structures of SRL between Chinese, Indian, and Malay students

	χ^2	df	$\Delta\chi^2$	Δdf	Statistical Significance
Unconstrained model	27.00	23	-	-	
Constrained model	8.31	9	18.69	14	ns

The overall findings of this study suggest that differences in cultural groups have no significant influence on the relationships between student motivation, learning strategies, and academic achievement. Independent of the cultural background, prior achievement showed a positive but weak relation (relations indicated in standardised regression weights) to students' motivational beliefs (.10). In turn, students' motivational beliefs had a rather strong influence on the use of learning strategies (.80), which subsequently predicted their learning outcomes quite well. Prior achievement was also a strong predictor of their subsequent achievement outcomes (.20 and .35). Our findings suggest that the structural relationships between SRL and academic achievements do not differ as a function of cultural background – at least not in the Singapore context.

OVERALL DISCUSSION

The objective of this chapter was to address some current issues related to the cross-cultural construct validation of Western-based SRL instruments. We presented several studies that applied various methodologies in establishing validity evidence. We also addressed some concerns voiced by cultural researchers about the potential pitfalls in treating culture as a static entity instead of examining it as a dynamic factor underlying many psychological

processes (Zusho & Pintrich, 2003). In an attempt to address some of these issues we presented the findings of three studies we have conducted with the Chinese, Malay, and Indian cultural groups in Singapore.

The purpose of the first study was to test whether the U.S.-developed MSLQ is a valid instrument to measure students' motivational beliefs and learning strategies in the Singapore context. The results of the confirmatory factor analysis as well as the reliability analysis demonstrated that the psychometric properties of the Singapore MSLQ are as strong as or even stronger than that of the original U.S. version. The results lent support to the cross-cultural validity of SRL as defined by the MSLQ. In the second study we investigated whether the underlying factorial structure of the SRL construct was invariant for the three cultural groups. As such, the researcher imposes restrictions on the factor loadings (i.e. assuming that the models are identical between the groups) and statistically compares the Chi-square values between the constrained and unconstrained models. The results revealed that the measurement models were not significantly different between Chinese, Malay, and Indian learners. Considering this outcome one can conclude that the MSLQ is a valid instrument that can be applied to measure cross-cultural differences in the Singapore learning context. As a next step we were able to examine if there are cultural differences in students' motivational beliefs and the use of self-regulatory learning strategies. Latent mean differences could only be observed in the motivation component of SRL. The use of learning strategies was invariant between the groups. The results suggest that students with different cultural backgrounds have different perceptions about what motivates them to learn. An interesting question that emerges from this observation is whether different motivational beliefs about school are responsible for the activation of specific learning strategies. With the third study we addressed this question by opening an operational window towards the dynamic processes between motivation, learning strategies, and academic outcomes. The results showed that the relationships between students' prior academic achievement, motivational beliefs, learning strategies, and present academic performance are invariant between the cultural groups. For Chinese, Indian, and Malay students alike, prior achievement is a reasonably good predictor of their present academic achievements. Moreover, the experiences

gained from prior academic achievement outcomes have an influence on their motivational beliefs about school in general, which in turn was a strong predictor for self-regulatory learning strategies. Subsequently, the use of learning strategies determines how students perform in class and how they score on the written achievement tests. Overall, the results of our studies suggest that self-regulated learning, as measured by the MSLQ, is largely indifferent between the cultural groups. It seems that besides some minor variations in motivational beliefs the reported use of self-regulatory learning strategies does not significantly differ between students with different cultural backgrounds. These findings are similar to the findings of Purdie et al. (1996) where despite the differences in students' conceptualisations about learning, the use of self-regulated learning strategies was very similar between the Australian and Japanese students.

Projecting our findings against the larger topic of socio-cultural differences, how can our studies contribute to a better understanding of the topic in general? Considering that the cultural groups subjected to our investigations (in particular the Chinese and Indian populations) represent a relatively large proportion of the world population it is rather surprising that most existing research agendas focus predominantly on differences between "Eastern" and "Western" learners. In order to come closer to standards of international best practice it seems relevant to add on to the "East-West" comparisons by conducting research on "Eastern" cultures as well. Needless to say our studies are just a modest start - more research is needed to gain a better picture of all the factors that may be of relevance in understanding differences in learning behaviour. The above does not imply that we should refrain from continuing comparative research studies between East and West; on the contrary, we should continue exploring the potential socio-cultural differences between all cultural groups. One of the potential shortcomings in our studies is that they are restricted to the Singapore context with Chinese, Indian, and Malay students. Future studies should incorporate a Western sample to examine whether our findings can be replicated. Moreover, our future studies should include models of achievement goal theory since they provide valuable information about students' motives to study and the goals they set for their learning. Zusho, Pintrich, and Cortina (2005) conducted such

a study to examine whether there are differences between Asian American and Anglo American students. They applied a structural equation modelling approach to investigate the relationships between motives (i.e. motives to approach success and fear of failure), goals (mastery and performance goals), and student outcomes. Although no discernable cultural differences in the pattern of relationships among the measured variables could be found it would be interesting to investigate whether there are differences in motives and goals between the three cultural groups in Singapore that may shed more light on the differences in motivational beliefs we observed in Study 2. For now it seems too early to speculate whether these differences may have been due to different goal orientations or other potentially culture-dependent factors.

CHAPTER 6
SITUATIONAL INTEREST AND ACHIEVEMENT IN THE ACTIVE-LEARNING CLASSROOM[5]

ABSTRACT

The objective of the present study was to extend findings from situational interest theory to the active-learning classroom. Seven measures of situational interest were administered at various points in time to 66 polytechnic students during a one-day, problem-based learning cycle. Results demonstrated that situational interest significantly increased after the problem stimulus was presented. Subsequently, situational interest gradually and significantly decreased over the day. Testing a path model relating the situational interest measures revealed strong (directional) interrelations. Moreover, situational interest was highly predictive for observed achievement-related classroom behaviours. The latter, in turn, proved to be a significant predictor of academic achievement. Aggregating situational interest over the day led to less accurate predictions of achievement-related classroom behaviours and academic achievement. Implications of these findings for situational interest research are discussed.

INTRODUCTION

What motivates a student to engage in and persist on a learning task? What are the factors that draw a student's attention to a text, a problem, or a puzzle, resulting in him or her being fully emerged in thinking and learning? What are the factors that trigger and maintain these positive and desirable behaviours? The research on situational interest is concerned with providing answers to these questions. As the term implies, it does not consider the extent to which a student engages in a learning task as a stable disposition of the learner, but as a situational, transitory, and content-dependent response to it (Hidi &

[5] Rotgans & Schmidt (submitted). *Situational Interest and Academic Achievement in the Active Learning Classroom*. British Journal of Educational Psychology.

Renninger, 2006). As such, situational interest is defined as an immediate affective response to certain conditions and/or stimuli in the learning environment that focuses one's attention on the task (Hidi, 1990; Mitchell, 1992; Schraw, Flowerday, & Lehman, 2001). The activation and continuation of situational interest has been described as two phases in Hidi and Renninger's model of interest development (Hidi & Renninger, 2006). In their model, the first phase represents the initiation phase in which situational interest is triggered by means of a text or task. The second, subsequent phase is referred to as maintained situational interest. Maintained situational interest is described in terms of interest that involves focused attention, increased levels of engagement, and persistence over an extended period of time (Hidi & Renninger, 2006). Most of the research in this area revolves around the question of how situational interest is triggered, and in particular how it is triggered by means of textual materials (Schraw & Lehman, 2001). The overall findings suggest that text-based situational interest is triggered by unexpectedness of information (Hidi, 1990), the extent to which a reader identifies with a main character (Anderson, Shirey, Wilson, & Fielding, 1987), the level of activity described in a text (Hidi & Baird, 1986), and by structural aspects of a text such as coherence and completeness (Hidi & Baird, 1988; Schraw, Bruning, & Svoboda, 1995; Wade, 1992), informational complexity (van Dijk & Kintsch, 1999), suspense (Jose & Brewer, 1984), vividness (Garner, Brown, Sanders, & Menke, 1992), imagery (Goetz & Sadoski, 1995), and ease of comprehension (Schraw, 1997).

In contrast, the question of how situational interest is *maintained* over a longer period of time has attracted less attention. Some researchers assume that situational interest is highly transitory and may disappear as fast as it emerges (Hidi & Renninger, 2006; Jetton & Alexander, 2001). It may well be possible that additional stimuli are needed to keep the learners interested and focused on the task. Situational interest may be a mental mechanism that can operate only during relatively short periods of time because maintaining it may demand additional cognitive or affective resources. Despite the potential educational significance, only few studies have investigated how situational interest is maintained over a longer time frame (Bergin, 1999; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000; Jetton & Alexander, 2001; Mitchell, 1992).

Mitchell (1992) administered a questionnaire to determine which elements of the classroom experience help according to learners in sustaining situational interest in secondary school mathematics. The results pointed to working with computers, puzzles, and group work as important factors in maintaining situational interest. Similarly, Harackiewicz et al. (2000) conducted a study with undergraduate psychology students. They were able to show that perceived meaningfulness of the task was an important factor in maintaining situational interest. In these studies, however, the extent to which situational interest is actually reinforced and maintained over time was not investigated. Ainley, Hidi, and Berndorff (2002) noted that, if one is interested in understanding the stability or variability of situational interest over time, it is necessary to repeatedly administer relevant measures at different points in time to observe real-time changes in the intensity of situational interest.

A second issue deserving attention is that, while situational interest is extensively studied in the context of text comprehension, classroom studies are virtually absent (Bergin, 1999; Jetton & Alexander, 2001). This is somewhat disappointing because the classroom setting in principle could provide a rich array of situational stimuli that trigger students' situational interest and maintain it. Learning from texts represents only one facet of the diversity of learning in an authentic classroom environment. For instance, other activities such as group discussions, direct instruction, and self-regulated learning activities may trigger situational interest as well (or contribute to its demise).

There are additional reasons to believe that in particular an active-learning classroom may be an appropriate context for investigating situational interest, because in those classrooms students are often provided with opportunities to formulate their own learning goals and pursue them. Deci (1992) has suggested that classrooms that promote student autonomy and choice increase intrinsic motivation and situational interest (see also Cordova & Lepper, 1996; Schraw et al., 2001). Deci, Vallerand, Pelletier, and Ryan (1991) pointed out that choice has a positive effect on interest because people have an innate psychological need for competence, belonging, and autonomy. In self-determination research, having a choice is a means of satisfying the need for autonomy. A second element deemed important in the active-learning classroom is the use of problems or puzzles (Mitchell, 1992). The authentic

character of such problems or puzzles is assumed to increase task value and be meaningful to students, which should result in increased levels of situational interest. Moreover, working in small groups seems also beneficial to triggering as well as maintaining situational interest since it may increase the feeling of belonging and autonomy from the direct intervention of a teacher. Mitchell (1992) refers to this aspect as *empowerment*. The study to be discussed below was conducted in a problem-based learning curriculum that resembles most of the active learning features mentioned here (e.g. Hmelo-Silver, 2004; Schmidt & Moust, 2000) and enabled us to study the effects of different learning activities in which students engage in such classrooms on the maintenance of situational interest.

A third challenge for interest research is the clarification of its relation to academic achievement. Common sense suggests that if a learner is interested in a particular topic, he or she will engage more extensively with that topic than another learner who is less interested in the topic. More engagement, that is spending more time and effort on working on the topic, should lead to higher achievement. However, generally, observed correlations between interest and academic achievement are fairly small. In order to be able to promote interest as a variable of educational significance, as has been done recently (e.g. Boekaerts & Boscolo, 2002; Hidi, 2006; Silvia, 2008), research needs to be conducted to understand how exactly interest is related to achievement. Schiefele, Krapp, and Winteler (1992) were among the first who pointed to this challenge based on findings of a meta-analysis. The results of this meta-analysis revealed that the mean value of the correlation coefficients of 121 studies between interest and achievement was .31. The correlations observed in the interest domain are quite similar to findings in the general motivation literature. Rotgans, Alwis, and Schmidt (2008) argued that it is unlikely that beliefs students have about their motivation to study directly translate into academic achievement. They demonstrated that the predictive validity of self-reported motivational beliefs could be improved by using achievement-related classroom behaviours as a mediator between motivation and academic achievement. Their assumption was that motivational beliefs as measured by self-report measures must convert into observable achievement-related classroom behaviours first, before they can influence achievement.

