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Self-regulated Learning and Academic Achievement of Hong Kong Secondary School Students

ESTHER SUI-CHU HO
Department of Educational Administration and Policy,
The Chinese University of Hong Kong

Education aims to enable students not only to acquire knowledge but also to become capable and enthusiastic lifelong learners. Prior research has found that learning is more likely to be effective where a student plays a proactive role in the learning process. Such a proactive process, including learning on students' own initiative and strategies, is often described as "self-regulated learning" (SRL). The present study aims at investigating SRL in Hong Kong students as compared with students in other countries that participated in the first cycle of PISA (Programme for International Students Assessment) study. Using Hierarchical Linear modeling, the study also investigates the relationships between SRL and academic performance of 15-year-old students in Hong Kong. The findings suggest that most of the SRL constructs are positively related to academic achievement in reading, mathematics, and science domains in Hong Kong students. Particularly, the results show that control strategies *and* self-efficacy *appears to be the two most important learning strategies associated with performance in all three domains; but* instrumental motivation *and* memorization *have negative associations with mathematical and scientific literacy performances. Although most of the SRL indices are found to have positive relation with academic achievement, it is interesting to find that Hong Kong students use SRL strategies far less frequently than do students in other countries in PISA except* competitive strategies. *If educating students to self-regulate their own learning and to become intrinsically motivated to learn is crucial for the Hong Kong educational reform, further studies should be conducted to find out how*

learning environment in Hong Kong can be adjusted to help students obtain this goal.

Education systems aim to enable students not only to acquire knowledge but also to become capable and enthusiastic lifelong learners (Organisation for Economic Co-operation and Development, 2003). Prior research has found that learning is more likely to be effective where a student plays a proactive role in the learning process. Such a proactive process, including learning on students' own initiative and strategies, is often described as "self-regulated learning" (SRL).

Among various theoretical orientations, a common conceptualization of a self-regulated learner is someone who is meta-cognitively, motivationally, and behaviorally proactive in his or her own learning (e.g., Zimmerman, 1986, 1989b, 1990). Instead of relying on the help from teachers or parents, self-regulated learners initiate and direct their own efforts to acquire knowledge and skills (e.g., Zimmerman, 1989a). Meta-cognitively, they plan, set goals, self-monitor and self-evaluate their learning (e.g., Corno, 1986, 1989). Motivationally, they have adaptive beliefs and attitudes that drive them to engage in and endure at academic tasks. Particularly, they are high in self-efficacy and encompass intrinsic task interests (e.g., Schunk, 1986).

Literature Review

Evolving Definitions of SRL — A Personal Attribute to a Social Event

As the research in SRL evolved over the past 30 years, instead of viewing it merely as a personal quality or an individual attribute — "a relatively enduring attribute of a person that predicts future behavior" (Winne & Perry, 2000, p. 534), increasing emphasis has been placed on how the social context, or the environment, interacts with the individual in affecting the attainment of SRL. This perspective highlights the importance of viewing SRL as not purely an individual skill or knowledge, but also an event that involves a social aspect of interactions with peers and teachers (e.g., Patrick & Middleton, 2002; Pressley, 1995).

The social-cognitive view, for example, sees a "triadic reciprocity" among cognitions, behaviors, and environments (Zimmerman, 1989a). According to social cognitive theorists, SRL is not merely determined by personal processes; instead, these processes are reciprocally influenced by the environment and behavioral events. They advocate that self-efficacy is a key variable that affects SRL (Bandura, 1986; Schunk, 1986; Zimmerman, 1986), and that students with high self-efficacy have better learning strategies, more self-monitoring of the learning outcomes, higher task persistence, and higher academic achievement.

Sociocultural approaches, similarly, see that the social context and social interactions play a crucial role in the accomplishment of self-regulation (McCaslin & Hickey, 2001; Yowell & Smylie, 1999). They argue that the development and preservation of self-regulation occurs through reciprocal interactions among individuals and the social context. Moreover, co-regulation (McCaslin & Good, 1996), which emphasizes the shared responsibility among teachers and students for establishing and maintaining relationships as they coordinate multiple goals through scaffolding supports, is also seen as essential in sociocultural approaches of SRL (McCaslin & Hickey, 2001). Autonomy is thus seen as a relationship instead of an individual attribute, and whether or not a student self-regulates depends on whether or not he or she is given the opportunities and supportive context to do so (Perry, VandeKamp, Mercer, & Nordby, 2002).

The Classroom Environment and SRL

With the increased emphasis on environmental influences on students' SRL, recent research has focused on how the learning context, particularly the classroom environment, instructional strategies, and teacher-student interactions, affects students' SRL.

Contributing to the debate on the effects of different instructional approaches on children's learning and motivational development, an empirical study by Stipek, Feiler, Daniels, and Milburn (1995) provided insight on the influence of contextual environment on SRL. The study investigated the effect of instructional context on children's achievement, self-perceptions, self-efficacy, preference for challenge, dependency, pride in accomplishment and anxiety. These constructs were compared in two different types of preschools or kindergartens: didactic,

teacher-directed classrooms and child-centered classrooms (Stipek et al., 1995). Teacher-directed classrooms were characterized as high in *academic emphasis*, which included "basic skills focus" (focusing on prepared materials such as worksheets and instructions that were not connected to children's everyday experiences), "performance pressure" (the degree to which teachers gave negative evaluations, criticized wrong responses, and used punishment to motivate children), and "evaluation stress" (the degree to which teachers gave external evaluations and rewards and made social comparisons). Teacher-directed classrooms were also low on *social climate*, which included "child initiative," in which children are given choices of activities in a play-like atmosphere that encouraged peer interactions; "teacher warmth," with nurturing, accepting, respectful, and responsive teachers; and "positive control," in which the teacher used positive approaches to maintain student engagement. Child-centered classrooms, on the contrary, were high in *social climate* and low in *academic emphasis*. Empirical results showed that children in teacher-directed classrooms outperformed children in child-centered classrooms in achievement tests, but they had significantly lower self-perceived ability and expectations for success, had lower preference for challenge, showed more dependency on adults' instructions, and had higher anxiety and worries about school than children in child-centered classrooms (Stipek et al., 1995). It appears that a balance of the two approaches is a promising avenue for nurturing high achieving students with positive life-long learning attitude.

Using qualitative research methods to investigate how teacher-student interactions can foster young children's SRL, it was found that even kindergarten students can and do engage in SRL when they are given opportunities to engage in open-ended activities, make choices, control challenge, and evaluate themselves and others (Perry et al., 2002). In the same vein, Turner (1995) found that students showed more volitional control, used more strategies, and persisted longer during difficulties in open-ended environments. Paris and Paris (2001) also concluded that it is important to provide open-ended instructional activities and scaffold the student for SRL, while less emphasis should be placed on workbook exercises and routine tasks. Open-ended tasks thus promote thoughtful engagement and provide opportunities for students to make choices, set goals, and gain self-efficacy (Paris & Turner, 1994).

Moreover, it was also found that students demonstrated SRL when teachers created non-threatening and intrinsically motivating learning contexts in which evaluations were made without punitive outcomes, and errors were viewed as opportunities to learn (Perry et al., 2002; Turner et al., 2002). In line with the above, it was suggested that teachers should minimize objective tests (e.g., multiple-choice tests), competitive test scores, and public comparisons of performance which could diminish students' self-efficacy and sense of mastery (Paris & Paris, 2001). When teachers emphasized peer competition, students tend to see classroom tasks as busy work, and engage in activities in superficial manners (Blumenfeld, Hamilton, Bossert, Wessels, & Meece, 1983; Doyle, 1983)

SRL and Academic Achievement in Hong Kong Chinese

The superiority in academic achievement of ethnic Chinese, especially in mathematics, has been documented in many studies (e.g., Chen & Stevenson, 1995; Lapointe, Mead, & Askew, 1992; McKnight et al., 1987; Stevenson, Chen, & Lee, 1993; Whang & Hancock, 1994). This academic superiority has been attributed to a variety of reasons such as parental expectations and behaviors (Chen & Stevenson, 1995; Stevenson et al., 1993), education system, teaching practices (Fuligni & Stevenson, 1995; Stevenson & Lee, 1996), and the cultural values in education (e.g., Ho, 1994).

However, there are very few studies relating SRL and academic attainment in the Chinese. Although the importance of SRL in predicting higher academic achievement has been well recognized in many Western studies (e.g., Pintrich & De Groot, 1990; Pressley, 1986; Zimmerman, 1990; Zimmerman & Martinez-Pons, 1990), it should not be assumed that it would inevitably affect academic achievement in the Chinese to the same extent, given the very different cultures and socialization processes.

Evidence shows that there are motivational and cognitive differences across cultural groups. While academic performance has been found to improve when students in the United States were trained to have higher self-efficacy beliefs (Schunk, 1994), Chinese students have been found to have lower self-perceptions of competence and lower levels of self-efficacy than students in the United States (e.g., Eaton & Dembo, 1997; Whang & Hancock, 1994), even though they

showed higher academic achievement than American students. Eaton and Dembo (1997) have further found that students' fear of the consequence of academic failure better explained Asian-American's academic performance than did self-efficacy.

