STUDENTS' USE OF GOOD QUALITY LEARNING STRATEGIES: A MULTILEVEL MODEL OF CHANGE OVER FIVE YEARS OF SECONDARY SCHOOL

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- *students' and teachers' knowledge about what helps people to learn*
- *students' motivational, cognitive and metacognitive strategy knowledge*
- *mental health interventions in educational settings (e.g. KidsMatter and KidsMatter Early Childhood Evaluations)*
- *building capacity for wellbeing in school communities (e.g. Australian Research Council [ARC] Linkage Grant)*
- *developing a transnational, multilevel framework for mental health promotion in educational settings (e.g. collaboration with international partners with the support of an Australian Academy of Science Grant).*

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Abstract

As students progress through school we expect that their knowledge about the various subject matters, such as biology or maths, becomes more extensive, more structured and readily available for application in diverse contexts. A substantial amount of research has demonstrated that students need to employ good-quality learning strategies and reflect upon their learning processes and outcomes in order to develop their subject-matter knowledge: students need to be effective self-regulators of their learning. Thus, alongside subject-matter instruction we would expect attention to be paid to developing students' cognitive and metacognitive knowledge and strategies for learning. If we asked, 'Do biology students increase their knowledge about biology during secondary school?' we would expect the answer, in general, to be 'Yes'. Instead, we asked, 'Do students report increased use of good-quality cognitive and metacognitive strategies for learning as they progress through five years of secondary school?' Results from students attending three South Australian schools showed, at the whole-group level, moderate use of learning strategies. Hierarchical linear modelling showed significant differences among subgroups. Disappointing growth trajectories raise questions about whether five years of secondary schooling adds value to students' self-regulatory learning capacities.

A generation ago, Weinstein and Mayer (1986) provided an overview of useful strategies to enable students to learn. In that same era, Klauer (1988, p. 351) argued that 'teachers should be qualified not only to teach the respective subject matter but also to teach students how to learn this subject matter'. Since then, a wealth of research has demonstrated the beneficial effects of cognitive and metacognitive strategies for good-quality learning.

Cognitive strategies can include generating questions, taking notes, making mental images and drawing concept maps (Kiewra, 2002; Novak, 1990). Meanwhile, metacognitive knowledge (declarative, procedural, conditional) and regulation (planning, monitoring, evaluation) directs the use of cognitive strategies (Schraw, Crippen & Hartley, 2006). Hattie's (2009) meta-analysis of instruction involving cognitive, metacognitive and affective components revealed an average effect size (Cohen's d) of 0.59, with a higher average effect of 0.69 for metacognitive strategy instruction.

Van der Stel and Veenman's (2010) study of the development of early adolescents' metacognitive skilfulness found a continuous growth of metacognitive skills with increasing age, accompanied by intellectual growth. However, Schwonke et al. (2013) argued that the development of metacognition is neither an automatic nor a guaranteed partner to increased domain knowledge.

A consistent message from the literature is that some learners continue to demonstrate learning strategy deficits (e.g. Winne, 2005), suggesting that some students do not acquire effective learning strategies as they grow older. Indeed, Schneider (2010) argued that memory development is not necessarily due to maturation, but rather to education and practice. However, longitudinal studies about students' cognitive and metacognitive growth usually deal with relatively short time frames, typically of a few months to a couple of years (e.g. van der Stel & Veenman, 2010). In this paper we address this gap in the literature with a five-year study that investigated students' reported use of selected cognitive and metacognitive strategies as they progressed through their secondary schooling.

Research questions

Do students report increased use of good-quality cognitive and metacognitive strategies for learning as they progress through secondary school?

Do students' reports vary by gender, school, year level and learning strategy groups?

Method

Sample

We administered a questionnaire to students attending three secondary schools in Adelaide, South Australia, at the end of each academic year for five consecutive years. Two schools were rated as minimum disadvantage schools[1] with, respectively, 12 per cent and 17 per cent of students receiving school fee relief. The third school was rated as a high disadvantage school, with approximately 79 per cent of students receiving school fee relief.