Motivation without engagement cannot influence performance. In their study, these achievement-related classroom behaviours, 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. Achievement-related behaviours seem to be initiated primarily by mastery or performance goals (Elliott & Dweck, 1988). Much of the achievement motivation research indicates that students show the most positive achievement-related behaviours when they pursue mastery goals (Meece, Anderman, & Anderman, 2006). Research suggests that with a focus on mastery goals, students show higher levels of task involvement (Harackiewicz et al., 2000), students are more likely to persist at difficult tasks (Elliott & Dweck, 1988), students report higher levels of effort (Grant & Dweck, 2003; Miller, Greene, Montalvo, Ravindran, & Nichols, 1996; Wolters, 2004), and use deeper processing strategies that enhance conceptual understanding of a topic (Ames & Archer, 1988; Elliot, McGregor, & Gable, 1999). It seems plausible to assume that these behaviours are closely related to students' maintained situational interest. A study conducted by Harackiewicz et al. (2000), for instance, provides support to this assumption since its results demonstrated that self-reported mastery goals were positively related to interest. These findings suggest that studies of situational interest would profit from including measures of achievement-related classroom behaviours to increase the predictability of students' academic achievement.

In summary, the literature suggests that situational interest has a phase in which it is triggered and a phase in which it is supposed to be maintained over time. Whether this is the case or how situational interest is related to learning and academic achievement is however not fully understood. In addition, hardly any study has been conducted in an authentic classroom setting. Based on the hypothesised commonalities between the characteristics of the active-learning classroom and what is known about the factors that trigger and maintain situational interest, the present study was conducted in a problem-based learning environment where students had to work in small teams on one problem during the course of one day. To determine how situational interest is triggered and maintained, measures of situational interest were

administered on seven occasions during the day. Each of the selected measurement occasions - first confrontation with the problem, small-group discussion about the problem, self-directed study activities, continued discussion of the problem, and elaboration on what was learned - represented critical events that were supposed to foster situational interest and task engagement. Moreover, measuring students' situational interest seven times during the day was expected to cast more light on the question of how situational interest is maintained over time. Since studies have suggested that prior knowledge has a positive effect on interest (e.g. Alexander, Jetton, & Kulikowich, 1995; Schiefele, 1992; Schraw & Lehman, 2001) we also incorporated a measure of students' prior knowledge into the present investigation to assess its influence on triggering situational interest. Potential causal relationships among the observed variables were analysed using path analysis.

METHOD

Participants

The sample consisted of 66 participants (61% female and 39% male) with an average age of 20.21 years (*SD* = 1.18). The majority of the participants, 96%, were Chinese; 11% were Malay, and 5% were Indian. All participants were enrolled in a second year economics module at a polytechnic in Singapore. Four classes were randomly selected to participate in the study.

Educational Context

In this polytechnic, the instructional method is problem-based learning (PBL) for all its modules and programmes. In this approach five students work together in one team under the guidance of a tutor. Each class comprises four to five teams. Unique to this polytechnic's approach to PBL is that students work on one problem during the course of each day (Alwis & O'Grady, 2002). This means that students deal with one problem each day in all modules. A typical day starts with the presentation of a problem. Students discuss in their teams what they know, do not know, and what they need to find out. By doing so, students activate their prior knowledge, come up with tentative

explanations for the problem, and formulate their own learning goals (Barrows, 1988; Hmelo-Silver, 2004; Schmidt, 1993). Subsequently, a period of self-study follows in which students individually and collaboratively try to find information to address the learning goals (Schmidt, 1993). At the end of the day the five teams come together to present, elaborate, and synthesise their findings.

Materials

Situational Interest Measures. Two measures of situational interest were devised which determine (1) the present psychological state of interest, involving increased attention and cognitive functioning, persistence, and an affective component, and (2) interest that emerges from the interaction of the person with the previous learning task (Hidi, 1990, 2001; Krapp, Hidi, & Renninger, 1992). The first situational interest measure, designed to measure the present state of interest (and, for clarity's sake to be called SI-present-state), consisted of four elements: (1) positive affect, (2) willingness to learn, (3) expectancy to succeed, and (4) increased levels of attention (see Ainley et al., 2002; Bergin, 1999; Hidi, 1990; Hidi & Renninger, 2006; Renninger & Hidi, 2002; Schraw et al., 2001; Schraw & Lehman, 2001; Shirey, 1992). Positive affect was measured by two items: "I will enjoy working on today's topic," and "Presently, I feel bored" (reversed). Willingness to learn was measured by: "I want to know more about today's topic" and "I think today's topic is interesting". Expectancy to succeed was measured by: "I expect to master today's topic well". And finally, increased levels of attention were reflected in: "I am fully focused on today's topic; I am not distracted by other things". The second situational interest measure, designed to measure situational interest derived from the previous learning task (and therefore called SI-task-engagement), consisted of three elements: (1) engagement with the task, (2) effort and persistence, and (3) experience of flow or having been totally emerged in the activity (see Csikszentmihalyi, 1975; Krapp & Lewalter, 2001; Mitchell, 1992; Prenzel, 1992; Schraw et al., 2001; Schraw & Lehman, 2001). Facets of task engagement were measured by three items: "I was engaged with the topic at hand", "I contributed good ideas" (i.e. the quality of a

student's engagement), and "I contributed more than others" (i.e. the quantity of a student's engagement). Effort and persistence were determined by two items: "I put in a lot of effort" and "I wish we could still continue for a while". And finally, the experience of flow was measured by "I was so involved that I forgot everything around me". For both situational interest measures, the participants responded to a 5-point Likert scale: 1 (*not true at all*), 2 (*not true for me*), 3 (*neutral*), 4 (*true for me*), and 5 (*very true for me*). The construct validity of the situational interest measures was established by means of confirmatory factor analysis (Byrne, 2001). The assumption was that all six items for each measure were manifestations of one underlying factor. The results revealed that the data fitted the hypothesised models well. The Chi-square/df ratio was for the SI-present-state measure .64, p = .80, RMSEA = .00 and CFI = 1.00. All factor loadings were statistically significant and ranged from .38 to .85, with an average of .70. The reliability of the measure was determined by calculating Hancock's coefficient *H*. The coefficient *H* is a construct reliability measure for latent variable systems that represents a relevant alternative to the conventional Cronbach's alpha. According to Hancock and Mueller (2001) the usefulness of Cronbach's alpha and related reliability measures is limited to assessing composite scales formed from a construct's indicators, rather than assessing the reliability of the latent construct itself as reflected by its indicators. The coefficient *H* is the squared correlation between a latent construct and the optimum linear composite formed by its indicators. Unlike other reliability measures the coefficient *H* is never less than the best indicator's reliability. In other words, a factor inferred from multiple indicator variables should never be less reliable than the best single indicator alone. Hancock recommended a cut-off value for the coefficient *H* of .70. The coefficient *H* for our situational interest measure was .89 (for the record: Cronbach's alpha = .87). Overall, the results demonstrate that the psychometric characteristics of SI-present-state measure are adequate. This was also the case for the SI-task-engagement measure; all factor loadings were statistically significant and ranged from .41 to .93, with a mean of .74. The data fitted the hypothesised model well: Chi-square/df ratio was 1.17, p = .14, RMSEA = .05 and CFI = .99. The coefficient *H* value was .93 (Cronbach's alpha = .88). Both the construct validity and the reliability are

indicative of adequate psychometric characteristics of SI-task-engagement measure.

Prior Knowledge and Academic Achievement Measure. In order to determine students' prior knowledge and their academic achievement, a single instrument was administered twice a day, once in the morning as a pre-test to measure students' prior knowledge and a second time at the end of the day as a post-test to determine what students have learned over the day. Findings in the interest literature suggest that prior knowledge is related to interest (Alexander et al., 1995; Schiefele, 1999). For instance, it seems that if an individual has little background knowledge about a topic, that person is more likely to be less interested in that topic than one that knows relatively more about the topic. In order to verify this claim, we incorporated a measure of students' prior knowledge in the present study. Prior knowledge, as well as students' academic achievement, was determined using the same instrument in a procedure commonly used in the cognitive psychology laboratory: a concept recognition test. The concept recognition test is a simplification of the concept mapping technique described by Novak (1998). Since concepts are the building blocks of our understanding of the world and much of instruction is directed at acquiring the meaning of these concepts (Solomon, Medin, & Lynch, 1999), a concept recognition test seems to be an appropriate measure of (prior and post) knowledge. In this test, students were asked to indicate how closely 20 presented concepts were related to the central topic of the problem they worked on for the day. An economics problem was used in the present study dealing with the topic of "market failure". Students were asked to indicate how closely for example "social costs" is related to the concept of market failure. A number of concepts were included that are not related to the concept of market failure such as "stock exchange" (these were "fillers"). Students responded to the test by means of a 5-point scale: 1 (*not at all related*), 2 (*a little bit related*), 3 (*to some extend related*), 4 (*quite closely related*), and 5 (*very closely related*). In order to determine the correct answers to the concept recognition test, two experts were asked to identify the most appropriate answers for the 20 concepts independently. Inter-rater agreement was determined (being 85%) and consensus was reached between the expert raters about initial disagreements. Students' scores were determined by

means of their deviations from the expert ratings (i.e. the larger the score, the more deviation from the expert rating). For each student it was determined in how far he or she deviated from the expert-ratings. The mean value comprising the deviations of all 20 items was calculated. For ease of interpretation, the mean scores were numerically reversed (i.e. "1" was reversed to "5", "2" to "4" etc.) so that a larger value was representative for higher achievement as compared to a smaller value.

Achievement-Related Classroom Behaviours. This measure was based on tutor observations representing students' achievement-related behaviours (Rotgans et al., 2008). In this measure tutors rated students' participation, teamwork, presentation skills, and self-directed learning. A grade was assigned to each student based on the tutor 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 and validity of this measure was established in a study by Chua and Schmidt (2007). Their findings were based on 1,059 student observations by 230 tutors, which resulted in generalisability coefficients ranging from .55 to .94 (average = .83). In addition, in their study the measure correlated .47 with the results of a written achievement test. These values are indicative of a high reliability and good predictive validity of this measure.

Procedure

The situational interest measures used in this study were administered in a pencil-and-paper format. At the beginning of the day students were informed about the study and handed a booklet containing all the questionnaires. A researcher was present in class during the data collection and instructed the students when to respond to the individual questionnaires. The questionnaires were administered on seven occasions. The concept recognition pre-test as well as the first SI-present-state measure were administered before the problem was presented. The second SI-present-state measure was administered directly after the students read the problem. The SI-task-engagement measure and the third SI-present-state measure were then administered just before students commenced with their self-study.

Immediately after the allocated self-study time of approximately 2.5 hours students were asked to respond to the second SI-task-engagement measure as well as to the fourth SI-present-state measure. All five teams then presented their findings and were given the opportunity to elaborate on how they have dealt with the problem. After the elaboration phase, students were asked to respond to the fifth SI-present-state measure. In addition to this, the concept recognition post-test was administered to determine the extent of their learning. The tutors rated the achievement-related classroom behaviours for each student at the end of the day. See Figure 1 for the schedule of measurements in relation to the day's activities.

Analysis

As a first step in the analysis, mean values were calculated for all seven situational interest measures. Potential mean level differences in SI-present-state interest measures were determined by means of a one-way repeated measures ANOVA with LSD comparisons of the means. Subsequently, the relationships between the seven measures situational interest, as well as prior knowledge, achievement-related classroom behaviours, and academic achievement were analysed using path analysis. See Figure 1 for an overview of the hypothesised relationships.

For the model, Chi-square accompanied with degrees of freedom, *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 the observed and 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 3 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 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 calculated. The CFI value ranges from zero to one and a value greater than .95 is considered a good model fit (Byrne, 2001).

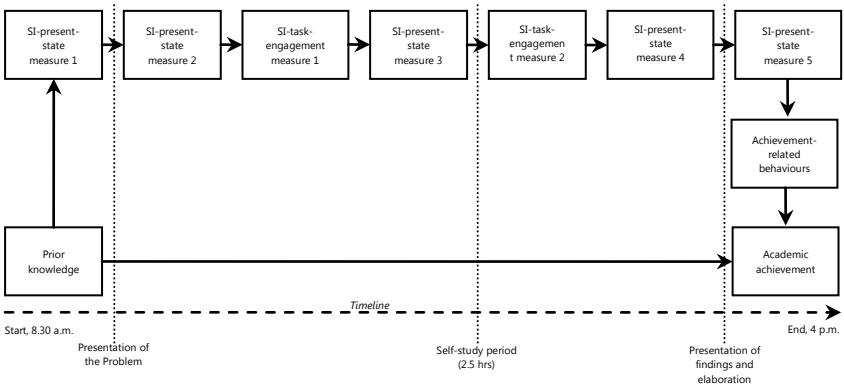


Figure 1: Hypothesised path model of the relationships between situational interest, achievement-related classroom behaviours, prior knowledge, and academic achievement (including the timeline for a typical problem day with major events, such as presentation of the problem, self-study period, presentation of the findings, and elaboration)

In addition to the proposed model, two variations were tested. The first variation tested our assumption that the studies reviewed by Schiefele et al. (1992) failed to find a sizable relationship between situational interest and achievement because they did not include a (mediating) measure of achievement-related behaviours. Therefore, we tested a model without achievement-related classroom behaviours. In the second variation, the seven situational interest measures were aggregated. If an aggregated index of students' situational interest would turn out to be a better predictor of achievement-related behaviours and eventually academic achievement, which is to be expected if one assumes that aggregated measures are always more stable and therefore better predictors than individual indicators of a construct (e.g. Schiefele, 1996), this would be an indication that situational interest is not that situational at all. We will reserve further discussion of this issue for the Discussion. For both variations, Chi-square accompanied with degrees of freedom, *p*-value, the RMSEA, and the CFI were generated.

RESULTS

Table 1 depicts the descriptive statistics as well as the correlation matrix. A repeated measures one-way ANOVA revealed that there were significant differences between the SI-present-state measures, F (1,65) = 2.90, p = .03 (eta-squared = .16). LSD comparisons revealed that there was a significant difference between SI-present-state measure 1 (M = 3.54) and SI-present-state measure 2 (M = 3.70), as well as SI-present-state measure 2 (M = 3.70) and SI-present-state measure 4 (M = 3.55). Although the differences between the mean values of the SI-present-state measures seem to be small in an absolute sense, the data suggest that there is an increase in situational interest between SI-present-state measure 1 and measure 2. Students' situational interest increases after having read the problem – in other words, their situational interest seems to be triggered by the problem. However, during the day situational interest seems to gradually decrease from SI-present-state measure 2 to SI-present-state measures 4 and 5.

As a next step, a path model was tested to examine if and how the situational interest measures are related to each other, to prior knowledge, to the achievement-related classroom behaviours, and to academic achievement. The path model with its path coefficients is depicted in Figure 2.

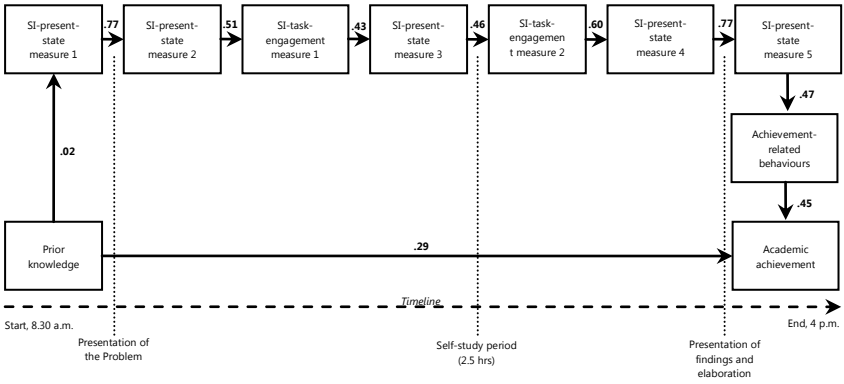


Figure 2: Path model of the relationships between situational interest, achievement-related classroom behaviours, prior knowledge, and academic achievement

Note: The numbers above the arrows represent standardised regression weights.

Table 1: Intercorrelations between situational interest measures, prior knowledge, achievement-related classroom behaviours, and achievement, as well as mean values and standard deviations for each measure

Measure	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	Mean (*SD*)
(1) SI-present-state measure 1	1	.78**	.44**	.74**	.26*	.49**	.42**	.12	.16	.16	3.54 (.67)
(2) SI-present-state measure 2		1	.52**	.74**	.33**	.56**	.49**	.12	.15	.16	3.70 (.67)
(3) SI-task-engagement 1			1	.67**	.53**	.55**	.55**	.04	.31*	.16	3.25 (.71)
(4) SI-present-state measure 3				1	.56**	.70**	.63**	.18	.23	.21	3.63 (.65)
(5) SI-task-engagement 2					1	.71**	.65**	.19	.38**	.24*	3.42 (.64)
(6) SI-present-state measure 4						1	.78**	.14	.40**	.24	3.55 (.61)
(7) SI-present-state measure 5							1	.21	.46**	.31*	3.61 (.66)
(8) Prior Knowledge								1	.16	.36**	2.12 (.39)
(9) Achievement-related Behaviours									1	.38**	3.27 (.54)
(10) Academic Achievement										1	2.93 (.31)

Note: ** correlation is significant at the 1% level, * correlation is significant at the 5% level.

The tested path model produced the following model fit statistics: Chi-square/df = .99, p = .48, CFI = 1.00, and RMSEA = .00. These values are indicative of an almost completely fitting model. All path coefficients (i.e. standardised regression weights) were statistically significant at the 1% level except for the path coefficient between prior knowledge and the first situational interest measure. Examination of the path model revealed that the measures of situational interest were moderately to strongly related to each other (average .60). The model also revealed that prior knowledge seems to have a non-significant effect on students' situational interest when they come to class (.02). It had however a significant effect in predicting their academic achievement at the end of the day (.29). In addition to prior achievement, students' achievement-related classroom behaviours formed a significant predictor of their academic achievement. Moreover, the last situational interest measure was related to students' achievement-related classroom behaviours. Overall, situational interest predicted 22% of the variance of students' achievement-related behaviours in the active-learning classroom. Achievement-related behaviours as well as prior knowledge explained 29% of the variance in students' academic achievement. Testing the first variation in which the measure of achievement-related classroom behaviours was removed from the model (i.e. determining the direct relationship between the last situational interest measure and academic achievements) led to an adequate model fit: Chi-square/df = 1.15, p = .28, CFI = .99, and RMSEA = .05. However, removing achievement related classroom behaviours from the model resulted in a relatively lower correlation of .26, between the seventh situational interest measure and achievement, thereby replicating the results of the studies reviewed in the Schiefele et al. (1992) meta-analysis of the relationship between situational interest and achievement.

In addition to the above path model, a second variant was tested in which the mean value of all seven situational interest measures was used to examine whether such measure would be a more accurate predictor of students' academic achievement (as is to be expected when situational interest is a stable characteristic of participants rather than a variable, situation-dependent characteristic). This aggregated model produced the following model fit statistics: Chi-square/df = .63, p = .53, CFI = 1.00, and RMSEA = .00. These

values are indicative of a very well-fitting model. Similar to the full path model, all path coefficients were statistically significant at the 1% level except for the path coefficient between prior knowledge and the aggregated situational interest measure (.17). The results revealed that the path coefficient between the aggregated situational interest measure and students' achievement-related classroom behaviours was .35. This is a considerable reduction in predictive validity when compared to the full model, in which the path coefficient between the most recent measure of situational interest and achievement-related classroom behaviours was .47. The aggregate measure is a poorer predictor of achievement than the single situational interest measure closest in time to achievement.

DISCUSSION

The objective of the present study was to investigate how situational interest is triggered and maintained in an active-learning classroom. Building on the findings in the text-processing literature we extended situational interest research to the active-learning classroom. The active-learning classroom is characterised by (1) authentic learning tasks, (2) collaborative learning, (3) limited direct instruction from teachers, and (4) self-initiated individual learning activities (Schmidt, 1993). It was hypothesised that all these factors would contribute to providing opportunities for triggering students' interest and keeping them engaged during a longer period of time (Schraw et al., 1995; Schraw et al., 2001; Schraw & Lehman, 2001). In addition, it was hypothesised that prior knowledge plays a significant role in the trigger phase of situational interest (Alexander et al., 1995; Schraw, 1997; Schraw et al., 1995), as well as predicting students' subsequent academic achievement. Finally, it was hypothesised that achievement-related classroom behaviours is a necessary mediator between situational interest and academic achievement.

To test the above hypotheses, seven measures of situational interest as well as prior knowledge, achievement-related classroom behaviours and academic achievement were administered to 66 students in a problem-based classroom at a polytechnic in Singapore during the course of one day. The measures were administered before and directly after critical events

throughout the day. The results revealed that situational interest increased significantly after the trigger material was presented. However, over the course of the day, students' situational interest decreased gradually. In a path analysis, the simplest fitting model was the one in which each measure of situational interest uniquely influenced each subsequent situational interest measure. The findings also demonstrated the significant mediating role of achievement-related classroom behaviours between situational interest and students' academic achievement. In our sample, prior knowledge was not related to situational interest, but it was a significant factor in predicting student achievement at the end of the day.

Why did situational interest significantly increase once the trigger material was presented? A possible answer to this question is that students were confronted with a problem describing phenomena from the real world that they did not understand, or even heard of. This confrontation with unknowns that are to be known made them feel interested. This is in line with Mitchell's (1992) observation that puzzles trigger students' interest and engage them in a learning task. The problem-based learning literature also assumes that the discrepancy between what people already know about the world (their prior knowledge) and what still needs to be known as exemplified by the problem, is a strong stimulus for the emergence of feelings of (intrinsic) interest (Norman & Schmidt, 1992; Schmidt, 1983). It seems that the underlying mechanism responsible for triggering situational interest is the awareness of one's own lack of knowledge, which is responsible for igniting curiosity to find out more about the topic. Berlyne (1954) referred to this process as the development of *epistemic curiosity*, which reflects a desire for new information that motivates exploratory behaviour and knowledge acquisition. The research in this area provides support to our assumption by suggesting that epistemic curiosity is aroused by novel questions, ambiguous statements, and unsolved problems (e.g. Litman, 2008; Litman, Hutchins, & Russon, 2005; Litman & Jimerson, 2004). But, what are the precise mechanisms that are at play here? It seems that besides the sheer pleasure associated with discovering new ideas (Spielberger & Starr, 1994), epistemic curiosity can also be aroused by a feeling of deprivation (Loewenstein, 1994) – that is, a perceived knowledge gap that must be closed by exploratory and information-seeking behaviours

(Litman, 2008; Litman et al., 2005). In sum, we suggest that the presentation of a problem that was novel and ambiguous, caused a feeling of deprivation, which resulted in increased levels of curiosity that was picked up by our situational interest measure. Since our study was observational rather than experimental, we however cannot exclude the alternative possibility that simply the more extended engagement with the subject matter involved was responsible for the increase in situational interest rather than its novelty or ambiguity.

Our data however also demonstrate that once situational interest is triggered it gradually decreases during the course of the day. This finding was counter to expectation. Based on the (scarce) existing sources (e.g. Ainley et al., 2002; Harackiewicz et al., 2000; Mitchell, 1992) we expected that activities such as engaging in brainstorming about the problem, getting involved in group discussions, searching for new information, and elaborating about possible problem explanations would result in a sustained level of situational interest throughout the day. This was however not the case. The question is why is this so. The most parsimoniously possible explanation for the decrease in situational interest is that the same mechanisms playing a role in triggering situational interest may explain why it decreases. If one accepts that situational interest increases in response to dealing with a novel problem due to the need to close the knowledge gap, it is tempting to see its decrease as a manifestation of the reduction of this need. Thus, epistemic curiosity gets satisfied through the learning activities in which students engage. It should however be noted that the decrease of situational interest over the day was small and had just reached statistical significance.

Examining how the seven measures of situational interest are related to each other revealed medium to high intercorrelations, ranging from .43 to .77. In addition, there is a clear directional path throughout the data, relating any measure of situational interest with its closest subsequent relative. What do these findings imply? Looking at the medium to high correlations among measures of situational interest, one cannot escape from the suggestion that their covariation must indicate some influence of a pre-existing, stable disposition among the participants. It seems that, in addition to the sensitivity for situational variation demonstrated by the differences in mean scores over

time, the situational interest measures also express stable pre-existing differences in interest among the students involved. This impression is reinforced by the fact that even different aspects of situational interest, as expressed by our measures, SI-present-state and SI-task-engagement, correlate highly over time. This suggests that situational interest is less situational than originally perceived. Students enter the classroom with differences in interest in a particular topic and these differences are preserved over time, independent of the activities designed to trigger and maintain interest.

On the other hand, closer examination of the correlational patterns over time reveals that the strength of correlation consistently decreases as a function of the distance between the measurement occasions. For instance, the correlation was always higher between adjacent situational interest measures 1 and 2 as compared to the correlation between situational interest measures 1 and 3, and so on. This finding runs counter to a dispositional interpretation of situational interest. If situational interest would be mainly dispositional in nature, this decrease over time would not have been observed; all measures would have correlated to a similar extent with each other. In addition, the directional paths, identified by the model, are sufficiently explained by assuming that situational interest measured at time x *only* influences situational interest at time x+1, but not anymore at time x+2. This model showed almost perfect fit although it was quite constrained in terms of number of degrees of freedom compared to the unconstrained model (in which everything correlates with everything else). The time dependence of the relationships in the model at least suggests that situational interest is primarily maintained by the immediately preceding state of interest and by situational factors, but not so much by a disposition brought into the situation. Finally, if situational interest is mainly dispositional, the aggregate of all situational interest measures should be a better, more stable, predictor of achievement than any individual measures. Although the aggregated model produced a slightly better model fit, the model was not significantly better than the full model. In fact, the aggregate's predictive power was half that of the situational measure closest in time to achievement, again supporting the situationality of situational interest. Further research is however necessary here, in particular

because current conceptualisations of situational interest do not allow for a dispositional influence (e.g. (Ainley et al., 2002; Hidi, 1990; Hidi & Renninger, 2006; Schraw & Lehman, 2001).

When it comes to the effects of prior knowledge on situational interest, our results suggest that prior knowledge does not play a significant role in predicting students' situational interest. In our sample the observed correlation was statistically non-significant. The reason for this lack of covariance is presently unknown and somewhat worrisome because in other studies prior knowledge was demonstrated to have an influence on interest (for a review see Schraw & Lehman, 2001). Part of the reason why we did not find a significant relationship may lie in the fact that the prior knowledge measure we used did not measure students' general domain knowledge but their specific topic knowledge (i.e. their knowledge about the specific topic of market failure but not about economics in general). According to a review by Schraw and Lehman (2001) interest studies that included measures of students' prior knowledge demonstrated that general domain knowledge is positively related to interest, whereas specific topic knowledge is typically not related to interest (see also Schraw et al., 1995). The reason why topic familiarity seems to be unrelated to situational interest is presently unknown and demands further research (Schraw & Lehman, 2001). As an alternative, it is of course possible that our prior knowledge measure did not adequately represent what students knew about the topic of market failure. If this is the case it is then rather difficult to explain why this measure turned out to be a significant predictor of students' subsequent achievement.

A final issue is the relationship between situational interest and academic achievement. In the Introduction to this paper, we have argued that common sense dictates that increased situational interest should engage students more extensively with the task at hand, which in turn would lead to better achievement. There is to date only limited support to this assumption in the literature. A meta-analysis conducted by Schiefele et al. (1992) demonstrated the mean of the correlation between interest and achievement to be equal to .31. We found a very similar value, when we correlated situational interest directly with achievement. Elsewhere, we have argued that it is unlikely that motivational beliefs as expressed by responses to a questionnaire, translate

themselves directly into achievement (Rotgans et al., 2008). These beliefs must express themselves in task-relevant behaviours first, before they can influence achievement; interest must influence achievement not directly but indirectly. Our findings illustrate this point of view. By incorporating achievement-related classroom behaviours as a mediator between situational interest and academic achievement, we were able to demonstrate the existence of such indirect influence of situational interest on achievement. In addition, the path coefficients between the variables involved were considerably higher than the correlations found in the Schiefele et al. (1992) study. Interest needs engagement to influence performance. It may therefore be worthwhile to incorporate measures of observable achievement-related behaviours into future investigations that are directed at making predictions about student achievement based on interest measures.

CONCLUSION

The study discussed here is, to our knowledge, the first attempt to study the emergence and maintenance of situational interest in the classroom setting. In this setting, active learning was promoted by encouraging students to discuss a problem, formulate issues for further learning, and engage in self-directed study activities. Unlike other studies in this field, situational interest was not measured only once, but seven times throughout the day. We were able to demonstrate that situational interest is indeed triggered by presenting students with a puzzling state of affairs and maintained (to some extent) by the various learning activities undertaken to understand the problem-at-hand in depth. We explained these findings by assuming that the confrontation with the problem induced students to become aware of their own ignorance to the topic at hand and that the learning activities undertaken served to satisfy the need for knowledge to fill the perceived gap. This would explain the observed decrease in situational interest throughout the day. Our explanation was however tentative and requires further research.

The fairly high intercorrelations found among the situational interest measures at least carry the suggestion that pre-existing differences in interest continued to play a role throughout the day and that situational interest is

perhaps less situational than the name implies. However taken as a whole, we did find in our data sufficient evidence to suggest that a dispositional element, if any, is limited in scope and strength. We were also able to demonstrate that measuring students' self-reported levels of situational interest is in itself insufficient to predict achievement. We argued that responses to a situational interest questionnaire have to translate themselves into active engagement first before sizable effects could be found on academic achievement. Including a measure of active engagement in the classroom and assuming an indirect effect of interest on achievement effectively almost doubled the predictive validity of situational interest. Our findings suggest that it would be useful to include measures of actual engagement with the subject matter into future studies on the effects of situational interest. This would apply to classroom and text processing studies alike.

An interesting issue is how to increase situational interest further through the use of problems or puzzles. Text-based research findings may lead the way here. These studies have demonstrated the importance of features such as coherence, vividness, seductiveness, and personal relevance in stimulating situational interest (Hidi, 2001; Schraw et al., 2001; Schraw & Lehman, 2001). These characteristics may to a certain extent be analogously applied to the active learning classroom. Besides stimulus materials such as problems or texts, teachers may also play an important role in triggering and maintaining situational interest. What teachers should do and what they should avoid doing to evoke situational interest is an interesting topic for further investigation.

CHAPTER 7
SUMMARY AND GENERAL DISCUSSION

Motivation has been portrayed as one of the most significant variables in education and has been studied extensively (Zimmerman, 2008). The research on motivation has a long history and manifest itself in a large spectrum of different theories and approaches, such as motivation as motives, goal theory, achievement motivation, expectancy-value models of motivation, and self-regulated learning (Atkinson & Feather, 1966; Boekaerts, 1995, 1997; Covington, 2000; Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002; Pintrich, 1999, 2000, 2004; Pintrich & De Groot, 1990; Wigfield, 1994; Wigfield & Eccles, 2000; Wolters, 2004b; Zimmerman, 1989, 1990). Despite the large variety of theories and approaches, at the heart of all of them is the explanation and prediction of achievement-related behaviours and outcomes. In essence, the research on motivation boils down to the general question: do students who are motivated behave differently in terms of their learning in the classroom and perform better than students who are less or not motivated? Finding answers to this question was the objective of this thesis.

The studies reported in this thesis were conducted at Republic Polytechnic in Singapore. This polytechnic is the newest of the five polytechnics in Singapore. Although the objective of all polytechnics is to develop well-skilled young individuals to enter the work force after 3 years of education, Republic Polytechnic stands out when it comes to its educational approach. In this polytechnic, the instructional method is problem-based learning (PBL) for all its modules and programmes. In this approach five students work together in one team under the guidance of a tutor. One class is made up of four to five teams. Unique to this polytechnic's approach to PBL is that students work on one problem during the course of one day (Alwis & O'Grady, 2002). This means that students deal with one problem each day in all modules. A typical day starts with the presentation of a problem. Students discuss in their teams what they know, do not know, and what they need to find out. In other words,

students activate their prior knowledge, come up with tentative explanations for the problem, and formulate their own learning goals (Barrows, 1988; Hmelo-Silver, 2004; Schmidt, 1993). Subsequently, a period of self-study follows in which students individually and collaboratively try to find information to address the learning goals (Schmidt, 1993). At the end of the day the five teams come together to present, elaborate, and synthesise their findings.

In order to systematically address the overall research question mentioned earlier, four research areas were identified that were expected to provide answers to the question of how motivation is related to academic achievement and whether students who are motivated display different behaviours in the classroom as compared to students who are less or not motivated. The four research areas comprise: (1) the context-specific nature of motivation and self-regulated learning, (2) the cross-cultural validity of motivation and self-regulated learning (and potential differences) between cultural groups in Singapore, (3) the causal relationships between prior achievement, motivation, self-regulated learning, achievement-related classroom behaviours, and academic achievement, and (4) students' situational interest in the active-learning classroom.

Firstly, we were interested to find out whether motivation is dependent on the learning context - for instance, students may have different motivational beliefs for mathematics than for English - or whether motivation is a personal characteristic of the learner which is relatively stable across different subject domains and study courses. To measure differences in motivational beliefs and learning strategies the *Motivated Strategies for Learning Questionnaire* (Pintrich, Smith, Garcia, & McKeachie, 1991), or MSLQ, was used. The advantage of using the MSLQ is that it covers a large range of motivational and cognitive constructs as compared to other available instruments which are much more limited in their measurement scope (Entwistle & McCune, 2004).

As a second step, we investigated the general relationships between prior knowledge, motivation, learning strategies, achievement-related classroom behaviours, and academic achievement. In this approach we combined the five motivational scales and nine learning strategies scales of the MSLQ to

represent students' general motivational beliefs and general learning strategies (i.e. we determined the overall mean values for both scales). The relationships between the five variables were then analysed by means of path analysis.

We progressed to investigate whether the MSLQ can be used in the multi-cultural context of Singapore. Various culture researchers have raised concerns about the cross-cultural validity of self-report measures that were based on Western theorisation and research (e.g. McInerney & Sinclair, 1991, 1992; Zusho & Pintrich, 2003). They argue that before using an instrument in a different cultural context, other than what it was originally designed for, the cross-cultural validity needs to be established first before conducting any form of analyses. We did this with the MSLQ and further explored whether there are differences in motivational beliefs and learning strategies between Chinese, Indian, and Malay students at the polytechnic in Singapore.

Since the influence of motivation on learning and achievement turned out to be far less significant than expected, in the final study we focused our attention on the learning context in the actual PBL classroom. We were particularly interested to see how the different learning activities, such as, the presentation of a problem, small group discussions, self-directed learning, presentation of the findings, and elaboration, influences students' interest in the classroom (this form of interest is referred to as situational interest). Our investigation did not only address the question of how situational interest is triggered, but also how it is maintained during the course of the PBL day. We wanted to know whether a PBL problem triggers situational interest and what happens after situational interest is triggered; does it decrease, increase, or does it remains rather stable over the course of the day? To examine this, we applied a so-called microanalytical measurement approach in which we administered the same short self-report measure (of 6 items) at seven crucial moments during the PBL day. For instance, we administered a measure of situational interest before and immediately after the problem was presented, so that we could see if and how situational interest increases. The study was conducted with four second-year economics classes. Similar to the previous study we analysed the data by means of path analysis in which we also

included a measure of students' prior knowledge, achievement-related classroom behaviours, and academic achievement.

MAIN FINDINGS

In short, the first two studies reported in this thesis revealed that motivation and self-regulated learning are far less context-specific than postulated under the current social-cognitive theory (Chapters 2 and 3). Moreover, our findings did not support the notion that there are large cultural differences in motivational beliefs and the use of learning strategies between different ethnic groups in the Singapore context (Chapter 5). Taken as whole, our findings point towards the conclusion that motivation and learning strategies, as measured with the MSLQ, represent stable dispositions of the learner rather than being context-dependent.

The results of the path analysis revealed that motivation is strongly related to the use of learning strategies, but not to any other measured educational variable, such as prior achievement, achievement-related classroom behaviours, or academic achievement (Chapter 4). As our studies progressed, it became apparent that the granularity of the MSLQ may be too large - that is, the MSLQ (even administered at the course-level) is not able to provide information about possible situational variations in motivational beliefs and learning strategies. As such, the MSLQ (and most likely similar self-report instruments that are administered at the end of a study course) is a rather crude instrument to measure students' motivational beliefs and learning strategies.

For our last study, we were interested to find out whether the level of situational interest (as a context-dependent form of motivation) varies during the one-day learning sequence at the polytechnic (Chapter 6). The results of this study demonstrated that situational interest increased significantly after the problem trigger was presented. Subsequently however the level of situational interest decreased. Unlike the MSLQ in previous studies, situational interest turned out to be a strong predictor of students' academic achievements.

CONTEXT-SPECIFIC NATURE OF MOTIVATION AND LEARNING STRATEGIES

The results of the studies reported in Chapters 2 and 3 suggest that motivational beliefs and learning strategies are far less context-specific than proposed by current motivation theories such as social-cognitive theory (e.g. Pintrich, 2004; Pintrich, Marx, & Boyle, 1993; Wolters & Pintrich, 1998). A first sign that motivation and learning strategies are rather stable and not context-dependent emerged in the first study described in Chapter 2, in which it was demonstrated that a general version of the MSLQ produced similar results by means of model fit statistics and predictive validity evidence when compared to the reported course-specific findings of the same instrument (cf. Pintrich, Simith, Garcia, & McKeachie, 1993).

Confirmation of the initial findings came from a second study that followed (Chapter 3), in which specific invariance tests were applied to compare whether the underlying factorial structure of the MSLQ differs between mathematics, science, and English. The results revealed that there were no significant differences between the subject domains in terms of the measurement model. It became apparent that our data did not support the general notion that motivation and learning strategies are highly context-dependent and manifest themselves as a situation-specific behavioural response to the learning task at hand. Strongest evidence came from the results of the predictive validity study, which demonstrated that there are only minor differences in the predictive validity of the general version of the MSLQ and the course-specific MSLQ. Considering this outcome it is hard to escape the question why should one administer an instrument repeatedly at the course-specific level when the predictions at the general level are of similar accuracy?

Paradoxically, despite the above findings it makes intuitive sense that some context-dependent differences between motivational beliefs and learning strategies should exist. For instance, motivational beliefs, such as self-efficacy judgments about one's abilities for mathematics may well be different for another subject domain such as English. We and others (e.g. Wolters & Pintrich, 1998) were however not able to detect these differences with the use

of the MSLQ, both, the general as well as the context-specific version. The difficulty to detect these differences seems to be related to the granularity of the instrument and the timing of administration. The MSLQ (and various other available instruments) is designed to be administered towards the end of a course with the instruction to think about the course in general when responding to the questionnaire. The statements, and more importantly students' recollection of the experiences during that particular course, seem however to be too general to determine context-dependent variations between two different courses. This of course does not imply that there may be some context-dependent differences in motivational beliefs and the use learning strategies. In fact, our last study (Chapter 6, see below) revealed that even during one learning event - that is, during one day - differences in motivational beliefs, in the form of situational interest did occur. This indicates that learning processes are rather dynamic and situation-specific. However, to measure contextual and situation-specific differences, conventional survey research, such as end-of-semester questionnaires, seem inadequate as the findings in Chapters 2 and 3 demonstrate. More dynamic microanalytical event measures such as the repeated measurement approach applied in the situational interest study of Chapter 6 or other "online measures" (see Ainley, Hidi, & Berndorff, 2002) are needed to provide a much more detailed picture of the learning processes in the actual classroom.

MOTIVATION AS A PREDICTOR OF ACADEMIC ACHIEVEMENT

In order to determine how motivation is related to academic achievement, the MSLQ was administered to a large cohort of polytechnic students. Besides the MSLQ measures of students' motivational beliefs and learning strategies we incorporated measures of students' prior knowledge, achievement-related classroom behaviours, and academic achievement. The relationships between the variables were examined using path analysis. The results of the path analysis reported in Chapter 4 revealed that motivation is not directly related to any of the achievement measures. Instead, motivation was only significantly (and strongly) related to the use of learning strategies. Even prior achievement was not related to motivational beliefs. This is unexpected since motivational

and self-regulated learning theories stress the reciprocal character of achievement and motivation (Pintrich & Schunk, 2002). For instance, Pintrich and Schunk, stressed the reciprocity of motivation and achievement; students who perform well are more likely to be more motivated to engage and study for that particular subject in the future. In our studies we were however not able to replicate these findings; for two large cohorts of students prior academic achievement was unrelated to motivation (in both directions). As an aside, it should however be noted that when we conducted our analyses with the smaller samples of the cultural groups in Singapore, we detected a weak, but significant relationship between motivation and prior achievement. Thus, this point needs to be addressed in further studies.

Overall, the findings of the path analyses demonstrate that motivation and achievement are not directly related but mediated by learning strategies and achievement-related classroom behaviours. Incorporating a measure of achievement-related classroom behaviours proved essential in understanding how motivation and learning strategies are related to academic achievement. It showed that motivational beliefs as measured by self-report measures must convert into observable achievement-related classroom behaviours first, before they can influence achievement. Motivation without engagement cannot influence performance. Overall, however, the predictions improved only marginally, which suggests that motivation is a relatively "isolated" construct that is neither influenced by prior achievement, nor did it relate to any other construct except for learning strategies. In the light of these findings it is questionable how ecologically valid the overall construct of motivation actually is when making predictions about students' academic achievement. This has implications for teachers and classroom practices since the present findings suggest that motivating students is not a solution to enhance students' academic achievement.

CULTURAL DIFFERENCES IN MOTIVATION AND SELF-REGULATED LEARNING

A questionnaire that has been developed in one cultural context may not be an adequate measure in another cultural context since different cultures may

have different perceptions or interpretations of the items used (Kong, Hau, & Marsh, 2003; McInerney & Ali, 2006; Purdie, 1998; Purdie, Pillay, & Boulton-Lewis, 2000; Zusho & Pintrich, 2003). In order to test whether the MSLQ is an adequate measure to be administered in the multi-cultural context in Singapore a cross-cultural validation study was first conducted (Chapter 5). The results indicate that the underlying factorial structure was invariant across Chinese, Indian, and Malay students. This confirmed that the instrument can be used in the Singapore educational context. Next it was investigated if there are significant differences between these three groupings when it comes to their motivational beliefs and the use of learning strategies. The results revealed that there were only minor differences for a few motivational subscales of the MSLQ, and no significant differences when it comes to the use of learning strategies. The results also showed that the relationships between students' prior academic achievement, motivational beliefs, learning strategies, and present academic achievement were non-significantly different between the three cultural groups. For Chinese, Indian, and Malay students alike, prior achievement is a reasonably good predictor of their present academic achievements. Experiences gained from prior academic achievement had a weak influence on their motivational beliefs, which in turn was a strong predictor of self-regulated learning strategies. The use of learning strategies was moderately to strongly related to their achievement-related classroom behaviours and academic achievement.

Taken as a whole, our results suggest that motivational beliefs and learning strategies, as measured by the MSLQ, are largely indifferent between the cultural groups. Besides some minor variations in motivational beliefs the reported use of learning strategies do not significantly differ between students with different cultural backgrounds in Singapore. Similar to our conclusions about the context-specificity of motivation and learning strategies, it may be possible that the differences between cultural groups do exist but are difficult to detect due to the large grain-size of the MSLQ.

SITUATIONAL INTEREST

Situational interest has been defined as an immediate affective response to certain conditions and/or stimuli in the learning environment that focuses one's attention on the learning task (Hidi, 1990; Mitchell, 1992; Schraw, Flowerday, & Lehman, 2001). As such, situational interest is not considered to be a stable disposition of an individual but determined by the features of a learning environment (e.g. a problem trigger in a PBL classroom, a puzzle, group discussions, or task choice). The study discussed in Chapter 6 is an attempt to investigate how situational interest is triggered and how it is maintained in a PBL classroom. In this active-learning classroom setting, students were first presented a problem trigger, then discussed it, formulated learning issues, engaged in self-directed study activities, and finally elaborated on their findings. Unlike other studies in this field, situational interest was not measured only once, but seven times throughout the day. This was done to track if and how situational interest is triggered and how it changes over the course of different learning activities. The results demonstrate that presenting students with a puzzling problem or phenomenon triggered situational interest. During the course of the day, however, situational interest gradually decreased. The initial increase and subsequent decrease in situational interest may be explained in the context of epistemic curiosity research (Berlyne, 1954, 1978). Epistemic curiosity reflects a desire for new information that motivates exploratory behaviour and knowledge acquisition. Spielberger and Starr (1994) suggest that epistemic curiosity can be aroused by a feeling of deprivation - that is, a perceived knowledge gap that must be closed by exploratory and information-seeking behaviours (see also Litman, 2008; Litman, Hutchins, & Russon, 2005). This is what most likely happened once the problem trigger was presented. Students were made aware of their knowledge gap, which resulted in increased engagement and information-seeking behaviour. But why did situational interest then decrease over the course of the day? If one accepts that situational interest increases in response to dealing with a novel problem due to the need to close the knowledge gap, it is tempting to see its decrease as a manifestation of the reduction of this need. Thus, epistemic curiosity gets satisfied through the learning activities in which students engage. In conclusion, our results demonstrate that the active-

learning classroom with its ample opportunities for self-directed learning and self-empowerment through task choice and independent small-group discussion was conducive in triggering students' situational interest and maintaining it (to a certain degree) over the course of one day.

Fairly high intercorrelations were found between the situational interest measures, which suggest that there are (to some degree) pre-existing differences in interest between the participants; situational interest is perhaps somewhat less situational than the name implies. However taken as a whole, our data suggest that a dispositional element, if any, is limited in scope and strength. We were also able to demonstrate that measuring students' self-reported levels of situational interest is in itself insufficient to predict achievement. Similar to the findings in Chapter 5, responses to a situational interest questionnaire have to translate themselves into active engagement first before sizable effects could be found on academic achievement.

ACHIEVEMENT-RELATED CLASSROOM BEHAVIOURS

Various studies in educational psychology in general and motivation research in particular showed rather moderate correlations between motivational, educational variables and students' academic achievement. Although statistically significant, in most cases the reported correlation coefficients do not exceed .30, explaining less than 10% of the variance caused in achievement. (cf. Pintrich & De Groot, 1990; Wolters, 1998; Wolters & Pintrich, 1998). These values are not very impressive when one is interested in understanding a correlational relationship and making adequate predictions. In several studies reported in this thesis, an achievement-related classroom behaviours measure was incorporated, which significantly improved the relationship between motivation, learning strategies, or situational interest and academic achievement respectively (see Chapters 3, 4, 5, and 6). In our studies, achievement-related classroom behaviours were measures of teacher observations, which consisted of three main 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. In the contemporary motivation literature,

achievement-related behaviours seem to originate from so-called mastery or performance goals (Elliott & Dweck, 1988). Much of the achievement motivation research indicates that students show the most positive achievement-related behaviours when they pursue mastery goals (Meece, Anderman, & Anderman, 2006). Research suggests that with a focus on mastery goals, students show higher levels of task involvement (Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000), students are more likely to persist at difficult tasks (Elliott & Dweck, 1988), students report higher levels of effort (Grant & Dweck, 2003; Miller, Greene, Montalvo, Ravindran, & Nichols, 1996; Wolters, 2004a), and use deeper processing strategies that enhance conceptual understanding of a topic (Ames & Archer, 1988; Elliot, McGregor, & Gable, 1999). These elements of mastery goal orientation were largely reflected by the teacher observations of students' classroom behaviours.

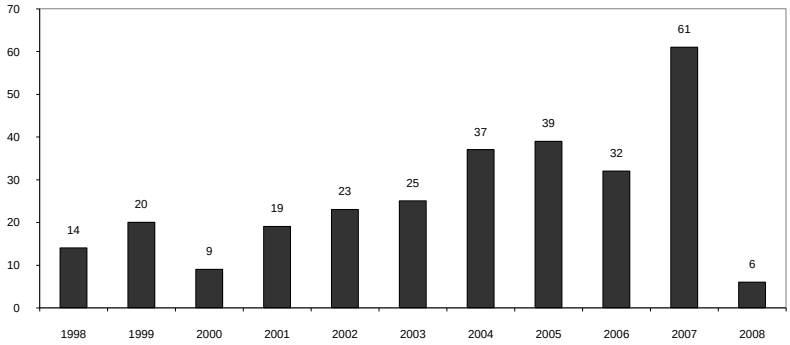
Overall, our results show that self-reported levels of motivation or the use of learning strategies are not sufficient to predict achievement; they need to be translated into actual behaviour to be an adequate predictor of achievement. A good example is the study described in Chapter 6, which clearly demonstrated that including achievement-related classroom behaviours in the path model effectively doubled the predictive validity of situational interest. Including achievement-related classroom behaviours may be a useful mediator to be adapted for future research studies.

CONCLUSIONS

The findings of the studies presented in this thesis allow for several conclusions. A first conclusion, based on the studies discussed in Chapters 2 and 3, is that motivational beliefs and learning strategies (as measured by the MSLQ) tend to be stable dispositions of the learner rather than being dependent on a specific context or subject domain. It is possible that the grain-size of the measurement produced by the MSLQ is too large to determine context-dependent differences in motivational beliefs and learning strategies between courses, subject domains, and learning contexts in general. It is likely that this is also the case for other similar self-report instruments that demand students to think about a course or subject domain in general when

responding to it. A study course or subject domain taken as a unit of analysis seems to be too general to adequately measure potential differences between motivational beliefs and learning strategies. This conclusion has direct implications on the use of the MSLQ. An increasing number of studies seem to use the MSLQ as a measure for motivational beliefs and the use of learning strategies at the course-specific level (Duncan & McKeachie, 2005). A search on "Google Scholar" (15 July 2008) as a search engine revealed that over the past 10 years there has been a significant increase of studies published in academic journals that referred to the use of the MSLQ. Figure 1 visualises this increasing trend over that period (r = .47, p < .05).

Figure 1: Google Scholar search, number of published academic journals that used the MSLQ from 1998 to 2008



Researchers who use or intend to use the MSLQ have to be aware of its limitation in discriminating between courses and subject domains. Our studies have shown that the same accuracy in predicting students' academic performance can be achieved with a general version of the MSLQ. Administering the MSLQ only once at the general curriculum level results in a significant reduction in effort and resources as compared to the repeated administration in different courses as it has been designed for.

A second conclusion is that motivation is a rather isolated construct with very limited predictive validity when it comes to academic achievement. In all our studies, motivation showed only strong correlations to learning strategies. It seems that studying motivation is only meaningful when it is related to the use of learning strategies, for instance, to examine which motivational beliefs are "responsible" for the activation of certain learning strategies.

A third conclusion is that achievement-related classroom behaviours play a significant role in mediating the relationship between motivation, as well as situational interest and academic achievement. Based on the findings reported in Chapters 3, 4, 5, and 6, it seems that responses to a self-report instrument are not sufficient in making accurate predictions of students' academic achievement. Motivational beliefs as well as situational interest measured by self-report instruments must convert into observable achievement-related classroom behaviours first, before sizable correlation effects can be observed. Motivation and situational interest without engagement cannot influence performance.

DIRECTIONS FOR FURTHER RESEARCH

Our studies have pointed out that the MSLQ has limitations in determining context-dependent variations, which are most probably due to the large grain-size of the instrument. With the situational interest study of Chapter 6 an alternative measurement approach was presented by repeatedly administering a measure of situational interest over the course of a day. This microanalytical approach enabled us to examine how situational interest develops and changes over a certain period of time. It would be interesting for future research to investigate whether the constructs used in the motivation literature, such as intrinsic motivation, self-efficacy judgments, task-value beliefs, and control for learning beliefs demonstrate similar variations and changing patterns during the course of a learning event. This would shed more light on the nature and development of motivational factors in an authentic classroom setting, rather than measuring the more trait-like dispositional component at the end of a course or semester (cf. Zimmerman, 2008). Moreover, this line or research could also extend to cultural psychology

research. It could be investigated, at a very detailed task or problem level, whether students with different cultural backgrounds report differences in terms of their motivational beliefs, interests, and the use of learning strategies.

The findings of the situational interest study reported in Chapter 6 suggest that a certain proportion of situational interest manifest itself also as trait or stable disposition. How large this component is and what it means for situational interest and classroom learning in general is presently unknown and demands further investigation. It may be necessary to include, besides a situational interest measure, also measures of personal interest (also referred to as individual interest). Moreover, further research should examine the role teachers and different problem types play in triggering and sustaining situational interest. It seems possible that specific teacher or problem characteristics, such as teacher beliefs about teaching (Fang, 1996; Kagan, 1992), cognitive congruence, or well- vs. ill-structured problems (De Grave, Dolmans, & van der Vleuten, 1999; Jacobs, Dolmans, Wolfhagen, & Scherpbier, 2003) are factors that influence students' situational interest.

IMPLICATIONS FOR EDUCATION

Somewhat to our disappointment, motivation was not a significant predictor of students' academic achievements or even their achievement-related classroom behaviours. In light of these findings, it can be argued that measuring motivational beliefs of students at the general curriculum level or the course level to inform educational practice may bear little benefit. However, as our final study demonstrated, the actual classroom context during which learning activities, such as discussing a problem and self-directed inquiry, provides rich information about student motivation. More importantly, the level of situational interest and engagement during class was a strong predictor of students' academic achievement. Considering these findings as a whole, it has implications for curriculum designers and teachers, since it helps to identify which learning activity leads to increased interest and thus engagement, learning, and achievement. Once we are able to identify which educational activities are responsible for triggering and maintaining situational interest (or motivation in general), necessary adjustments can be

made to the curriculum to increase student engagement and eventually academic achievement. Despite the fact that the active-learning classroom seems to provide the best conditions for enabling situational interest (e.g. by providing task choice, self-directedness, puzzles, and teamwork) the same microanalytical approach may be applied to other instructional formats, such as tutorials, projects, or even lectures.

REFERENCES

Arbuckle, J. L. (2003). *Amos 5.0 Update to the Amos User's Guide*: Marketing Dept., SPSS Inc.: SmallWaters Corp.

Ainley, M., Hidi, S., & Berndorff, D. (2002). Interest, learning, and the psychological processes that mediate their relationship. *Journal of Educational Psychology, 94*(3), 545-561.

Alexander, P. A., Jetton, T. L., & Kulikowich, J. M. (1995). Interrelationship of knowledge, interest, and recall: Assessing a model of domain learning. *Journal of Educational Psychology, 87*(4), 559-575.

Alexander, P. A., Kulikowich, J. M., & Schulze, S. K. (1994). How subject-matter knowledge affects recall and interest. *American Educational Research Journal, 31*(2), 313-337.

Alwis, W. A. M., & O'Grady, G. (2002). *One day-one problem at Republic Polytechnic*. Paper presented at the 4th Asia-Pacific Conference on PBL.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*(3), 261-271.

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology, 80*(3), 260-267.

Anderman, E. M., Eccles, J. S., Yoon, K. S., Roeser, R., Wigfield, A., & Blumenfeld, P. (2001). Learning to value mathematics and reading: Relations to mastery and performance-oriented instructional practices. *Contemporary Educational Psychology, 26*(1), 76-95.

Anderson, R. C., Shirey, L. L., Wilson, P. T., & Fielding, L. G. (Eds.). (1987). *Interestingness of children's reading material*. Hillsdale, NJ: Erlbaum.

Arbuckle, J. L. (2003). Amos 5.0 Update to the Amos User's Guide: Marketing Dept., SPSS Inc.: SmallWaters Corp.

Archer, J. (1994). Achievement goals as a measure of motivation in university students. *Contemporary educational psychology, 19*(4), 430-446.

Atkinson, J. W. (1957). Motivational determinants of risk-taking behaviour. *Psychological Review, 64*(6), 359-372.

Atkinson, J. W. (1964). *Introduction to motivation*. Princeton NJ: Van Nostrand.

Atkinson, J. W., & Feather, N. T. (1966). *A theory of achievement motivation* New York: Wiley.

Bandalos, D. L., & Finney, S. J. (Eds.). (2001). Item parceling issues in structural equation modeling. Mahwah, NJ: Lawrence Erlbaum Associates.

Bandalos, D. L., Finney, S. J., & Geske, J. A. (2003). A model of statistics performance based on achievement goal theory. *Journal of Educational Psychology*, 95(3), 604-616.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioural change. *Psychological Review, 84*(2), 191-215.

Bandura, A. (1997). *Self-efficacy: the exercise of control*. New York: Freeman & Co.

Bandura, A., Freeman, W. H., & Lightsey, R. (1999). Self-Efficacy: The exercise of control. *Journal of Cognitive Psychotherapy, 13*(2), 158-166.

Barrows, H. S. (1988). *The Tutorial Process*. Springfield IL: University School of Medicine.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, 107(2), 238-246.

Bergin, D. A. (1999). Influences on classroom interest. *Educational Psychologist, 34*(2), 87-98.

Berlyne, D. E. (1954). A theory of human curiosity. *British Journal of Psychology, 45*(3), 180-191.

Berlyne, D. E. (1978). Curiosity and learning. *Motivation and Emotion, 2*(2), 97-175.

Biggs, J. (1987). *Study Process Questionnaire Manual*. Student Approaches to Learning and Studying: Australian Council for Educational Research Ltd., Radford House, Frederick St., Hawthorn 3122, Australia.

Biggs, J. (1993). What do inventories of students' learning process really measure? A theoretical review and clarification. *British Journal of Educational Psychology, 63*(1), 3.

Biggs, J. B. (1987a). *Student approaches to learning and studying*. Camberwell: Australian Council for Educational Research.

Biggs, J. B. (1987b). *The Study Process Questionnaire (SPQ): Manual*. Hawthorn: Australian Council for Educational Research.

Biggs, J., Kember, D., & Leung, D. Y. P. (2001). The revised two factor Study Process Questionnaire: R-SPQ-2F. *British Journal of Educational Psychology*, 71(1), 133-155.

Boekaerts, M. (1995). Self-regulated learning: Bridging the gap between metacognitive and metamotivation theories. *Educational Psychologist, 30*(4), 195-200.

Boekaerts, M. (1996). Personality and the psychology of learning. *European Journal of Personality, 10*, 377-404.

Boekaerts, M. (1997). Self-regulated learning: a new concept embraced by researchers, policy makers, educator, teachers, and students. *Learning and Instruction, 7*(2), 161-186.

Boekaerts, M., & Boscolo, P. (2002). Interest in learning, learning to be interested. *Learning and Instruction, 12*(4), 375-382.

Boekaerts, M., & Corno, L. (2005). Self-Regulation in the classroom: A perspective on assessment and intervention. *Applied Psychology, 54*(2), 199-231.

Bong, M. (1996). Problems in academic motivation research and advantages and disadvantages of their solutions. *Contemporary Educational Psychology, 21*(2), 149-165.

Bong, M. (2001). Between-and within-domain relations of academic motivation among middle and high school students: Self-efficacy, task-value, and achievement goals. *Journal of Educational Psychology, 93*(1), 23-34.

Bong, M. (2004). Academic motivation in self-efficacy, task value, achievement goal orientations, and attributional beliefs. *Journal of Educational Research*, 97(6), 287-298.

Bong, M. (2004). Academic motivation in self-efficacy, task value, achievement goal orientations, and attributional beliefs. *The Journal of Educational Research, 97*(6), 287-297.

Bong, M., & Hocevar, D. (2002). Measuring self-efficacy: Multitrait-multimethod comparison of scaling procedures. *Applied Measurement in Education, 15*(2), 143-172.

Bong, M., & Skaalvik, E. M. (2003). Academic self-concept and self-efficacy: how different are they really? *Educational Psychology Review*, 15(1), 1-40.

Brookhart, S. M., & Durkin, D. T. (2003). Classroom assessment, student motivation, and achievement in high school social studies classes. *Applied Measurement in Education*, 16(1), 27-54.

Brown, A., Bransford, J., Ferrara, R., & Campione, J. (1983). Learning, remembering, and understanding. In P. Mussen, J. Flavell & E. Markman (Eds.), *Handbook of Child Psychology* (Vol. vol. 3. Cognitive development, pp. 77-166). New York: Wiley.

Byrne, B. M. (2001). *Structural equation modeling with Amos: Basic concepts, applications and programmeming*. Mahwah, N.J.: Lawrence Erlbaum Assoc Inc.

Chua, J. C., & Schmidt, H. G. (2007). *Generalisability and unicity of global ratings by teachers*. Paper presented at the International Problem-Based Learning Symposium

Chen, G., Gully, S. M., & Eden, D. (2004). General self-efficacy and self-esteem: Toward theoretical and empirical distinction between correlated self-evaluations. *Journal of Organisational Behvaior, 25*, 375.

Chuan, K. E., Chow, H. T., Tyng, P. M., Ching, L. S., & Wing, W. K. (2006). *Singapore Resident Population 1990-2006*. Retrieved from: http://internet-stg1.singstat.gov.sg/pubn.html.

Cordova, D. I., & Lepper, M. R. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. *Journal of Educational Psychology, 88*(4), 715-730.

Covington, M. V. (2000). Goal theory, motivation, and school achievement: An integrative review. *Annual Reviews in Psychology, 51*(1), 171-200.

Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety*. San Francisco: Jossey-Bass.

De Grave, W. S., Dolmans, D., & van der Vleuten, C. P. M. (1999). Profiles of effective tutors in problem-based learning: Scaffolding student learning. *Medical Education, 33*(12), 901-906.

Deci, E. L. (1992). The relation of interest to the motivation of behaviour: A self-determination theory perspective. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 43-70). Hillsdale, NJ: Lawrence Erlbaum Associates.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26*(3&4), 325-346.

Duff, A. (2004). Understanding academic performance and progression of first-year accounting and business economics undergraduates: The role of approaches to learning and prior academic achievement. *Accounting Education, 13*(4), 409-430.

Dyne, A., Taylor, P., & Boulton-Lewis, G. (1994). Information processing and the learning context: An analysis from recent perspectives in cognitive psychology. *British Journal of Educational Psychology*, 64(3), 359-372.

Eccles, J. S. (Ed.). (1983). Expectancies, values, and academic behaviour. San Francisco: Freeman.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, value, and goals. *Annual Review of Psychology, 53*, 109-132.

Elliot, A. J., & Harackiewicz, J. M. (1996). Approach and avoidance achievement goals and intrinsic motivation: A mediational analysis. *Journal of Personality and Social Psychology, 70*(3), 461-475.

Elliot, A. J., McGregor, H. A., & Gable, S. (1999). Achievement goals, study strategies, and exam performance: A mediational analysis. *Journal of educational psychology, 91*(3), 549-563.

Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology, 54*(1), 5-12.

Entwistle, N. J., & McCune, V. (2004). The conceptual bases of Study Strategy Inventories. *Educational Psychology Review, 16*(4), 325-345.

Entwistle, N. J., & Ramsden, P. (1983). *Understanding student learning*. London: Croom Helm.

Entwistle, N. J., & Waterston, S. (1988). Approaches to studying and levels of processing in university students. *British Journal of Educational Psychology, 58*, 258.

Entwistle, N., & McCune, V. (2004). The conceptual bases of study strategy inventories. *Educational Psychology Review, 16*(4), 325-345.

Fan, X., Thompson, B., & Wang, L. (1999). Effects of sample size, estimation methods, and model specification on structural equation. *Structural Equation Modeling*, 6(1), 56-83.

Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational Research, 38*(1), 47-65.

Garcia, T., & McKeachie, W. J. (2005). The making of the Motivated Strategies for Learning Questionnaire. *Educational Psychologist, 40*(2), 117-128.

Garcia, T., & Pintrich, P. R. (1994). *Regulating motivation and cognition in the classroom: The role of self-schemas and self-regulatory strategies*. Hillsdale: Lawrence Erlbaum Associates.

Garner, R., Brown, R., Sanders, S., & Menke, D. J. (1992). "Seductive details" and learning from text. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 239-254). Hillsdale, NJ: Erlbaum.

Goetz, E. T., & Sadoski, M. (1995). The perils of seduction: Distracting details or incomprehensible abstractions? *Reading Research Quarterly, 30*(3), 500-511.

Grant, H., & Dweck, C. S. (2003). Clarifying achievement goals and their impact. *Journal of Personality and Social Psychology, 85*(3), 541-553.

Grossman, P., & Stodolsky, S. (1995). Content as context: The role of school subjectis in secondary teaching. *Educational Researcher*, 24(8), 5-11.

Groves, M. (2005). Problem-based learning and learning approach: Is there a relationship? *Advances in Health Sciences Education, 10*(4), 315-326.

Hancock, G. R., & Mueller, R. O. (2001). Rethinking construct reliability within latent systems. In R. Cudeck, S. d. Toit & D. Sörbom (Eds.), *Structural equation modeling: Present and future - A festschrift in honor of Karl Jöreskog* (pp. 195-216). Lincolnwood, IL: Scientific Software International.

Harackiewicz, J. M., Barron, K. E., Pintrich, P. R., Elliot, A. J., & Thrash, T. (2002). Revision of achievement goal theory: Necessary and illuminating. *Journal of Educational Psychology, 94*, 638.

Harackiewicz, J. M., Barron, K. E., Pintrich, P. R., Elliot, A. J., & Thrash, T. M. (2002). Revision of achievement goal theory: Necessary and illuminating. *Journal of Educational Psychology, 94*(3), 638-645.

Harackiewicz, J. M., Barron, K. E., Tauer, J. M., Carter, S. M., & Elliot, A. J. (2000). Short-term and long-term consequences of achievement goals: Predicting interest and performance over time. *Journal of Educational Psychology, 92*(2), 316-330.

Henderson, R. W. (1986). Self-regulated learning: Implications for the design of instructional modules. *Contemporary Educational Psychology, 11*(2), 405-427.

Hidi, S. (1990). Interest and its contribution as a mental resource for learning. *Review of Educational Research, 60*(4), 549-571.

Hidi, S. (2001). Interest, reading, and learning: Theoretical and practical considerations. *Journal of Educational Psychology Review 13*(3), 191-209.

Hidi, S. (2006). Interest: A unique motivational variable. *Educational Research Review, 1*(2), 69-82.

Hidi, S., & Baird, W. (1986). Interestingness - A neglected variable in discourse processing. *Cognitive Science, 10*(2), 179-194.

Hidi, S., & Baird, W. (1988). Strategies for increasing text-based interest and students' recall of expository texts. *Reading Research Quarterly, 23*(4), 465-483.

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist, 41*(2), 111-127.

Hidi, S., Renninger, K., & Krapp, A. (2004). Interest, a motivational variable that combines affective and cognitive functioning. In D. Dai & R. Sternberg (Eds.), *Motivation, Emotion, and Cognition* (pp. 89–115). London: Lawrence Erlbaum Associates.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review, 16*(3), 235-266.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1-55.

Jacobs, A., Dolmans, D., Wolfhagen, I., & Scherpbier, A. (2003). Validation of a short questionnaire to assess the degree of complexity and structuredness of PBL problems. *Medical Education, 37*(11), 1001-1007.

Jetton, T. L., & Alexander, P. A. (2001). Interest assessment and the content area literacy environment: Challenges for research and practice. *Educational Psychology Review, 13*(3), 303-318.

Jose, P. E., & Brewer, W. F. (1984). Development of story liking: Character identification, suspense, and outcome resolution. *Developmental Psychology, 20*(5), 911-924.

Kagan, D. M. (1992). Implication of research on teacher belief. *Educational Psychologist, 27*(1), 65-90.

Kaldeway, J., & Korthagen, F. A. J. (1995). Training in studying in higher education: Objectives and effects. *Higher Education, 30*(1), 81-98.

Kong, C., Hau, K., & Marsh, H. (2003). Cross-cultural validation of self-concept measures and theoretical models in the Chinese context. In F. Salili & R. Hoosain (Eds.), *Teaching, learning, and motivation in a multicultural context*. Greenwich: Information Age Publishing Inc.

Krapp, A., & Lewalter, D. (Eds.). (2001). *Development of interests and interest-based motivational orientations: A longitudinal study in vocational school and work settings*. Amsterdam: Pergamon.

Krapp, A., Hidi, S., & Renninger, K. A. (1992). Interest, learning and development. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 3-25). Hillsdale, NJ: Lawrence Erlbaum Associates.

Lim, E. P. Y. (1999). Educational Assessment in Singapore. *Assessment in Education: Principles, Policy & Practice, 6*(3), 391-404.

Linnenbrink, E. A., & Pintrich, P. R. (2002). Motivation as an enabler for academic success. *School Psychology Review, 31*, 313.

Litman, J. A. (2008). Interest and deprivation factors of epistemic curiosity. *Personality and Individual Differences, 44*(7), 1585-1595.

Litman, J. A., & Jimerson, T. L. (2004). The measurement of curiosity as a feeling of deprivation. *Journal of Personality Assessment, 82*(2), 147-157.

Litman, J. A., Hutchins, T., & Russon, R. (2005). Epistemic curiosity, feeling-of-knowing, and exploratory behaviour. *Cognition & Emotion, 19*(4), 559-582.

Little, T. D., Cunningham, W. A., Shahar, G., & Widaman, K. F. (2002). To parcel or not to parcel: Exploring the question, weighing the merits. *Structural Equation Modeling*, 9(2), 151-173.

Loewenstein, G. (1994). The psychology of curiosity: A review and reinterpretation. *Psychological Bulletin, 116*(1), 75-98.

Lonka, K., Olkinuora, E., & Mäkinen, J. (2004). Aspects and prospects of measuring studying and learning in higher education. *Educational Psychology Review, 16*(4), 301-323.

Mäkinen, J., Olkinuora, E., & Lonka, K. (Eds.). (2002). *Orientations to studying in Finnish higher education. Comparison of study orientations in university and vocational higher education.* Tampere, Finnland: Tampere University Press.

McInerney, D. M., & Ali, J. (2006). Multi-dimensional and Hierarchical Assessment of School Motivation: Cross-cultural validation. *Educational Psychology, 26*(6), 717-734.

McInerney, D. M., & Sinclair, K. E. (1991). Cross cultural model testing: Inventory of school motivation. *Educational and Psychological Measurement 51*(1), 123-133.

McInerney, D. M., & Sinclair, K. E. (1992). Dimensions of school motivation: A cross-cultural validation study. *Journal of Cross-Cultural Psychology, 23*(3), 389-406.

Meece, J. L., Anderman, E. M., & Anderman, L. H. (2006). Classroom goal structures, student motivation, and academic achievement. *Annual Review of Psychology, 57*, 487-503.

Miller, R. B., Greene, B. A., Montalvo, G. P., Ravindran, B., & Nichols, J. D. (1996). Engagement in academic work: The role of learning goals, future consequences, pleasing others, and perceived ability. *Contemporary Educational Psychology, 21*(4), 388-422.

Mitchell, M. (1992). Situational interest: Its multifaceted structure in the secondary mathematics classroom. *Journal of Educational Psychology, 85*(3), 424-436.

Norman, G. T., & Schmidt, H. G. (1992). The psychological basis of problem-based learning: A review of the evidence. *Academic Medicine, 67*(9), 557-565.

Novak, J. D. (1998). *Learning, creating, and using knowledge: Concept maps as facilitative tools in schools and corporations*. Mahwah, N.J.: Lawrence Erlbaum Associates.

Ommundsen, Y. (2003). Implicit theories of ability and self-regulation strategies in physical education classes. *Educational Psychology*, 23(2), 141-157.

Paris, S. G., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist, 36*(2), 89-101.

Pintrich, P. R. (1988a). A process-oriented view of student motivation and cognition. In J. Stark & L. Mets (Eds.), *Improving teaching and learning through research: New directions for institutional research* (Vol. 57, pp. 65-79). San Francisco: Jossy-Bass.

Pintrich, P. R. (1988b). Student learning and college teaching. In R. E. Young & K. E. Eble (Eds.), *College teaching and learning: Preparing for new commitments. New Directions for Teaching and Learning* (Vol. 33, pp. 71-86). San Francisco: Jossey-Bass.

Pintrich, P. R. (1989). The dynamic interplay of student motivation and cognition in the college classroom. *Advances in Motivation and Achievement, 6*, 117-160.

Pintrich, P. R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *Educational Research, 31*(6), 459-470.

Pintrich, P. R. (2000a). An achievement goal theory perspective on issues in motivation terminology, theory, and research. *Contemporary Educational Psychology, 25*(1), 92-104.

Pintrich, P. R. (2000b). 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 Press.

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review, 16*(4), 385-407.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33-40.

Pintrich, P. R., & Schunk, D. H. (2002). *Motivation in education: Theory, research, and applications* (2nd ed.). Englewood Cliffs, N.J.: Merrill, Prentice-Hall International.

Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research, 63*(2), 167.

Pintrich, P. R., Simith, D., Garcia, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire

(MSLQ). *Educational and Psychological Measurement, 53*(3), 801-813.

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 Center for Research to Improve Postsecondary Teaching and Learning.

Pokay, P., & Blumenfeld, P. C. (1990). Predicting achievement early and late in the semester: The role of motivation and use of learning strategies. *Journal of Educational Psychology, 82*(1), 41-50.

Prenzel, M. (1992). The selective persistence of interest. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 71-98). Hillsdale, NJ: Lawrence Erlbaum Associates.

Purdie, N. (1998). *Conceptions of learning in different cultures*. Paper presented at the XIVth International Congres on the International Association for Cross-Cultural Psychology.

Purdie, N., Hattie, J., & Douglas, G. (1996). Student conceptions of learning and their use of self-regulated learning strategies: A Cross-cultural comparison. *Journal of Educational Psychology, 88*(1), 87-100.

Purdie, N., Pillay, H., & Boulton-Lewis, G. (2000). Investigating cross-cultural variation in conceptions of learning and the use of self-regulated strategies. *Education Journal, 28*(1), 65-84.

Renninger, K. A., & Hidi, S. (2002). Student interest and achievement: Developmental issues raised by a case study. In A. Wigfield & J. S. Eccles (Eds.), *Development of Achievement Motivation* (pp. 173-195). New York, NY: Academic.

Renninger, K. A., & Wozniak, R. H. (1985). Effect of interest on attentional shift, recognition, and recall in young children. *Developmental Psychology, 21*(4), 624–632.

Rotgans, J. I., & Schmidt, H. G. (2007). Is the Motivated Strategies for Learning Questionnaire a suited instrument to measure student motivation and self-regulated learning strategies at the general school level? *Manuscript submitted for publication.*

Rotgans, J. I., & Schmidt, H. G. (2008). The relationships between, motivation, learning strategies, and academic achievement. *Submitted for publication*.

Rotgans, J. I., Alwis, W. A. M., & Schmidt, H. G. (2008). *Measuring self-regulation, motivation, and academic achievement*. Paper presented at the Annual meeting of the American Educational Research Association.

Rotgans, J., & Schmidt, H. (In Press). Examination of the context-specific nature of self-regulated learning. *Educational Studies*.

Schiefele, U. (1991). Interest, learning, and motivation. *Educational Psychologist, 26*(3), 299-323.

Schiefele, U. (1992). Topic interest and levels of text comprehension. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 151-182). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schiefele, U. (1996). Topic interest, text representation, and quality of experience. *Contemporary Educational Psychology, 21*(1), 3-18.

Schiefele, U. (1999). Interest and learning from text. *Scientific Studies of Reading, 3*(3), 257-279.

Schiefele, U., Krapp, A., & Winteler, A. (1992). Interest as a predictor of academic achievement: A meta-analysis of research. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 183-212). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schmidt, H. G. (1983). Problem-based learning: Rationale and description. *Medical Education, 17*(1), 11-16.

Schmidt, H. G. (1993). Foundations of problem-based learning: Some explanatory notes. *Medical Education, 27*(5), 422-432.

Schmidt, H. G., & Moust, J. H. C. (2000). Processes that shape small-group tutorial learning: A review of research. In D. H. Evensen & C. E. Hmelo (Eds.), *Problem-based learning: A research perspective on learning interactions* (pp. 19-52). Mahwah, N.J.: Lawrence-Erlbaum.

Schneider, W., & Pressley, M. (1989). *Memory development between 2 and 20*. New York: Springer-Verlag New York.

Schraw, G. (1997). Situational interest in literary text. *Contemporary Educational Psychology, 22*(4), 436-456.

Schraw, G., & Lehman, S. (2001). Situational interest: A review of the literature and directions for future research. *Educational Psychology Review, 13*(1), 23-52.

Schraw, G., Bruning, R., & Svoboda, C. (1995). Sources of situational interest.

Journal of Reading Behaviour, 27(1), 1-17.

Schraw, G., Flowerday, T., & Lehman, S. (2001). Increasing situational interest in the classroom. *Educational Psychology Review, 13*(3), 211-224.

Schraw, G., Flowerday, T., & Lehman, S. (2001). Increasing situational interest in the classroom. *Educational Psychology Review, 13*(3), 211-224.

Schunk, D. H. (1989). Self-efficacy and achievement behaviours. *Educational Psychology Review, 1*(3), 173-208.

Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist*, 26(3), 207-231.

Seibert, D. C. (2002). Effects of engagement principles in a video teleconferencing environment on the development of knowledge, motivation and clinical expertise. *Dissertation International*, 63(6), 2136.

Shirey, L. L. (1992). Importance, interest, and selective attention. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 281-296). Hillsdale, NJ: Lawrence Erlbaum Associates.

Shweder, R. A., Goodnow, J., Hatano, G., LeVine, R. A., Markus, H., & Miller, P. (1998). The cultural psychology of development: One mind, many mentalities. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology: Theoretical models of human development* (Vol. 1, pp. 865–937). New York: Wiley & Sons.

Siegler, R. S. (1988). Individual differences in strategy choices: Good students, not-so-good students, and perfectionists. *Child Development, 59*(4), 833-851.

Silvia, P. J. (2008). Interest - The curious emotion. *Current Directions in Psychological Science, 17*(1), 57-60.

Solomon, K. O., Medin, D. L., & Lynch, E. (1999). Concepts do more than categorize. *Trends in Cognitive Sciences, 3*(3), 99-105.

Spielberger, C. D., & Starr, L. M. (1994). Curiosity and exploratory behaviour. In H. F. O'Neil Jr. & M. Drillings (Eds.), *Motivation, theory and research* (pp. 221-243). Hillsdale, NJ: Erlbaum.

Sternberg, R. J. (1988). *The Triarchic Mind: A New Theory of Human Intelligence*. New York: Viking.

Stodolsky, S. S. (1988). *The subject matters: Classroom activity in math and social studies*. Chicago: University of Chicago Press.

Stodolsky, S., & Grossman, P. (1995). The impact of subject matter on curricular activity: An analysis of five academic subjects. *American Education Research Journal*, 32(2), 227-249.

Trigwell, K., & Prosser, M. (2004). Development and use of the Approaches to Teaching Inventory. *Educational Psychology Review*, 16(4), 409.

Urdan, T. C., & Maehr, M. L. (1995). Beyond a two-goal theory of motivation and achievement: A case for social goals. *Review of Educational Research, 65*(3), 213-243.

van Dijk, T. A., & Kintsch, W. (1999). *Strategies of discourse comprehension*. New York: Academic Press.

Vermetten, Y. J., Lodewijks, H. G., & Vermunt, J. D. (1999). Consistency and variability of learning strategies in different university courses. Higher Education, 37(1), 1-21.

Vermunt, J. D. (1998). The regulation of constructive learning processes. British *Journal of Educational Psychology*, 68(2), 149-172.

Wade, S. E. (1992). How interest affects learning from text. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and developmentt* (pp. 281-296). Hillsdale, NJ: Lawrence Erlbaum Associates.

Walker, C. O., Greene, B. A., & Mansell, R. A. (2006). Identification with academics, intrinsic/extrinsic motivation, and self-efficacy as predictor of cognitive engagement. *Learning and Individual Differences, 16*(1), 1-12.

Wigfield, A. (1994). Expectancy-value theory of achievement motivation: A developmental perspective. *Educational Psychology Review, 6*(1), 49-77.

Wigfield, A., & Eccles, J. S. (1992). The development of achievement task values: A theoretical analyses. *Developmental Review*, 12(3), 165-310.

Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology, 25*(1), 68-81.

Wolters, C. (1998). Self-regulated learning and college students' regulation of motivation. *Journal of Educational Psychology, 90*, 224.

Wolters, C. (2004). Advancing achievement goal theory: Using goal structures and goal orientations to predict students' motivation, cognition, and achievement. *Journal of educational psychology, 96*(2), 236-250.

Wolters, C. A. (1998). Self-regulated learning and college students' regulation of motivation. *Journal of Educational Psychology, 90*(2), 224-235.

Wolters, C. A., & Pintrich, P. R. (1998). Contextual differences in student motivation and self-regulated learning in mathematics, English, and social studies classrooms. *Instructional Sciences*, 26(1-2), 27-47.

Wolters, C., Yu, S. L., & Pintrich, P. R. (1996). The relation between goal orientation and students' motivational beliefs and self-regulated learning. *Learning and Individual Differences, 8*(3), 211-238.

Zeegers, P. (2004). Student learning in higher education: a path analysis of academic achievement in science. *Higher Education Research & Development, 23*(1), 35-56.

Zimmerman, B. J. (1989). Models of self-regulated learning and academic achievement. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theory, research and practice* (pp. 1). New York: Springer-Verlag.

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

Zimmerman, B. J. (1989a). Models of self-regulated learning and academic achievement. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theory, research, and practice* (pp. 1-25). New York: Springer.

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

Zimmerman, B. J. (1989c). Models of self-regulated learning and academic achievement. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theory, research, and practice* (pp. 1-25). New York: Springer.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview *Educational Psychologist, 25*(1), 3-17.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *25*(1), 3-17.

Zimmerman, B. J. (1994). *Dimensions of academic self-regulation: A conceptual framework for education*. Hillsdale: Lawrence Erlbaum Associates.

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology, 25*(1), 82-91.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal, 45*(1), 166-183.

Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assesing student use of self-regulated learning strategies. *American Educational Research Journal, 23*(4), 614-628.

Zimmerman, B. J., & Martinez-Pons, M. (1990). Student differences in self-regulated learning: Relating grade, sex, and giftedness to self-efficacy and strategy use. *Journal of Educational Psychology, 82*(1), 51-59.

Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-Motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American Educational Research Journal, 29*(3), 663-676.

Zusho, A., & Pintrich, P. R. (2003). A process-oriented approach to culture: Theoretical and methodological issues in the study of culture and motivation. In F. Salili & R. Hoosain (Eds.), *Teaching, learning, and motivation in a multicultural context* (pp. 33–65). Greenwich: Information Age Publishing.

Zusho, A., Pintrich, P. R., & Coppola, B. (2003). Skill and will: The role of motivation and cognition in the learning of college chemistry. *International Journal of Science Education*, 25(9), 1081-1094.

Zusho, A., Pintrich, P. R., & Cortina, K. S. (2005). Motives, goals, and adaptive patterns of performance in Asian American and Anglo American students. *Learning and individual Differences,* 15(2), 141-158.

Matrix of model combinations between the motivation beliefs subscales and learning strategies subscales of the Motivated Strategies for Learning Questionnaire

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

CURRICULUM VITAE

Ingmar Jerome Rotgans was born on December 10, 1976 in Tübingen, Germany. He completed his secondary education in 1995 at the Gymnasium Garenfeld, Germany after which he commenced his studies in The Netherlands. He graduated with a Bachelor of Science in Maritime Operations and Naval Engineering from Hogeschool Zeeland (Maritiem Instituut "De Ruyter") in 2001. After his graduation, and a brief time in the Royal Netherlands Navy, he worked at the Maritime Institute "De Ruyter" where he developed maritime master programs and coordinated a national e-learning project for maritime officers in the Dutch merchant navy. In 2004 he received his Master of Science in Integrated Quality Safety and Environmental management from the University of Bradford in the United Kingdom. In 2005 Jerome moved to Singapore where he started to work at Republic Polytechnic's Centre for Educational Development and later at the Office of Academic Affairs. Besides teaching, he headed the Centre's curriculum group and engaged in academic research around problem-based learning. He now holds a senior academic position and is chair of research at the Centre for Educational Development.

PUBLICATIONS

Rotgans & Schmidt (in press). *Examination of the context-specific nature of self-regulated learning*. Educational Studies.

Rotgans & Schmidt, (2008). Cross-cultural validation of self-regulated learning in Singapore. In O.S. Tan, D.M. McInerney, A.D. Liem, & A. Tan (Eds.), *Volume 7 of Research in Multicultural Education and International Perspectives, "What the West can learn from the East: Asian Perspectives on the Psychology of Learning and Motivation*" (pp.245-266). Information Age Publishing.

PRESENTATIONS

Rotgans & Schmidt, (2009). Situational interest, task engagement, and academic achievement in an active learning environment. Paper presented at the annual meeting of the American Educational Research Association (AERA), San Diego.

Rotgans & Schmidt, (2008). *Situational interest, learning, and achievement in problem-based learning: A pilot study*. Paper presented at the Asian-Pacific Educational Research Association (APERA) Conference, Singapore.

Rotgans & Schmidt, (2008). *Measuring self-regulation, motivation, and academic achievement.* Paper presented at the annual meeting of the American Educational Research Association (AERA), New York City.

Rotgans & Schmidt, (2008). *Examination of the context-specific nature of self-regulated learning*. Paper presented at the 15th International Learning Conference, Chicago.

Rotgans (2005). *Implementing concept learning in modularized problem-based learning curricula*. Paper presented at the Conference of the International Society for the Scholarship of Teaching and Learning, Vancouver.

Rotgans (2005). Concept learning as integral part of Republic Polytechnic's problem-based learning curriculum. In F.E.H. Tay, T.S. Chuan, & S.Han-Ming (Eds.) *Proceedings of the International Conference on Education 2005*. National University of Singapore, Singapore.

Rotgans (2003). *Problem-based learning in maritime education and training*. Paper presented at the International Workshop on Problem Based Learning in Maritime Education and Training, University of Izmir, Turkey.