One piece of empirical evidence found that the positive relationship between academic attainment and SRL strategy use (Pintrich & De Groot, 1990; Pressley, 1986; Zimmerman & Martinez-Pons, 1990) was not replicable in a Hong Kong Chinese sample (Rao, Moely, & Sachs, 2000). No significant relationship was found between either cognitive or motivational scales of SRL and academic attainment in these Secondary 4 and 5 Hong Kong students, supporting that theories of SRL developed in the West may not be able to account for academic attainment in Chinese students, and that cultural factors should be taken into account when considering the importance of motivational factors in predicting academic achievement.

Empirical research on the possible effects of the Hong Kong education system, cultural values, socialization and motivational beliefs on SRL, and the effect of SRL on academic attainment in Hong Kong students is lacking. Research should be conducted to clarify whether SRL is as important a factor affecting academic achievement as it is in Western cultures; why it is or why it is not; and most importantly, what are the variables that could promote life-time learning as well as the overall well-being of students in Hong Kong.

Using the data from the first cycle of PISA study, the present study aims at investigating the nature of SRL in Hong Kong students as compared with students in other countries. It will also investigate the relationships between SRL and academic performance of students in Hong Kong.

Method

Measuring SRL

Forty-four items were used in the Cross-Curriculum Competencies questionnaire in the PISA study. Students were asked to indicate the extent to which they agreed with statements like "I am certain I can understand the most difficult material presented in readings," "I have always done well in Mathematics," and "I like to try to be better than other students" on a 4-point Likert scale. These items collect information on nine constructs: control strategies, effort and persistence,

memorization, self-efficacy, control expectation, elaboration strategies, instrumental motivation, competitive learning, and cooperative learning (Table 1).

Table 1. Definitions and Reliabilities of the SRL Constructs and Competitive Learning

Index	Definition	Sample items	Reliability coefficients
Control strategies	Indicates the extent of executive control over one's learning	• I start by figuring out when exactly I need to learn • I force myself to check to see if I remember what I have learned	.76
Effort and persistence	Indicates the importance of hard work in learning	• I keep working even if the material is difficult • I put forth my best effort	.83
Self-efficacy	Indicates the ability perceived by oneself	• I am certain I can understand the most difficult material presented in readings • I am certain I can master the skills being taught	.68
Control expectation	Indicates the confidence in whether a learning task is manageable	• When I sit down to learn something really hard, I can learn it • If I decide not to get any bad grades, I can really do it	.73
Instrumental motivation	Indicates the importance of realistic consideration in motive to learn	• To increase my job opportunities • To ensure that my future will be financially secure	.86
Elaboration strategies	Indicates the importance of relating things being learned to prior knowledge	• I try to relate new material to things I have learned in other subjects • I try to understand the material better by relating it to things I already know	.81
Memorization	Indicates the importance of memorization and reciting when one learns	• I try to memorize as much as possible • I memorize all new material so that I can recite it	.76
Competitive learning	Indicates the importance of competition with others as a driving force to learn	• I like to try to do better than other students • Trying to be better than others makes me work well	.72
Cooperative learning	Indicates the extent to which a student prefers to work with others when learning	• I like to work with other students • I learn the most when I work with other students	.64

Database

Data for the present study is from the first cycle of the Programme for International Student Assessment (PISA), an international study developed by the Organisation for Economic Co-operation and Development (OECD). Hong Kong joined the PISA in 2000 and collected the data of the main study in January to February 2002. A total of 4,405 fifteen-year-old students from 140 Hong Kong secondary schools were collected. These students were spread across six grades in the secondary schools but most of them (61%) were from Secondary 4, about 17% were from Secondary 5, and 21% from Secondary 1 to Secondary 3. The sample had approximately the same proportion of boys and girls.

Analysis

Hierarchical Linear modeling (HLM; see Bryk & Raudenbush, 1992) was used to investigate the associations of SRL and students' literacy performance. The background variables of student and school level were included and controlled for, in order to find out the relationship between SRL and students' literacy performance after controlling for these variables. Student background variables included grade, gender, socio-economic status (SES), parent education, immigrant status, family structure, and number of siblings. School level background variables included school intake, student composition in terms of school mean parent SES, school mean parent education, and the percentage of nuclear families.

Results and Discussion

SRL of Hong Kong 15-year-olds from an International Perspective

Nine indices of SRL were constructed and measured in the first cycle of PISA study. The indices were scaled using a weighted maximum likelihood estimate method (Warm, 1985). A total of 33 countries/regions completed the SRL questionnaire. The indices were standardized with the average scores across the participated OECD countries/regions set at 0 and the standard deviations set at 1. A positive value on the index indicates that the use of these strategies is more frequent in that country/region than the OECD average.

Overall, Hong Kong has the second to sixth lowest values in the following indices: control strategies, effort and persistence, self-efficacy, control expectation, elaboration strategies, and instrumental motivation. Hong Kong has average values in memorization and cooperative learning indices. Most remarkably, Hong Kong has the highest competitive learning index among all the participating countries/regions (Table 2).

The index of *control strategies* measures the extent to which students executive control over one's learning. *Effort and persistence* measures the perception of students concerning the importance of hard work in learning. *Self-efficacy* indicates the ability perceived by oneself. *Control expectation* indicates the confidence of students in whether a learning task is manageable. *Instrumental motivation* indicates the importance of realistic consideration in motive to learn. *Elaboration strategies* measures students' perception on the importance of relating things being learned to prior knowledge. *Memorization* measures student's perception on the importance of memorization and reciting when one learns. *Competitive learning* measures to what extent students perceive the importance of competition with others as a driving force to learn. *Cooperative learning* measures to what extent students prefer to work with others when learning.

The control strategies indices of Hong Kong and Republic of Korea are –0.28 and –0.44, which ranked the 6th and 3rd lowest respectively, whereas the highest mean values are those of Albania, Chili, and Austria, which are 0.45, 0.41, and 0.40 respectively. This suggests that Hong Kong students have relatively little control over their learning tasks. The effort and persistence indices of Hong Kong and Republic of Korea are the 2nd lowest and the lowest, –0.25 and –0.39. The three highest values range from 0.54 to 0.61. The memorization index of Hong Kong is about the OECD average. It contrasts with the common perception that Hong Kong students use memorization extensively. In terms of the self-efficacy index, Thailand, Republic of Korea, and Hong Kong are the lowest. Thailand and Hong Kong also have the lowest control expectation index. The elaboration strategies index of Hong Kong is –0.21 whereas the highest value is 0.57. This suggests that Hong Kong students seldom relate what is being learned to their prior knowledge. They learn things in an isolated fashion. For the instrumental motivation index, all the Asia-Pacific participants obtained the lowest mean values, ranging from –0.18 to –0.42 whereas the

Table 2. Mean Scores of the Nine Self-regulated Learning Indices Across Different Countries/Regions in PISA 2000

	Control strategies	Effort & persistence	Memorization	Self-efficacy	Control expectation	Elaboration strategies	Instrumental motivation	Competitive learning	Cooperative learning
Albania	0.45	0.61	0.82	0.28	0.17	0.48	0.45	0.47	0.24
Australia	0.02	0.02	0.14	0.10	–0.05	0.07	–0.22	0.10	0.04
Austria	0.40	0.18	–0.03	0.20	0.03	0.16	0.21	–0.19	–0.10
Belgium	0.14	0.05	0.06	–0.01	–0.01	–0.16	0.02	–0.38	–0.15
Brazil	0.22	0.40	0.22	0.24	0.23	0.47	0.42	–0.03	0.47
Bulgaria	0.19	0.13	0.21	0.07	0.33	0.39	0.23	0.31	0.09
Chili	0.41	0.59	0.00	0.45	0.49	0.44	0.39	0.49	0.54
Czech Republic	0.27	–0.13	–0.06	–0.20	–0.13	0.10	0.08	0.14	–0.05
Denmark	–0.23	–0.05	0.05	–0.03	0.09	–0.12	–0.08	0.19	0.50
Finland	–0.47	–0.03	–0.10	–0.16	–0.08	–0.15	–0.02	–0.25	0.04
Germany	0.24	0.07	0.03	0.06	–0.17	0.05	0.07	–0.07	–0.21
Hong Kong	**–0.28**	**–0.25**	**0.07**	**–0.37**	**–0.37**	**–0.21**	**–0.18**	**0.67**	**0.05**
Hungary	0.21	0.24	0.89	0.01	0.24	0.15	0.45	0.10	–0.34
Iceland	–0.36	–0.09	–0.27	0.04	–0.24	–0.24	0.04	0.01	–0.29
Ireland	0.07	–0.03	0.27	–0.10	–0.06	–0.09	–0.11	0.15	0.22
Israel	0.30	0.24	0.13	0.40	0.25	–0.03	–0.18	0.18	–0.05
Italy	0.23	0.04	–0.68	0.01	0.23	–0.11	–0.13	0.00	0.20

Table 2 (Cont'd)

	Control strategies	Effort & persistence	Memorization	Self-efficacy	Control expectation	Elaboration strategies	Instrumental motivation	Competitive learning	Cooperative learning
Korea, Republic of	–0.44	–0.39	–0.15	–0.42	–0.14	–0.03	–0.42	–0.14	–0.85
Latvia	–0.12	–0.25	0.17	–0.16	–0.01	0.05	0.05	0.22	0.24
Liechtenstein	0.14	0.09	–0.09	0.07	–0.01	–0.01	–0.08	–0.21	–0.02
Luxembourg	0.04	–0.02	–0.09	–0.10	–0.19	–0.12	0.13	–0.18	–0.41
Macedonia	0.33	0.54	–0.25	0.36	0.47	0.57	0.23	0.60	–0.04
Mexico	0.16	0.19	0.06	0.35	0.39	0.33	0.08	0.54	0.22
Netherlands	–0.07	–0.15	–0.02	–0.09	–0.19	–0.19	–0.08	–0.25	0.14
New Zealand	0.07	–0.02	0.24	0.06	–0.06	0.10	–0.21	0.29	0.29
Norway	–0.58	–0.16	–0.60	–0.04	0.16	–0.22	–0.07	–0.03	0.17
Portugal	0.19	0.17	0.03	–0.07	–0.25	0.17	0.29	–0.22	0.59
Russian Federation	0.08	–0.04	0.36	–0.10	0.29	0.14	0.40	0.13	–0.23
Sweden	0.03	0.02	0.17	0.19	0.18	0.01	0.31	–0.01	–0.21
Switzerland	0.11	0.01	–0.02	0.06	–0.01	0.09	–0.05	–0.26	–0.01
Thailand	–0.38	–0.17	–0.07	–0.44	–0.50	0.02	0.10	0.32	0.32
United Kingdom	0.32	0.28	0.36	0.07	0.03	0.20	0.16	0.18	0.39
United States	–0.08	–0.08	0.08	0.07	0.07	0.01	–0.42	0.27	0.35

highest value is 0.45. Hong Kong has the highest mean competitive learning index, 0.67, among the 33 countries/regions. On the contrary, most of the European countries, including Finland, have the lowest mean values in this index. Hong Kong and Finland have average values in cooperative learning index, which are 0.05 and 0.04 respectively. Republic of Korea has the lowest mean value in the cooperative learning index. These figures suggest that Hong Kong students seldom use these learning strategies except for competitive learning strategies. In contrast, Finland is the 3rd lowest in the competitive index. It is worth noting that Finnish students have achieved outstanding results in reading without perceiving learning as competitive.

As shown in Table 2, Republic of Korea has negative values in all the indices. It means that Korean students reported using all the strategies less frequently than the OECD averages. This is an interesting case in light of Korean students' high performance in the three domains of reading, mathematics, and science. Hong Kong has a pattern similar to that of Korea except in memorization, competitive learning, and cooperative learning. It is interesting to note that students from both Australia and New Zealand reported using memorization strategies more than Hong Kong and Korean students did. This contradicts the common perception that Asian students learn by rote.

Another prominent characteristic of Hong Kong students is their predominant use of competitive learning strategies. For Hong Kong, the competitive learning index is 0.67, which is the highest among the participating countries/regions, followed by Macedonia (0.60), Mexico (0.54), and Chile (0.49).

As shown in Table 2, the relationship between competitive learning and cooperative learning cannot be stated easily. For instance, a high competitive learning index is likely to be accompanied by a low cooperative learning index in Republic of Korea and Hong Kong. But this relationship is less prominent in Australia. In contrast, the two indices are similar in New Zealand. This indicates that there are some other factors affecting the choice of learning strategies.

Correlation Analysis Among SRL Indices

Table 3 shows the correlation coefficients among self-regulated indices. Instrumental motivation and cooperative learning indices have low

Table 3. Correlation Coefficients Among SRL Constructs

	Control strategies	Effort and persistence	Memorization	Self-efficacy	Control expectation	Elaboration strategies	Instrumental motivation	Competitive learning
Effort and persistence	0.75**							
Memorization	0.63**	0.61**						
Self-efficacy	0.67**	0.64**	0.47**					
Control expectation	0.66**	0.62**	0.47**	0.69**				
Elaboration strategies	0.69**	0.61**	0.41**	0.62**	0.59**			
Instrumental motivation	0.33**	0.32**	0.36**	0.25**	0.29**	0.24**		
Competitive learning	0.45**	0.44**	0.36**	0.41**	0.46**	0.35**	0.34**	
Cooperative learning	0.31**	0.31**	0.20**	0.26**	0.25**	0.28**	0.07**	0.37**

** $p < .01$

correlations with other indices, ranging from 0.07 to 0.37. However, it should be noted that some indices are highly correlated with one another. For instance, the control strategies index is highly correlated with the effort and persistence, memorization, self-efficacy, control expectation, and elaboration strategies indices. The correlations are 0.75, 0.63, 0.67, 0.66, and 0.69 respectively. Similarly, effort and persistence and self-efficacy are also highly correlated with other indices. It is not surprising to find high correlations among these indices. In fact, they make sense both intuitively and theoretically. A high control strategies index suggests that a person accesses and uses learning strategies more frequently. Apart from general control strategies, one might use elaboration and memorization strategies as well. As a result of access to a repertoire of strategies and effective use of them, one is likely to be more confident in one's learning and have a better sense of control. That is, one is likely to have high self-efficacy and control expectation indices. Overall, one-third of the correlation coefficients were high (> 0.5). The relationship between "instrumental motivation," "competitive learning," "coorperative learning" and other SRL constructs is moderate with correlation coefficients around 0.3.

Correlation Analysis Among SRL Indices and Literacy Performance

Table 4 shows the correlation coefficients among SRL indices and literacy performance. Although all correlation coefficients are significant, they were all smaller than 0.3. Across the three performance domains, control strategies, effort and persistence, self-efficacy, control expectation, and competitive learning had the largest correlation coefficients with literacy performance. Memorization, elaboration strategies, instrumental motivation, and cooperative learning had the lowest correlation coefficients with the three domains of literacy performance. Given the large sample size of the HKPISA project, it is easy to get a significant correlation coefficient for each of the indices with students' academic achievement. Therefore, the final analysis attempts to use HLM model to examine the relative contribution of different types of SRL strategies on the three domains of achievement.

Table 4. Correlation Coefficients Among Self-regulated Indices, Literacy Performance and Competitive Learning in Hong Kong Students

	Combined reading literacy	Mathematical literacy	Scientific literacy
Control strategies	0.26**	0.25**	0.27**
Effort and persistence	0.24**	0.21**	0.25**
Self-efficacy	0.22**	0.21**	0.24**
Control expectation	0.21**	0.20**	0.23**
Instrumental motivation	0.12**	0.08**	0.10**
Elaboration strategies	0.17**	0.18**	0.20**
Memorization	0.20**	0.15**	0.17**
Competitive learning	0.23**	0.21**	0.22**
Cooperative learning	0.12**	0.08*	0.11**

* $p < .05$; ** $p < .01$

Multi-level Analysis of SRL and Literacy Performance

In the final analysis, a multi-level regression model was constructed to investigate the associations of SRL indices and reading literacy (Table 5). Student and school level background variables were included and controlled for, in order to find out the importance of SRL in literacy performance after controlling for these variables.

Regarding the association between the nine self-regulated coefficients and reading, results indicate that seven indices appear to have a significant impact on reading. Control strategies appears to be the most important learning strategy in reading. Elaboration strategies has a marginally significant negative association with students' reading outcomes, whereas instrumental motivation and memorization indices have no significant association with the reading literacy scale. Competitive and cooperative learning also predict better reading achievement.

For literacy performance in mathematics, control strategies, self-efficacy, and competitive learning have significant positive associations with mathematical literacy, whereas instrumental motivation and memorization have significant negative associations with mathematical performance. On the other hand, in the science domain, control strategies, effort and persistence, self-efficacy, competitive learning, and cooperative learning all have significant

Table 5. Multi-level Analyses of the Relationship Between SRL Indices and Reading, Mathematical, and Scientific Literacy Scales After controlling for Student and School Background Factors

	Reading		Mathematics		Science	
	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*
Control strategies	5.1***	0.79	5.2***	0.78	5.3***	1.03
Effort and persistence	2.6***	0.58	2.1	1.91	4.2***	1.10
Self-efficacy	3.9***	0.50	4.3**	1.63	3.3*	1.51
Control expectation	0.8***	0.15	1.2	0.89	0.9	0.90
Instrumental motivation	–0.5	0.54	–2.7**	0.85	–1.3	0.82
Elaboration strategies	–1.4*	0.67	1.9**	0.70	–0.16	1.14
Memorization	–1.7	0.90	–5.3***	1.54	–4.3**	1.35
Competitive learning	3.5***	0.47	4.3***	0.57	2.7*	1.22
Cooperative learning	1.3***	0.34	0.9	1.00	3.3***	0.33
Between-school variance	590***		666***		431***	
Within-school variance	3091***		3889***		3394***	
Between-school variance explained	0.77		0.83		0.83	
Within-school variance explained	0.15		0.18		0.15	
Total variance explained	0.47		0.48		0.47	

Note: *p < .05; **p < .01; ***p <.001

positive associations with scientific literacy, whereas memorization has a significant negative association with this domain of performance.

These findings are different from the previous study of Rao et al. (2000) which found that there was no significant relationship between either cognitive or motivational scales of SRL and academic attainment in the Secondary 4 and 5 students in Hong Kong. These differences might be due to the differences of SRL indices used and the differences in analytical tools in the two studies. First, the indices used by Rao et al. (2000) are self-efficacy, intrinsic value, test anxiety, strategy use and method scale, self-concept in mathematics ability, ego-involved motivation in mathematics, task-involved motivation in mathematics, and parental perceptions. Of these indices, only one construct — "self-efficacy" was used in the present study (which is based on the OECD scales of SRL). Moreover, Rao et al.'s scales are more subject-specific (i.e., related only to mathematics) whereas the OECD scales are more general and not subject-specific.

Second, the sample size of Rao et al.'s (2000) study is only 94 students, which is relatively small; Rao et al.'s study can only use

multiple regressions as their analytical tools. In PISA study, the sample size is more representative and the 4,405 student data are nested within 140 schools. Given such a delicate data structure, multi-level modeling can be used to examine the association between SRL and achievement. In brief, the prior study by Rao et al. is not comparable to the present study in terms of the SRL indices constructed and the analytical tools used in the two studies. Since the sample of the present study is representative for the Hong Kong secondary schools and the SRL indices is more general to be applied to different subjects, the findings should be more reliable. The results in the present study are more informative for further study of the impact of the general SRL in the local schooling context.

Conclusion

Consistent with previous studies (e.g., Pintrich & De Groot, 1990; Zimmerman & Martinez-Pons, 1990), the results in this study support that SRL is positively related to academic achievements in reading, mathematics, and science domains in Hong Kong students.

Particularly, the results in the current study show that control strategies and self-efficacy appear to be the two most important learning strategies associated with performance in all three domains. It is, however, interesting to find that instrumental motivation and memorization have significant negative associations with literacy performance in both mathematics and science domains. It appears that students who are instrumental in learning or those who try to memorize as much as possible are more likely to obtain a worse score.

Although SRL is found to have a positive relation with academic achievement, it is very interesting to find that at a cultural level, Hong Kong students use SRL strategies far less frequently than do students in other countries (obtaining the second to the sixth lowest mean values among the participating countries/regions), yet they obtain very high scores in all domains of literacy performance. These results have the following implications.

First, other factors apart from SRL might contribute to the outstanding achievement of Hong Kong students. Due to differences in cultural values and socialization processes, self-efficacy and other SRL strategies might be less important a factor affecting academic

achievement of students in Hong Kong. For example, parental expectations (Chen & Stevenson, 1995; Stevenson et al., 1993), education system, teaching practices (Fuligni & Stevenson, 1995; Stevenson & Lee, 1996), and the cultural values in education (e.g., Ho, 1994) have been proposed to affect academic achievement in Chinese. Empirical evidence for the above propositions is however still scarce. Further investigations should be conducted to obtain empirical evidence for other possible factors at both cultural and individual levels that could contribute to Hong Kong students' academic performance.

Second, the very low mean scores of self-regulated indices of Hong Kong suggests that there is much room for SRL skills to be acquired and developed in Hong Kong students. With previous studies suggesting that a competitive learning environment could diminish students' SRL (e.g., Blumenfeld et al., 1983; Doyle, 1983; Paris & Paris, 2001), it is possible to attribute Hong Kong students' low score in SRL to their highly competitive learning style. With the highly competitive learning environment, Hong Kong students might be highly extrinsically motivated, aiming at performing well and obtaining higher grades than others instead of understanding the learning contents. Although it appears that such competitive learning style does predict better literacy performance, it could at the same time diminish the students' ability to self-regulate their learning and thus, in the long run, lower their ability to pursue their own knowledge. The goal of education is not to produce individuals who can only obtain high scores, but to train them to pursue their own knowledge life-long. Educating students to self-regulate their own learning and become intrinsically motivated to learn is thus crucial. Further studies should be conducted to find out how the classroom environment in Hong Kong can be adjusted to help students obtain this goal.

References

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Blumenfeld, P., Hamilton, V., Bossert, S., Wessels, K., & Meece, J. (1983). Teacher talk and student thought: Socialization into the student role. In J. M. Levine & M. C. Wang (Eds.), *Teacher and student perceptions: Implications for learning* (pp. 143–192). Hillsdale, NJ: Lawrence Erlbaum Associates.

Bryk, A. S., & Raudenbush, S. W. (1992). *Hierarchical linear models: Applications and data analysis*. Newbury Park: Sage.

Chen, C., & Stevenson, H. W. (1995). Motivation and mathematics achievement: A comparative study of Asian-American, Caucasian-American, and East-Asian High school students. *Child Development*, *66*(4), 1215–1234.

Corno, L. (1986). The metacognitive control components of self-regulated learning. *Contemporary Educational Psychology*, *11*(4), 333–346.

Corno, L. (1989). Self-regulated learning: A volitional analysis. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theory, research, and practice* (pp. 111–141). New York: Springer-Verlag.

Doyle, W. (1983). Academic work. *Review of Educational Research*, *53*(2), 159–199.

Eaton, M. J., & Dembo, M. H. (1997). Differences in the motivational beliefs of Asian American and non-Asian students. *Journal of Educational Psychology*, *89*(3), 433–440.

Fuligni, A. J., & Stevenson, H. W. (1995). Time use and mathematics achievement among American, Chinese, and Japanese high school students. *Child Development*, *66*(3), 830–842.

Ho, D. Y. F. (1994). Cognitive socialization in Confucian heritage cultures. In P. Greenfield & R. Cocking (Eds.), *The development of the minority child: Culture in and out of context* (pp. 285–313). Hillsdale, NJ: Lawrence Erlbaum Associates.

Lapointe, A. E., Mead, N. A., & Askew, J. M. (1992). *Learning mathematics*. Princeton, NJ: Educational Testing Service.

McCaslin, M., & Good, T. L. (1996). *Listening in classrooms*. New York: HarperCollins.

McCaslin, M., & Hickey, D. T. (2001). Educational psychology, social constructivism, and educational practice: A case of emergent identity. *Educational Psychologist*, *36*(2), 133–140.

McKnight, C. C., Crosswhite, F. J., Dossey, J. A., Kifer, E., Swafford, J. O., Travers, K. J., & Cooney, T. J. (1987). *The underachieving curriculum: Assessing U.S. school mathematics from an international perspective*. Champaign, IL: Stipes.

Organisation for Economic Co-operation and Development. (2003). *Learners for life: Student approaches to learning — Results from PISA 2000*. Paris: Author.

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

Paris, S. G., & Turner, J. C. (1994). Situated motivation. In P. R. Pintrich, D. R. Brown, & C. E. Weinstein (Eds.), *Student motivation, cognition, and learning: Essays in honor of Wilbert J. McKeachie* (pp. 213–237). Hillsdale, NJ: Lawrence Erlbaum Associates.

Patrick, H., & Middleton, M. J. (2002). Turning the kaleidoscope: What we see when self-regulated learning is viewed with a qualitative lens. *Educational Psychologists, 37*(1), 27–39.

Perry, N. E., VandeKamp, K. O., Mercer, L. K., & Nordby, C. J. (2002). Investigating teacher-student interactions that foster self-regulated learning. *Educational Psychologist, 37*(1), 5–15.

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

Pressley, M. (1986). The relevance of the good strategy user model to the teaching of mathematics. *Educational Psychologist, 21*(1–2), 139–161.

Pressley, M. (1995). More about the development of self-regulation: Complex, long-term, and thoroughly social. *Educational Psychologist, 30*(4), 207–212.

Rao, N., Moely, B. E., & Sachs, J. (2000). Motivational beliefs, study strategies, and mathematics attainment in high- and low-achieving Chinese secondary school students. *Contemporary Educational Psychology, 25*(3), 287–316.

Schunk, D. H. (1986). Verbalization and children's self-regulated learning. *Contemporary Educational Psychology, 11*(4), 347–369.

Schunk, D. H. (1994). Self-regulation of self-efficacy and attributions in academic settings. In D. H. Schunk & B. J. Zimmerman (Eds.), *Self-regulation of learning and performance: Issues and educational applications* (pp. 75–99). Hillsdale, NJ: Lawrence Erlbaum Associates.

Stevenson, H. W., Chen, C., & Lee, S-Y. (1993). Mathematics achievement of Chinese, Japanese, and American children: Ten years later. *Science, 259*, 53–58.

Stevenson, H. W., & Lee, S-Y. (1996). The academic achievement of Chinese students. In M. H. Bond (Ed.), *The handbook of Chinese psychology* (pp. 124–142). Hong Kong: Oxford University Press.

Stipek, D., Feiler, R., Daniels, D., & Milburn, S. (1995). Effects of different instructional approaches on young children's achievement and motivation. *Child Development, 66*(1), 209–223.

Turner, J. C. (1995). The influence of classroom contexts on young children's motivation for literacy. *Reading Research Quarterly, 30*(3), 410–441.

Turner, J. C., Midgley, C., Meyer, D. K., Gheen, M., Anderman, E. M., Kang, Y., & Patrick, H. (2002). The classroom environment and students' reports of avoidance strategies in mathematics: A multimethod study. *Journal of Educational Psychology, 94*(1), 88–106.

Warm, T. A. (1985). *Weighted maximum likelihood estimation of ability in Item Response Theory using test of finite length* (Technical Report CGI-TR-85-08). Oklahoma City, OK: U.S. Cost Guard Institute.

Whang, P. A., & Hancock, G. R. (1994). Motivation and mathematics achievement: Comparisons between Asian-American and non-Asian students. *Contemporary Educational Psychology, 19*(3), 302–322.

Winne, P. H., & Perry, N. E. (2000). Measuring self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation: Theory, research and applications* (pp. 531–566). San Diego, CA: Academic Press.

Yowell, C. M., & Smylie, M. A. (1999). Self-regulation in democratic communities. *Elementary School Journal*, *99*(5), 469–490.

Zimmerman, B. J. (1986). Becoming a self-regulated learner: Which are the key subprocesses? *Contemporary Educational Psychology*, *11*(4), 307–313.

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

Zimmerman, B. J. (1989b). 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-Verlag.

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

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.