Questionnaire design

In developing the cognitive items in the questionnaire, we reviewed Mayer's (1998) three stages of knowledge acquisition, namely focusing attention, elaborative processing, and organising and summarising. For the metacognitive items, we adopted the conceptual categories of monitoring of knowledge, and control of thinking processes and learning activities (Nelson, 1996). After a process of broad selection and then refinement, we created an 11-item (see Table 1, on p. 100) Learning Strategies questionnaire. Students were asked to think about the subject that they 'do best at', and respond on 7-point Likert scales (strongly disagree [1] to strongly agree [7]).

Ethics

Ethics approvals were obtained from the Flinders University Social and Behavioural Research Ethics Committee and from the Department of Education and Child Development. Agreement to conduct the study was obtained from each school principal. Consent to participate was obtained from parents and students. Participation in the study was informed, voluntary and confidential.

Procedure

Questionnaires were distributed in class to students who were present on the day of data collection. Response rates in each class, in each year, were almost 100 per cent. Participant attrition occurred over the 5 years due to a number of factors, including administrative arrangements

1 The Index of Educational Disadvantage was developed using a combination of Education Department and Australian Bureau of Statistics data. It groups all schools into one of seven ranks of educational disadvantage based on four measures: parental income; parental education and occupation; Aboriginality; and student mobility.

Table 1 Cognitive and metacognitive strategies items

I draw pictures or diagrams to help me understand this subject
I make up questions that I try to answer about this subject
When I am learning something new in this subject, I think back to what I already know about it
I discuss what I am doing in this subject with others
I practise things over and over until I know them well in this subject
I think about my thinking, to check if I understand the ideas in this subject
When I don't understand something in this subject I go back over it again
I make a note of things that I don't understand very well in this subject, so that I can follow them up
When I have finished an activity in this subject I look back to see how well I did
I organise my time to manage my learning in this subject
I make plans for how to do the activities in this subject

in schools, student absences, student transfers, and students not completing 5 years of secondary schooling. A limitation of this study is the possibility that students who dropped out of the study may have different characteristics from students who remained.

Data analysis

Questionnaires with invalid responses comprised less than 1 per cent of the sample and were discarded, leaving 4145 valid questionnaires. Students' ages ranged from 11 to 18 years, with approximately equal numbers of boys and girls in each year. The proportion of students identifying as Aboriginal or Torres Strait Islander was less than 1 per cent in each of two schools, and approximately 9 per cent in the third school.

The 11 questionnaire items were subjected to Principal Components Analysis[2] (PCA). A Learning Strategies factor was identified, accounting for 42.2 per cent of the variance in 2007 to 50.5 per cent of the variance in 2011. Following the PCA we calculated a Learning Strategies score for each student based upon each student's averaged (mean) item scores in each year of the study.

Four Learning Strategies groups were calculated from the students' initial Learning Strategies scores, namely Low, Low–Medium, Medium–High and High. Next, students' averaged Learning Strategies scores were corrected to account for potential regression to the mean (Nielsen, Karpatschof & Kreiner, 2007).

We undertook two-level HLM (V6), as specified in Equation 1.

Equation 1 The two-level random coefficients model

Level-1 Model

LEARNING STRATEGIES = P0 + P1*(TIME) + E

Level-2 Model

P0 = B00 + B01*(GENDER) + B02*(SCHOOL A) + B03*(SCHOOL B) + B04*(LEARNING STRATEGIES: LOW) + B05*(LEARNING STRATEGIES: LOW–MEDIUM) + B06*(LEARNING STRATEGIES: MEDIUM–HIGH) + R0

P1 = B10 + B11*(GENDER) + B12*(SCHOOL A) + B13*(SCHOOLB) + B14*(LEARNING STRATEGIES: LOW) + B15*(LEARNING STRATEGIES: LOW–MEDIUM) + B16*(LEARNING STRATEGIES: MEDIUM–HIGH) + R1

Results

The likelihood ratio test indicated a reduction in deviance, from the null 3 parameter model to the 18-parameter final model, of 10902.858, an amount significant at $p < 0.000$, indicating a better fitting model.

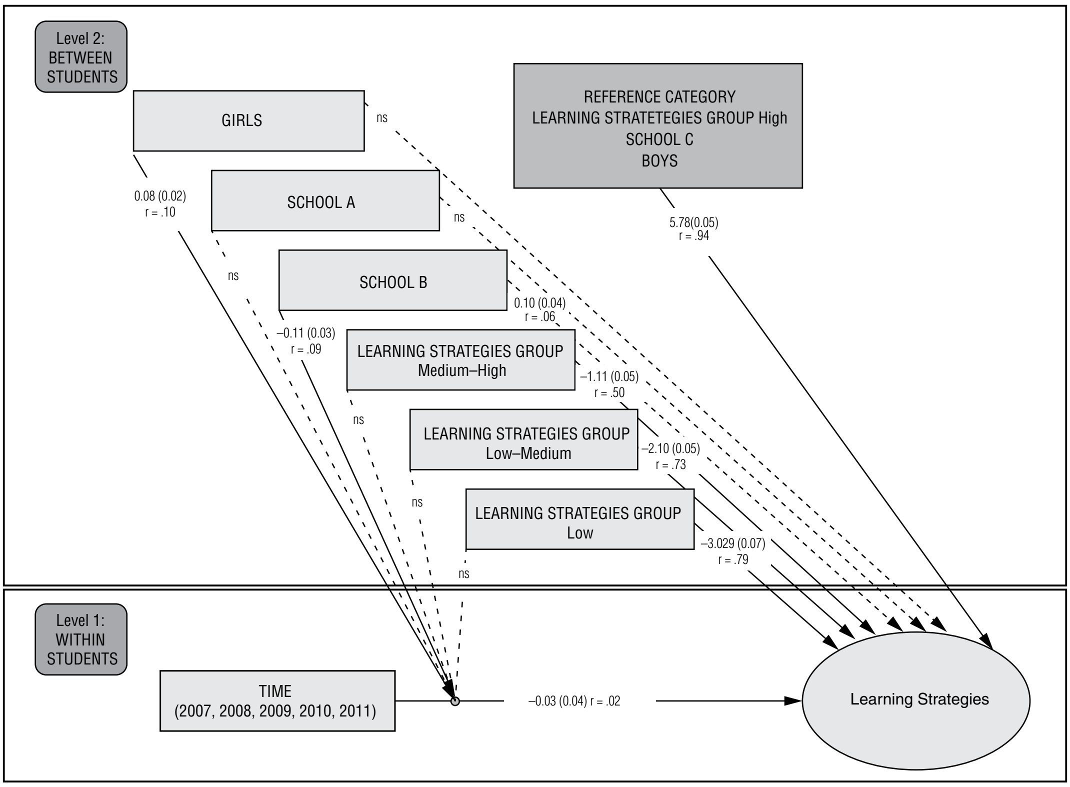
Table 2 shows the results of the final model. The Level 2 intercept has a variance component of 0.067, and in the final model does not exert a significant effect on the mean Learning Strategies score. Meanwhile, the 'TIME slope' term has a variance of 0.046, and although small is significant at $p < 0.000$.

Figure 1 displays the fixed effects for the final model. There are seven fixed effects significant at $p < .05$, controlling for other variables in the model. From Figure 1, beginning with effects on the intercept, the coefficient for GENDER is not significant. The coefficient for School B is significantly different from the reference group, School C ($p < 0.05$), with a very small effect size. Of most interest are the effects for the Learning Strategies GROUPS, which show significant differences, with large effect sizes ranging

2 Details about the factor structure of the questionnaire can be obtained from the corresponding author.

Table 2 HLM model fit and random effects

Final estimation of Level-1 and Level-2 variance components (random intercepts and random slopes)					
Random effect	Standard deviation	Variance component	df	Chi-square	P-value
INTERCEPT1, RO	0.258	0.067	1071	816.427	>0.500
TIME slope, R1	0.215	0.0467	1071	1269.668	0.000
Level-1, E	0.765	0.5857			



Two-level hierarchical linear model with path coefficients (robust standard errors)
Effect sizes: r = .1, small; r = .24, medium; r = .37, large

Figure 1 Visual representation of HLM results

from 0.50 to 0.80. For example, from Figure 1, the mean Learning Strategies score for the reference group (High) was 5.78. The coefficient for the Low group was –3.029. The difference (5.78 – 3.029) indicates a mean Learning Strategies score for the Low group of 2.65, which is well below the middle of the 7-point Likert scale.

Next, the slope for TIME shows that for each 1-year increase in TIME, the Learning Strategies score reduced by –0.03, which was not significant. The change over time for girls was significantly more positive than for boys ($p < 0.001$), with a small effect size. The change over time for School B was significantly more positive than the change over time for the reference group, School C ($p < .01$), with a small effect size. There were no apparent differences between Learning Strategies groups in their rate of change over time.

To summarise, the major findings are the large Learning Strategies GROUP effects on the intercept, associated with the lack of significant change in students' Learning Strategies scores over five years of secondary schooling. Small differences between the three schools and boys/girls were also apparent. Figure 2 provides a visual representation of these results for School C.

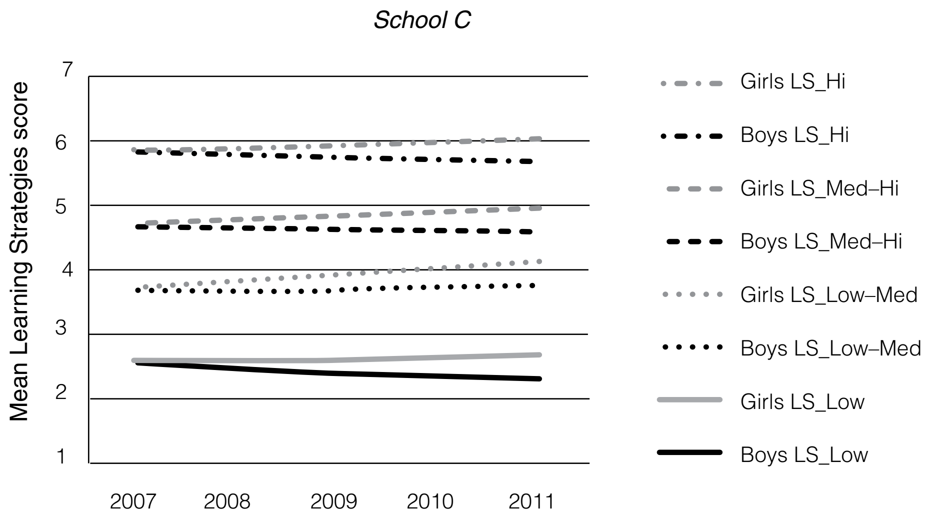


Figure 2 Estimated mean Learning Strategy scores for students in the reference group (School C)

Conclusions

Students' reports of their learning strategy use did not increase much over five years, even though it might be anticipated that as school work increases in complexity, the development of good-quality learning strategies would be highly advantageous. It is notable that the separation between the Learning Strategy groups, which was determined in the first year of data collection, remained over the five years. Lower groups did not move up into the trajectories of higher groups. Furthermore, the mean score trajectories for the lowest two groups do not rise above the mid-point of the Learning Strategies Scale, indicating that students in those lower groups report that they use the strategies identified in our questionnaire relatively infrequently at the beginning, and at the end, of their schooling.

Our findings did not give general support to our expectation that as students progressed through high school there would be evidence of more frequent use of useful learning strategies. Why might this be so? Perhaps students do not see the advantages associated with such strategies. Perhaps teachers also do not see such an advantage, and so the strategies are not the topic of explicit instruction.

These possibilities have been canvassed in the literature. According to Dignath-van Ewijk and van der Werf (2012, p. 8), 'the area of direct strategy instruction has somehow got lost in teachers' minds (or has never existed)'. Similarly, Dunlosky (2013) proposed that teachers overemphasise the importance of the subject-matter content of their lessons and undervalue the advantages associated with detailed learning strategy knowledge. Teachers who do this are content to rely heavily on strategies such as highlighting and repetition, which, while important, cannot substitute for strategies that support other key components of self-regulated learning, such as metacognitive knowledge. However, students do need knowledge about cognitive and metacognitive strategies, because in a typical classroom group-learning situation they must direct much of their own learning: a single teacher has very limited time for one-on-one interaction with students (Galton & Pell, 2012). The study reported in this paper lends support to the need for explicit cognitive and metacognitive strategy instruction throughout the secondary school years.

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