5

Conclusions and Implications for Policy and Practice

OVERVIEW

Teaching and learning strategies are broad concepts. Teaching strategies refer to a wide range of processes, from the way in which classrooms are organised and resources used to the daily activities engaged in by teachers and students to facilitate learning. Student learning strategies refer to cognitive and meta-cognitive processes employed by students as they attempt to learn something new.

PISA 2003 used a variety of questionnaire items to measure teaching and learning strategies in mathematics. These items were combined and scaled to yield a number of composite or index variables representing broad constructs. Examples of these constructs are disciplinary climate, teacher-student relations, memorisation strategies and time spent on various learning activities. In PISA 2003 these measures were specifically geared towards the learning of mathematics.

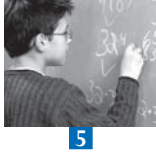
Analysing the data collected in PISA 2003 can inform policy makers in individual countries as to how their situation might differ from that of other countries in terms of consistency or variety among schools. It can also provide a broad profile of commonalities and differences in mathematics teaching and learning within an educational system. Merging these variables with the PISA assessment of individual competencies, it is also possible to analyse the relationship between student performance and teaching and learning strategies. While limited by the scope of PISA, its cross-sectional nature and the sheer complexity of the processes involved in teaching and learning strategies, these relationships yield important insights for education policy makers and stakeholders.

The evidence emerging from PISA 2003 shows that systems differ substantially in the kinds of teaching and learning practices most commonly used across schools. Even within the same educational system, there is a large variation in the teaching and learning practices most commonly employed across schools. While PISA shows teaching and learning factors are related to mathematics achievement, the relationships are not consistent and robust across all PISA countries and economies. Significant country differences stand out for many of the variables measuring teaching and learning strategies. Socio-economic background factors are among the most significant factors affecting performance, even after accounting for different teaching and learning strategies.

Two general messages merge from this evidence. First, the effects of teaching and learning strategies are best interpreted within countries or clusters of countries with similar cultural backgrounds or school systems. Second, across all countries the use of teaching and learning strategies does not seem to significantly mitigate the disadvantaged social backgrounds of some students.

With respect to findings on specific teaching and learning strategies, the evidence presented in this report highlights a number of interesting results. In terms of teaching strategies this study shows the importance of disciplinary climate and instruction time. The analysis however does not reveal how to achieve a more effective use of either of these strategies, only that they are associated with higher performance.

In terms of student learning strategies, this study stresses the importance of antecedents over different meta-cognitive strategies. For example, student attitudes such as motivation and confidence are strongly associated with higher performance, while anxiety is associated with lower performance, even after accounting for learning strategies and other factors. It is unclear, however, if these student attitudes lead to higher performance or if it is this high performance that leads to, for example,



more confidence. For meta-cognitive strategies, while an association between higher performance and student use of control and elaboration strategies is observed, it disappears or turns negative when other factors are taken into account. The analysis does not reveal however how student learning strategies interact with other student factors.

An important conclusion for education policy makers and analysts emerges from this report. For policy makers and stake holders, the value added of the PISA data in this area is highest as a descriptive tool. The data can best be used to better understand which teaching and learning strategies are most common and how much variation exists across schools within a particular system. Moreover, the complexity and the cross country variance apparent in the results suggest that while teaching and learning strategies are an important area of educational policy and research, a cross-sectional international perspective such as offered by PISA is of limited use when trying to understand which teaching and learning strategies lead to higher student performance and which ones do not, particularly for complex processes such as individual student meta-cognitive strategies or student-teacher relations.

OVERARCHING ISSUES

The place of socio-economic status

Socio-economic background remains one of the strongest predictors of achievement, even in the presence of widely varying teaching and learning strategies. Ideally, the impact of socio-economic background on achievement would be moderated by the use of appropriate teaching and learning strategies, and many educational policy initiatives are intended to compensate for adverse socio-economic effects. The models used in this study adjust for socio-economic background when examining the effects of teaching and learning strategies. Yet, the results show that the teaching and learning variables examined here do not seem, in practice, to mitigate very much the disadvantaged social backgrounds of some students.

Student attitudes, motivations and self-concept

As with socio-economic status, students' self-confidence and motivation as learners show consistent correlations with achievement. Since these variables can be considered to be related to teaching and learning strategies as well as to achievement, they are therefore included as antecedents in the models. Nevertheless, unlike socio-economic background, the direction of causation is for these constructs varies. It is possible that attitudes can be influenced by teaching strategies and that attitudes, themselves, influence learning strategies or are affected by achievement. Furthermore, cultural differences are likely to affect students' interpretation of self-confidence and motivation questions. Therefore, results in these areas should be interpreted taking into account the context and culture of each specific country.

PISA 2003 measured self-efficacy, specifically in relation to mathematics, using questionnaire items in which students were asked to judge their competence at solving a variety of mathematics problems, yielding the index of self-efficacy in mathematics. Countries in which students have a greater sense of self-efficacy tend to have better overall performance in mathematics, while within most countries there is a correlation with performance that remains even when adjusting for other factors. The average sense of self-efficacy (set as zero internationally) varies considerably across

countries. In the Slovak Republic students on average have self-efficacy half a standard deviation above average, while those in Japan and Korea, and the partner country Thailand, are the same amount below average. In countries where students have the least confidence in their own efficacy, this variable also makes the least difference to their predicted achievement; the variable is most closely correlated in some countries with above-average self-efficacy overall.

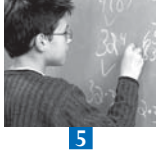
Another variable showing wide differences across countries was anxiety in mathematics. Students in Japan, Korea and Mexico, and their partner countries Brazil, Thailand and Tunisia (a contrasting mix of high- and low-achieving countries), express particularly high levels of anxiety about mathematics. However, in Denmark, Finland, the Netherlands and Sweden (all relatively high-achieving countries), students show particularly low anxiety. Both within and across countries, students who are anxious about learning mathematics tend to perform worse in the subject. Again, there may be lessons here for teachers, especially in countries where anxiety is highest, to make more effort to reduce it. Particularly in Mexico and the partner country Brazil, high anxiety tends to go with low mathematics performance.

Instructional time

For school authorities, the length of the school year and school day are among the most salient time variables. States can also regulate other aspects of time allocation, such as allocations to particular subjects or the length of class periods, although these matters are often left to the school. Since PISA 2003 did not measure jurisdictional-level variables directly, the available information on global time allocations comes from the school questionnaire and hence reflects variations among schools.

The number of weeks in the school year varies considerably in countries taking part in PISA, with a norm of 36-40 weeks, but only 33 weeks in Ireland, 32 in the partner country Tunisia and 24 in Mexico. These country differences do have a positive correlation with performance, but within countries, the correlation is weak and mostly negative. A second time measure, the length of the school week, shows greater variation within some countries than that of the school year, especially in the United States, although in Finland and the partner country Latvia, for example, neither the school week nor the school year vary much. In these countries, the main correlation with performance is within countries, although when adjusting for other factors the association tends to disappear. Similar results apply to the quantity of mathematics teaching, even though here country differences are striking: the partner countries Hong Kong-China and Macao-China give over 4.5 hours of mathematics instruction each week to 15-year-olds, whereas Finland gives only 2.6 hours.

Yet, across systems there is a strong correlation among total instruction time and mean performance in mathematics. Combining the information from the number of hours per week and the length of the school year in weeks per year, an index of total instruction time is constructed. The total instruction time in the year varies considerably across and within countries. Some of the countries with the highest average performance, such as Korea, have also one of the highest yearly instruction times with an estimate of over 1000 hours per year. Mexico is at the other extreme, with an estimate of less than 600 hours of instruction per year on average. Interestingly Korea achieves a high total instruction time with over 30 hours per week, the most among OECD countries, and less than 36 weeks per year, the OECD average. Mexico has an estimated mean of 24 hours per week, the OECD average, but at below 24 weeks of instruction per year, it also has one of the lowest estimates for the OECD in this measure.



STUDENT LEARNING STRATEGIES

Alternative uses of student learning time outside schools

PISA measures student use of time by questions on exposure to tutoring and other out-of-class instruction and by time spent on homework. The proportion of students being tutored in mathematics is in the 10% to 20% range for most countries. It is less than 10% in several high-achieving countries such as Belgium, Finland and Japan, but exceeds 30% in some low-achieving countries, particularly Greece, