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Educational Psychology

An International Journal of Experimental Educational Psychology

ISSN: 0144-3410 (Print) 1469-5820 (Online) Journal homepage: http://www.tandfonline.com/loi/cedp20

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To cite this article: Woon Chia Liu, Chee Keng John Wang, Ying Hwa Kee, Caroline Koh, Boon San Coral Lim & Lilian Chua (2014) College students' motivation and learning strategies profiles and academic achievement: a self-determination theory approach, Educational Psychology, 34:3, 338-353, DOI: 10.1080/01443410.2013.785067

To link to this article: https://doi.org/10.1080/01443410.2013.785067

Educational Psychology, 2014
Vol. 34, No. 3, 338–353, http://dx.doi.org/10.1080/01443410.2013.785067

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College students' motivation and learning strategies profiles and academic achievement: a self-determination theory approach

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(*Received 21 August 2011; final version received 11 March 2013*)

The development of effective self-regulated learning strategies is of interest to educationalists. In this paper, we examine inherent individual difference in self-regulated learning based on Motivated Learning for Learning Questionnaire (MLSQ) using the cluster analytic approach and examine cluster difference in terms of self-determination theory related variables. The sample of the study consisted of 238 junior college students from 12 intact classes. Two adaptive clusters and two maladaptive clusters were uncovered based on the MLSQ, with the adaptive clusters showing better academic grades. Results from the one-way MANOVA showed that the four clusters differed significantly in terms of their needs satisfaction, behavioural regulations, enjoyment, effort and value. The findings supported the importance of needs satisfaction in the development of self-regulated learning behaviour.

Keywords: autonomy-supportive; self-regulated learning; cluster analysis; needs satisfaction; learning styles

Since good learning habits normally predict better academic performance (e.g. Kleijn, van der Ploeg, & Topman, 1994), educators are interested in how productive learning strategies are developed (e.g. Vermunt & Vermetten, 2004). This is a topic of importance and has been discussed from multiple perspectives (e.g. Vermetten, Vermunt, & Lodewijks, 1999). In this paper, we focus on the motivated self-regulated learning framework outlined by Pintrich and De Groot (1990) and seek to understand the inherent individual difference in self-regulated learning adoption from the self-determination theory perspective (SDT; Deci & Ryan, 1985). Specifically, we applied the cluster analytic approach to profile junior college students' motivation and learning strategies and examined the cluster differences in terms of their basic needs satisfaction, behavioural regulation, intrinsic motivation and academic grades. The reason for selecting college students is because the motivated self-regulated learning framework was based on the conceptual model of college student motivation and self-regulated learning developed by Pintrich (1989).

To be successful in a learning situation, students need to have both the 'will' and the 'skill' for learning (Pintrich & De Groot, 1990). The 'will' in learning corresponds to the motivation of the learner, while the 'skill' pertains to the use of strategies that are effective for learning. In essence, effective self-regulation – which

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involves both motivation and effective use of learning strategy – promotes learning performance (Izabela & Marko, 2009; Virtanen & Nevgi, 2010). For example, in terms of motivation, Wolters (1998) suggests that students who sustained their involvement in academic tasks by highlighting the importance of grades or by promising themselves extrinsic rewards may receive a higher course grade than other students who did not use these strategies. In terms of cognitive strategy use, Pintrich and De Groot (1990) also found that higher levels of academic achievement corresponded with greater use of cognitive strategy and self-regulation. In an intervention study, which emphasised both motivation and learning strategies, Camahalan (2006) reported success in her six-week Mathematics Self-Regulated Learning Programme geared at changing students' self-regulation belief system and teaching them learning strategies. The study shows that students in the experimental group had better improvements in the Mathematic Achievement Test and report greater use of self-regulated learning at the end of the intervention period, even though no difference in the Mathematics School Grade was observed. The lack of difference in academic grade is possibly due to the inclusion of other criteria in the grading system (Camahalan, 2006). Nevertheless, Camahalan's findings corroborated with previous evidence on the positive relations between self-regulated learning and academic achievements.

Within a typical class, there will be students who are high achievers and some recognised as low achievers. Differences in academic achievements may vary due to capabilities for motivation regulation and learning strategies adoption. The capacity to self-regulate effectively during learning tasks certainly differs between learners. Self-regulated learners are 'metacognitively, motivationally, and behaviourally active participants in their own learning process' (Zimmerman, 1989, p. 329). Given the associations between high levels of self-determination, intrinsic motivation towards learning task, and higher quality of learning characterised by fuller understanding of the newly acquired information and flexibility in its utilisation (e.g. Rigby, Deci, Patrick, & Ryan, 1992) among high achievers, we examined students' self-regulated learning strategies in relation to characteristics of their self-determination and grades with the aim of better understanding productive learning strategies adoption.

According to SDT, the three innate psychological needs – competence, autonomy, and relatedness – when satisfied yield enhanced self-motivation and well-being, but when thwarted lead to diminished motivation and well-being (Ryan & Deci, 2000). Competence brings about the pursuits of optimal challenge in line with personal capacities and is a 'felt sense of confidence and effectance in action' (Ryan & Deci, 2002, p. 7). Autonomy is related to perceiving that one's action originates from the self (Ryan & Deci, 2002). Finally, relatedness 'concerns the psychological sense of being with others in secure community or unity' (Ryan & Deci, 2002, p. 7). The impact of need satisfaction on motivation in the educational setting were previously studied (e.g. Cox & Williams, 2008; Filak & Sheldon, 2003; Wang, Liu, Koh, Tan, & Ee, 2011), and findings generally concur with the SDT in that need satisfaction has adaptive consequences. For example, Vansteenkiste, Simons, Lens, Sheldon and Deci (2004) found that presenting tasks consistent with satisfaction of basic psychological needs (whether via the content or the context of the task) led to positive learning–related outcomes such as less superficial processing, more deep processing and better performance. As needs satisfaction has been described as being facilitative for successes in self-regulated behaviour, including

that of learning (Deci, Ryan, & Williams, 1996), we pursue this line of research by examining its links with self-regulated learning habits.

The attempt to examine self-regulated learning in the light of variables related to the SDT is purposeful. Self-regulated learning can be thought of as a process, as Zimmerman (1989, p. 2) noted that academic self-regulation is a 'self-directive process through which learners transform their mental abilities into academic skills'. One way of understanding learning behaviour is through a social-cognitive view of motivation and self-regulated learning (Pintrich, 2003), by taking into consideration affordances and constraints that are operating in the local classroom, school, community or cultural context. With this approach, the student is 'represented as an active processor of information whose beliefs and cognition mediated important instructional input and task characteristics' (Duncan & McKeachie, 2005, p. 117). The interplay of individual learners' characteristics, behaviour/task and environmental factors are thought to promote or undermine self-regulated learning (Zimmerman, 1989). In this regard, the availability of conducive environments that support the satisfaction of the students' basic needs could potentially contribute to the promotion of their self-regulated learning adoption.

Past research suggest that students' self-determination towards learning can be promoted by making efforts to satisfy students' basic needs as proposed by SDT. Firstly, works on autonomy-supportive teaching styles suggest that teachers who supports autonomy, for example, by listening, allowing time for independent work and asking questions about what they want to do as they teach, enhance students' intrinsic motivation and internalisation (Reeve, Bolt, & Cai, 1999). Sierens, Vansteenkiste, Goossens, Soenens and Dochy (2009) suggest that when help, instructions and expectations are provided in an autonomously supportive way to the students, there is a better likelihood that they would self-evaluate, plan their study activity and think of themselves as learners. Similarly, need satisfaction in terms of social relatedness and competence also seems to benefit self-regulated learning. Young (2005) found that faculty who promotes class interaction, provides supportive feedback and adopts clear goals that emphasise learning over grades increase intrinsic motivation and the use of self-regulated learning strategies. More recently, Moos and Honkomp (2011) reported a mixed-method study highlighting the beneficial effects of adventure learning by showing that the motivation components of the Motivated Strategies for Learning Questionnaire (MSLQ) corroborated with reported experience of higher competence and social relatedness. In sum, the prevalence of self-regulated learning may be related to students' need satisfaction, and teachers could in turn intervene more effectively with a better understanding of such relationship at an intra-individual level.

Despite the potential links between self-regulated learning and need satisfaction, very few studies examine the components of MSLQ in relation to SDT variables and academic grades directly at the intra-individual level. To advance knowledge in this area, there is a need to acknowledge that self-regulated learning strategies use and the motivation to use these strategies differ between individuals and understanding how they are related to need satisfaction, behavioural regulations, and intrinsic motivation can bear further insights for effective intervention. In this study, cluster analysis is applied to identify the subgroups of junior college students with homogenous MSLQ learning profile before comparing their differences in the various self-determination variables and academic grades. With this approach,

individuals with similar profiles can be grouped and segmentation strategies can later be developed to increase the effectiveness of interventions (Wang & Biddle, 2001, 2007). Specifically, we speculate that students have different degrees of motivation and cognitive strategies for learning, and understanding how they may be optimised is important.

In summary, the two research questions posed to achieve the goal of understanding self-regulated learning in relation to key variables of SDT from an intra-individual perspective are as follows:

First research question: What are the distinctive profiles of students uncovered based on cluster analysis of their MLSQ scores?

Second research question: What are the adaptive and maladaptive clusters, and how do they differ in terms of their basic needs satisfaction, perceived relative autonomy, intrinsic motivation and grades?

While this is an exploratory study, we predicted that clusters with adaptive self-regulated learning behaviour would score higher in the positive psychological variables within the SDT framework. For completeness sake, we also included the grades as the objective outcome variable, for which we expect clusters with adaptive self-regulated learning behaviour to have better grades.

Method

Participants and procedure

The sample of the study consisted of 238 junior college students from 12 intact classes (i.e. from the same class). The number of students in each class ranged from 9 to 26. There were 117 males and 116 females (excluding five missing data) ranging in age from 16 to 19 ($M = 17.46$, $SD = .60$). The data were collected based on their reflections on specific subject. There were six classes of chemistry, three classes of physics and three classes of economics. Participants were informed that there were no right or wrong answers, assured of the confidentiality of their responses and encouraged to ask questions if necessary. Completion of questionnaires took about 30 min. Permission for the study was granted by the Deans of the school, and no students refused to take part.

Measures

Motivated strategies for learning questionnaire

We used six scales from the MSLQ developed by Pintrich and De Groot (1990) to assess student self-efficacy (five items), task value (six items), test anxiety (four items), rehearsal (four items), elaboration (five items) and metacognitive self-regulation (four items). Students responded on a 7-point scale ranging from 1 (not true at all) to 7 (very true of me). This is a shortened form of the MSLQ with 44 items. We further reduced the items to 28 by matching the Pintrich and De Groot's version with the full version of the MSLQ (Duncan & McKeachie, 2005). Duncan and McKeachie (2005) suggest that the scales can be adapted in modular to suit the need of the researcher. Please see the result section for the psychometric properties of the adapted MSLQ.

Basic needs satisfaction

We used a shortened form of the Basic Need Satisfaction from Liu, Wang, Tan, Koh, and Ee (2009). There were six items for assessing autonomy, and three items each for competence and relatedness. Example item for autonomy was 'I feel that my teacher provides me with choices and options in school'. An example item for relatedness was 'I feel close to my school mates' and a competence item example will be 'In school, I feel pretty competent'. Student indicated the extent to which they thought each item was true of them on a 7-point scale from 1 (not true at all) to 7 (very true).

Academic self-regulation questionnaire

The Academic Self-Regulation Questionnaire developed by Ryan and Connell (1989) was used to assess four types of behavioural regulation in the project work context. This scale is also named as Perceived Locus of Causality (PLOC) in the sport and exercise setting (see Goudas, Biddle, & Fox, 1994). The scale was modified with a stem for all 14 items 'I do my work in project work …'. External regulation (e.g. 'because I'll get into trouble if I don't') and introjection (e.g. 'because I'll feel bad about myself if I didn't') were assessed through four items each. Identification (e.g. 'because I want to improve in project work') and intrinsic motivation (e.g. 'because project work is fun') were measured through three items each. The PLOC also includes amotivation, a three item subscale from the Academic Motivation Scale (Vallerand et al., 1992, 1993). The stem for the items is 'I do my work in project work …'. The three items are: 'but I really do not know why', 'but I do not see why we should have project work', and 'but I really feel I am wasting my time in project work'. A 7-point scale was used (1 = Not at all true, to 7 = Very true).

Intrinsic motivation inventory (IMI)

Three subscales of the Intrinsic Motivation Inventory (IMI) (McAuley, Duncan, & Tammen, 1989) were used to assess students' outcome in terms of enjoyment, effort and value. Enjoyment was assessed using the four items from the IMI interest/enjoyment subscale. An example item was 'I would describe school as very interesting'. Effort was measured by three items (e.g. 'I put a lot of effort into my school work'), and value was assessed by four items (e.g. 'I believe schooling could be beneficial to me'). All the items were measured on a 7-point scale ranging from 1 (not true at all) to 7 (very true).

Grades

Three weeks after the initial data collection, the students' grades for the particular subject were collected from the teachers.

Data analysis

Confirmatory Factor Analyses (CFA) were conducted to examine the validity of the main measures followed by internal consistency tests. EQS for Windows 6.1 was used for the CFAs (Bentler, 2006). Subsequent analyses were performed using IBM

SPSS Statistics 19. Descriptive statistics and Pearson product–moment correlations of the main variables were computed. In the main analysis, cluster analysis was used to identify homogenous groupings of participants with distinct patterns of MSLQ. Following that, we examined the cluster differences in relation to needs satisfaction, RAI, IMI subscales and grades. A one-way MANOVA and follow-up ANOVAs were conducted, followed by *post hoc* tests using Tukey's Honestly Significant Difference (HSD). A separate ANOVA was conducted for academic grades among the clusters.

Results

CFA for the Measures

The measurement model of the MSLQ consisted of 28 indicators representing the six latent variables (task value, self-efficacy, anxiety, rehearsal, elaboration and metacognitive regulation). The overall model fit was satisfactory, scaled $\chi^2[324] = 477.86$, $p < .05$; $\chi^2/df = 1.47$; NNFI = .916, CFI = .928, RMSEA = .046; 90% CI of RMSEA = .037, .054). The internal consistency coefficients for task value ($\alpha = .79$), self-efficacy ($\alpha = .86$), anxiety ($\alpha = .83$), rehearsal ($\alpha = .70$), and elaboration ($\alpha = .75$) and metacognition regulation ($\alpha = .70$) were satisfactory.

CFA on the Basic Needs Satisfaction showed acceptable fit indices (Scaled $\chi^2 = 84.45$, $df = 49$, $p < .001$, NFI = .943, CFI = .957, RMSEA = .056, 90% CI of RMSEA = .035, .075). The internal consistency coefficients for autonomy ($\alpha = .84$), relatedness ($\alpha = .67$), and competence ($\alpha = .83$) were satisfactory. The fit indices for PLOC using CFA were as follows: Scaled $\chi^2 = 148.75$, $df = 64$, $p < .001$, NFI = .914, CFI = .9393, RMSEA = .075, 90% CI of RMSEA = .059, .091. Cronbach's alphas for external regulation, introjection, identification and intrinsic motivation were .83, .80, .67 and .83, respectively. An overall Relative Autonomy Index (RAI) was calculated by weighting each subscale to indicate the level of autonomy in the following way: external regulation (-2) + introjection (-1) + identification $(+1)$ + intrinsic regulation (+2) (see Goudas et al., 1994). A positive RAI score represents more autonomous regulation and a negative RAI score represents more controlled regulation.

The three-factor structure of the IMI yielded fit indices of: Scaled $\chi^2 = 73.10$, $df = 39$, $p < .001$, NFI = .957, CFI = .970, RMSEA = .062, 90% CI of RMSEA = .039, .083. Cronbach's alphas for enjoyment, effort and value were .90, .73 and .85, respectively, for the present sample.

Descriptive statistics

The means, standard deviations and Pearson product–moment correlations coefficients of the main variables are presented in Table 1, the intra-class correlation of the dependent variables are shown in Table 2. In general, the student reported moderately high task value, elaboration, value and effort for their subjects in school. Task value was positively correlated with self-efficacy; both variables also have a positive relationship with elaboration, metacognition self-regulation, needs satisfaction, RAI, enjoyment, effort and value. Rehearsal, elaboration, and metacognition self-regulation were positive related to effort and value. Anxiety was associated with rehearsal and negatively related to needs satisfaction and RAI. From Table 2 and it seems that most of the intra-class correlation coefficients ranged from small

Table 1. Means, standard deviations, Pearson correlation of the key variables of the overall sample.

Subscales	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Intrinsic value	5.02	.91										
2. Anxiety	3.93	1.48	−.06									
3. Self-efficacy	4.26	1.12	.55**	−.31**								
4. Rehearsal	4.36	1.23	.15*	.35**	.07							
5. Elaboration	4.93	.91	.61**	.09	.47**	.41**						
6. Metacognition self-regulation	4.37	1.05	.52**	.05	.47**	.43**	.67**					
7. Needs satisfaction	4.39	.69	.33**	−.42**	.46**	−.11	.11	.13*				
8. RAI	3.24	5.43	.52**	−.31**	.28**	−.12	.21**	.20**	.47**			
9. Enjoy	4.02	1.31	.59**	−.25**	.42**	.04	.28**	.32**	.50**	.69*		
10. Effort	4.74	1.02	.40**	.01	.34**	.30**	.40**	.48**	.18**	.26**	.33**	
11. Value	5.50	1.01	.58**	.05	.30**	.25**	.39**	.34**	.25**	.37**	.42**	.25**

Note: *$p < .05$, **$p < .001$.

Table 2. Intra-class correlations of the dependent variables.

	Intra-class correlation
1. Intrinsic value	.07
2. Anxiety	.14
3. Self-efficacy	.09
4. Rehearsal	.18
5. Elaboration	.01
6. Metacognition self-regulation	.03
7. Needs satisfaction	.06
8. RAI	.25
9. Enjoy	.33
10. Effort	.13
11. Value	.01

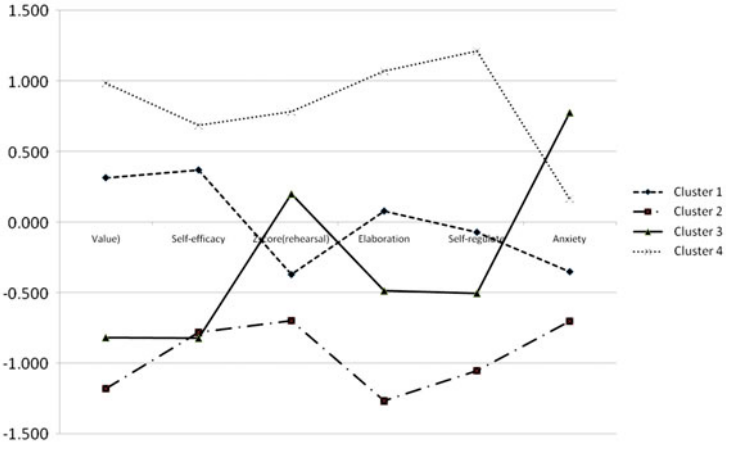

Figure 1. Cluster profiles based on MSLQ.

to medium effect sizes using .05, .10 and .15 as small, medium and large effect (Hox, 2002).

Cluster analysis

Before the cluster analysis, all the main variables were converted to standardised *Z* scores ($M = 0$, $SD = 1$). This is to facilitate interpretation of the results. *Z* scores of ±.5 or greater were used as criteria to describe whether a group scored relatively 'high' or 'low' in comparison to their peers. The results of the hierarchical cluster analysis using Ward's method showed that there were four distinct clusters in terms of MSLQ variables among the students (see Figure 1). The agglomeration schedule and dendrogram were used to decide the number of clusters.

Profiles of the motivated strategies for learning

In the first cluster, we found 91 students (38.4%) with moderate levels of MSLQ profile. This cluster can be labelled as the 'Average Motivated Strategies for Learn-

Table 3. Descriptive statistics of the four- cluster (*Z* scores in parentheses).

	Cluster 1 ($N=91$)		Cluster 2 ($N=30$)		Cluster 3 ($N=58$)		Cluster 4 ($N=57$)	
Variable	*M* (*Z*)	SD	*M* (*Z*)	SD	*M* (*Z*)	SD	*M* (*Z*)	SD
Intrinsic value	5.31 (.31)	.50	3.93 (−1.18)	.69	4.27 (−.82)	.53	5.92 (.98)	.63
Self-efficacy	4.67 (.37)	.78	3.38 (−.78)	.76	3.33 (−.83)	.71	5.02 (.68)	1.14
Anxiety	3.40 (−.35)	1.35	2.88 (−.70)	1.11	5.07 (.77)	.97	4.17 (.16)	1.48
Rehearsal	3.90 (−.37)	1.07	3.50 (−.70)	.98	4.60 (.20)	.93	5.32 (.78)	1.17
Elaboration	5.00 (.07)	.60	3.78 (−1.27)	.80	4.49 (−.49)	.57	5.90 (1.07)	.56
Self-regulation	4.29 (−.07)	.70	3.26 (−1.06)	.83	3.84 (−.51)	.68	5.64 (1.21)	.64

ing' group, and we used this cluster as a reference group (see Table 3). In the second cluster, we found 31 students (13%) with very low intrinsic value, self-efficacy, rehearsal, elaboration and metacognition self-regulation with low anxiety as well. This cluster is labelled as 'Negative Motivated Strategies for Learning' group. In the third cluster, we found a group of 58 students (24.5%) with low intrinsic value, low self-efficacy, elaboration and metacognition self-regulation and with high anxiety. We labelled this cluster as the 'Low Motivated Strategies for Learning and Highly Anxious' group. The final cluster ($N = 57$, 24%) had the highest motivated and learning strategies and average level of anxiety. This cluster was labelled as the 'Positive Motivated Strategies for Learning' group. There were no significant gender differences among the clusters using chi-square tests.

Cluster differences in SDT variables

In order to check the differences between the four clusters in terms of their needs satisfaction, RAI, enjoyment, effort and value, a one-way MANOVA was conducted. The results showed that the four clusters differed significantly in these SDT variables, Pillai's Trace = .558, F (15, 690) = 10.52, $p < .001$, $\eta^2 = .19$. Test of between-subjects effects indicated significant differences existed for all five dependent variables (all ps < .001). The results are presented in Table 4 with the Z scores, means and standard deviations of the dependent variables for the four clusters.

Post hoc tests using Tukey's HSD were conducted to examine the pairwise comparisons between the four clusters. Table 4 shows the results of all pairwise comparisons. In general, Clusters 1 and 4 had the more positive psychological outcomes, compared with Clusters 2 and 3.

Cluster differences in academic performance

In terms of their academic performance, the results of the ANOVA showed significant differences among the four clusters, F (3, 232) = 6.62, $p < .001$, $\eta^2 = .08$ (see Table 4). All pairwise comparisons were significant ($p < .05$), except between Clusters 1 and 4, 2 and 4, and between 2 and 3. Specifically, students in Clusters 1 and 4 had higher marks, compared with students from Clusters 2 and 3.

Discussion

The main purpose of the study was to examine intra-individual differences in self-regulated learning behaviour, in relation to variables from SDT for understanding the adoption of self-regulated learning strategies based on a junior college student sample. In addressing the first research question, four distinct clusters of students were found, of which two (Clusters 1 and 4) had relatively adaptive self-regulated learning characteristics, while the remaining two (Clusters 2 and 3) had maladaptive characteristics. As predicted, the adaptive clusters scored higher in the positive psychological outcomes in terms of SDT variables and had better grades. Taken together, the findings suggest that our snapshot of intra-individual differences in self-regulated learning behaviour correspond well with the expected differences in academic performance, needs satisfaction and other variables grounded in SDT. To address the second research question, characteristics of individual clusters are detailed below to highlight the potential role of SDT variables in explaining differences in self-regulated learning behaviour among junior college students.

Table 4. Comparisons among the four-cluster profiles (*Z* scores in Parentheses).

	Cluster 1 ($N=91$)		Cluster 2 ($N=30$)		Cluster 3 ($N=58$)		Cluster 4 ($N=57$)			
Variable	*M* (*Z*)	SD	*M* (*Z*)	SD	M (Z)	SD	*M* (*Z*)	SD	*F* (15, 690)	η^2
Needs satisfaction	$4.58\ (.27)_a$	.66	$4.37\ (-.03)_a$	.64	$3.97\ (-.62)_b$	.54	$4.54\ (.21)_a$	.74	11.90^{**}	.13
RAI	$4.64\ (.26)_a$	4.88	$1.65\ (-.29)_b$	4.57	$.13\ (-.57)_{bc}$	3.87	$4.89\ (.30)_a$	6.52	12.49^{**}	.14
Enjoy	$4.36\ (.26)_a$	1.18	$3.43\ (-.45)_b$	1.11	$3.14\ (-.67)_b$	1.05	$4.63\ (.46)_a$	1.24	21.59^{**}	.22
Effort	$4.69\ (-.05)_a$	.93	$4.03\ (-.69)_b$	1.01	$4.38\ (-.35)_{ab}$	.74	$5.50\ (.75)_c$	.93	23.02^{**}	.23
Value	$5.77\ (.27)_a$	.72	$4.41\ (-1.08)_b$	.80	$5.12\ (-.37)_c$	.91	$5.99\ (.49)_a$	1.07	28.31^{**}	.27
Marks	$54.43\ (.21)_a$	18.83	$44.95\ (-.32)_{bc}$	17.17	$43.83\ (-.39)_b$	11.47	$54.21\ (.20)_{ac}$	18.18	6.62^{**}	.08

Note: Means in the same row with different subscripts differ significantly at $p<.05$ in the Tukey's HSD comparison.
$^{**}p<.001$.

The two adaptive clusters are Clusters 1 and 4 as indicated by their MSLQ learning profiles. The key differences between these two clusters are their rehearsal, elaboration and self-regulation subscales scores, with Cluster 4 identified as being more adaptive than Cluster 1 given their higher cluster means in those areas. Interestingly, these subscales happen to be under the classification of learning strategies scales in MSLQ. One interpretation is that these two adaptive clusters differ more in learning strategies, but less in terms of motivation. Further analysis of cluster differences in SDT variables below would reveal differences between these two. In terms of academic performance, these two adaptive clusters also showed better academic grades than the two relatively maladaptive clusters identified.

The two maladaptive clusters identified are Clusters 2 and 3, characterised by lower task value and self-efficacy scores in comparison with the adaptive clusters. The key difference between the two maladaptive clusters is in their test anxiety scores, with Cluster 3 showing the highest assessment of test anxiety. While the test anxiety scores for Cluster 2 is lower than Cluster 3, and in fact, lowest among all clusters, it is difficult to judge whether having the lowest anxiety score is better than having the highest anxiety scores. High anxiety undermines performance, while the near complete absence of anxiousness towards performance assessment as seen in Cluster 2 could be signs of apathy. *Post hoc* comparison of cluster profiles in terms of SDT variables would reveal which among the two clusters is more maladaptive.

In examining cluster differences in needs satisfaction, it is clear that Cluster 3 has the lowest needs satisfaction. Unsurprisingly, needs satisfaction are generally higher among the adaptive clusters. *Post hoc* comparison reveals significant difference between the two maladaptive clusters, with Cluster 3 ('Low Motivated Strategies for Learning and Highly Anxious') showing lower needs satisfaction. Since higher test anxiety scores characterises Cluster 3, one interpretation is that lower needs satisfaction correlates with higher test anxiety. In fact, the samplewise r for test anxiety and needs satisfaction is significant at $-.42$. The observation that needs satisfaction corresponds to lower test anxiety is not surprising as the positive link between needs satisfaction and well-being is well-established. Specifically, Black and Deci (2000) also reported that students' perceptions of autonomy support from their instructors, indicative of satisfaction for need of autonomy, predicted a decrease in anxiety regarding a course grade. In short, we conclude in part that anxiousness towards poor performance in academic grades might be alleviated by increasing ones' needs satisfaction, such as through providing autonomy support.

In terms of behavioural regulation, the adaptive clusters clearly had higher RAI scores than the maladaptive clusters, showing stronger autonomous regulation. The higher autonomous regulation in the adaptive clusters suggests that the heightened motivation components within their MSLQ profiles (i.e. intrinsic value and self-efficacy) are indeed adaptive. The fact that students felt autonomous perhaps translates into their heightened perceived intrinsic value regarding learning; and aids in their sense of efficacy towards learning. A heightened sense of autonomy may increase the likelihood of students altering their task approach when less than ideal progress happens. This could inoculate against threats of decreased in self-efficacy (Schunk, 1991). Here again, we find support for citing autonomy support as a possible strategy for developing adaptive self-regulated learning profiles.

In the assessment of differences in intrinsic motivation, the adaptive clusters scored higher in enjoyment, effort and value than the maladaptive clusters. This suggests that those with better learning strategies and motivation assessed through

MLSQ shows more signs of intrinsic motivation. While these findings are not surprising, cluster analysis enables us to examine the nuances within the maladaptive clusters more closely. As earlier alluded to, it is difficult to judge which among the two maladaptive clusters is more maladaptive, as Cluster 3 has undesirably higher test anxiety score, while Cluster 2 has the lowest anxiety – potentially a result of apathy. The results show that members of Cluster 2 reported significantly lower perceived value of their academic effort compared to Cluster 3. It appears that students in Cluster 2, characterised with the lowest perceived test anxiety, do not attach much importance or value to their academic subjects. Based on this, Cluster 2 can be viewed as the most maladaptive cluster alongside their associated least overall motivation orientation and learning strategy use.

Taken together, the results suggest that SDT variables could account for some observed nuances in the self-regulated learning strategies among junior college students. Recently, Lewis and Vialleton (2011) highlighted the links between the role of control and consciousness in learner autonomy and self-regulated learning. They argue that control over the learning process is something learners need to be able to exercise in order to be successful in learning. Judging from the participants' MSLQ profiles, students in the adaptive clusters seem to have a stronger propensity to exercise control over their learning compared with the students from the maladaptive clusters. This we speculate may be explained by the better fulfilment of basic psychological needs among those in the adaptive clusters. Practical implications

The practical implication arising from this study is that teachers should seek to promote basic needs satisfaction in their students. For example, the providence of an autonomy-supportive learning climate could be a suitable way to which self-regulated learning can be nurtured in the classroom. A recent study by Sierens et al. (2009) suggest that teachers should provide help, instructions and expectations in an autonomy-supportive way if they want their students to adopt self-regulated learning behaviour. Since explicit strategy teaching in the classroom is rare, as Kistner et al. (2010) recently found in a study of mathematics teachers' natural classroom behaviour, which revealed that a large amount of strategy teaching took place in an implicit way, providing an autonomy-supportive classroom-learning climate may be more effective. To this end, we refer readers to existing works on teachers' autonomy-supportive behaviour in the classrooms (e.g. Reeve, 2006; Reeve, Bolt, & Cai, 1999; Reeve & Jang, 2006) for further reference. Similarly, the provision of opportunities for interaction between students may be important for fostering social relatedness which may in turn positively influence use of learning strategies and motivation.Future research

In view of the potential relations between MLSQ variables, needs satisfaction, perceived relative autonomy, intrinsic motivation and academic grades, future research could examine the roles of MSLQ act as the mediator and moderator for the relation between SDT variables and academic outcomes. Another interesting question to pursue is to examine whether MSLQ alone is enough to explain academic achievement, or would the inclusion of SDT variables improve the explanatory model, since the present research taking an intra-individual approach yields some interesting findings on the current state of junior college students' self-regulated learning habits, on the basis of differences observed in their SDT variables. 'anxiety was associated with rehearsal, and negatively related to needs satisfaction and RAI.' This would be a good topic for Future Research and could be described in more detail discussing the ways anxiety could be further assessed to determine

why it had a negative relationship to needs satisfaction and RAI. The study did not address the teacher's level of experience, which could be a confounding variable. For example, students were asked to respond to the question: 'I feel that my teacher provides me with choices and options in school.' We do not know whether the teachers' number of years teaching or level of experience had an impact on the number of choices or options made available to the students. Future studies should take into account the teaching experience of the teachers. Finally, future research should consider using multilevel modelling as data are nested in a hierarchical fashion (individual within class) in this study. However, the sample sizes of some classes were too small for a multi-level analysis. A cross-tab chi-square test (cluster by class) was conducted, and we found that 25% of the cells had cases less than 5. For these reasons, a multi-level modelling is not conducted in this study. Lüdtke et al. (2008) suggest that when a small sample of level 1 units (individuals) are sampled from each level 2 (class), the level 2 aggregate measure may be unreliable and result in a biassed estimate of the contextual effect. Hox (2002) recommends at least 30 groups with at least 30 individuals per group.

References

Bentler, P. M. (2006). *EQS 6 structural equations program manual*. Encino, CA: Multivariate Software.

Black, A. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. *Science Education, 84*, 740–756.

Camahalan, F. M. (2006). Effect of self-regulated learning on mathematics achievement of selected Southeast Asian Children. *Journal of Instructional Psychology, 33*, 194–205.

Cox, A., & Williams, L. (2008). The roles of perceived teacher support, motivational climate, and psychological need satisfaction in students' physical education motivation. *Journal of Sport & Exercise Psychology, 30*, 222–239.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum.

Deci, E. L., Ryan, R. M., & Williams, G. C. (1996). Need satisfaction and the self-regulation of learning. *Learning and Individual Differences, 8*, 165–183.

Duncan, T. G., & McKeachie, W. J. (2005). The making of the motivated strategies for learning questionnaire. *Educational Psychologist, 40*, 117–128.

Filak, V. F., & Sheldon, K. M. (2003). Student psychological need satisfaction and college teacher-course evaluations. *Educational Psychology, 23*, 235–247.

Goudas, M., Biddle, S., & Fox, K. (1994). Perceived locus of causality, goal orientations, and perceived competence in school physical education classes. *British Journal of Educational Psychology, 64*, 453–463.

Hox, J. (2002). *Multilevel analysis: Techniques and application*. Mahwah, New Jersey: Lawrence Erlbaum.

Izabela, S., & Marko, P. (2009). The role of students' interests in self-regulated learning: The relationship between students' interests, learning strategies and causal attributions. *European Journal of Psychology of Education, 24*, 545–565.

Kistner, S., Rakoczy, K., Otto, B., Dignath-van Ewijk, C., Büttner, G., & Klieme, E. (2010). Promotion of self-regulated learning in classrooms: Investigating frequency, quality, and consequences for student performance. *Metacognition and Learning, 5*, 157–171.

Kleijn, W. C., van der Ploeg, H. M., & Topman, R. M. (1994). Cognition, study habits, test anxiety, and academic performance. *Psychological Reports, 75*, 1219–1226.

Lewis, T., & Vialleton, E. (2011). The notions of control and consciousness in learner autonomy and self-regulated learning: A comparison and critique. *Innovation in Language Learning and Teaching, 5*, 205–219.

Liu, W. C., Wang, C. K. J., Tan, O. S., Koh, C., & Ee, J. (2009). A self-determination approach to understanding students' motivation in project work. *Learning and Individual Differences, 19*, 139–145.

Lüdtke, O., Marsh, H. W., Robitzsch, A., Trautwein, U., Asparouhov, T., & Muthén, B. (2008). The multilevel latent covariate model: A new, more reliable approach to group-level effects in contextual studies. *Psychological Methods, 13*, 203–229.

McAuley, E., Duncan, T. E., & Tammen, V. V. (1989). Psychometric properties of the intrinsic motivation inventory in a competitive sport setting: A confirmatory factor analysis. *Research Quarterly for Exercise and Sport, 60*, 48–58.

Moos, D. C., & Honkomp, B. (2011). Adventure learning: Motivating students in a Minnesota Middle School. *Journal of Research on Technology in Education, 43*, 231–254.

Pintrich, P. R. (1989). The dynamic interplay of student motivation and cognition in the college classroom. In C. Ames & M. Maehr (Eds.), *Advances in motivation and achievement: Motivation enhancing environments* (pp. 117–160). Greenwich, CT: Jai Press.

Pintrich, P. R. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology, 95*, 667–686.

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

Reeve, J. (2006). Teachers as facilitators: What autonomy-supportive teachers do and why their students benefit. *The Elementary School Journal, 106*, 225–236.

Reeve, J., Bolt, E., & Cai, Y. (1999). Autonomy-supportive teachers: How they teach and motivate students. *Journal of Educational Psychology, 91*, 537–548.

Reeve, J., & Jang, H. (2006). What teachers say and do to support students' autonomy during a learning activity. *Journal of Educational Psychology, 98*, 209–218.

Rigby, C. S., Deci, E. L., Patrick, B. C., & Ryan, R. M. (1992). Beyond the intrinsic-extrinsic dichotomy: Self-determination in motivation and learning. *Motivation and Emotion, 16*, 165–185.

Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology, 57*, 749–761.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*, 68–78.

Ryan, R. M., & Deci, E. L. (2002). An overview of self-determination theory. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3–33). Rochester, NY: University of Rochester Press.

Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist, 26*, 207–232.

Sierens, E., Vansteenkiste, M., Goossens, L., Soenens, B., & Dochy, R. (2009). The synergistic relationship of perceived autonomy support and structure in the prediction of self-regulated learning. *British Journal of Educational Psychology, 79*, 57–68.

Vallerand, R. J., Pelletier, L. G., Blais, M. R., Brière, N. M., Senécal, C., & Vallières, E. F. (1992). The academic motivation scale: A measure of intrinsic, extrinsic, and amotivation in education. *Educational and Psychological Measurement, 52*, 1003–1017.

Vallerand, R. J., Pelletier, L. G., Blais, M. R., Brière, N. M., Senécal, C., & Vallières, E. F. (1993). On the assessment of intrinsic, extrinsic and amotivation in education: Evidence on the concurrent and construct validity of the academic motivation scale. *Educational and Psychological Measurement, 53*, 159–172.

Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: The synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *Journal of Personality and Social Psychology, 87*, 246–260.

Vermetten, Y. J., Vermunt, J. D., & Lodewijks, H. G. (1999). A longitudinal perspective on learning strategies in higher education – different view-points towards development. *British Journal of Educational Psychology, 69*, 221–242.

Vermunt, J., & Vermetten, Y. (2004). Patterns in student learning: Relationships between learning strategies, conceptions of learning, and learning orientations. *Educational Psychology Review, 16*, 359–384.

Virtanen, P., & Nevgi, A. (2010). Disciplinary and gender differences among higher education students in self-regulated learning strategies. *Educational Psychology, 30*, 323–347.

Wang, C. K. J., & Biddle, S. J. H. (2001). Young people's motivational profiles in physical activity: A cluster analysis. *Journal of Sport and Exercise Psychology, 23*(1), 1–22.

Wang, C. K. J., & Biddle, S. J. H. (2007). Understanding young people's motivation towards exercise: An integration of sport ability beliefs, achievement goals theory, and self-determination theory. In M. S. Hagger & N. L. D. Chatzisarantis (Eds.), *Self-determination theory in exercise and sport* (pp. 193–208). Champaign, IL: Human Kinetics.

Wang, C. K. J., Liu, W. C., Koh, C., Tan, O. S., & Ee, J. (2011). A motivational analysis of project work in Singapore using self-determination theory. *The International Journal of Research and Review, 7*, 45–66.

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

Young, M. R. (2005). The motivational effects of the classroom environment in facilitating self-regulated learning. *Journal of Marketing Education, 27*, 25–40.

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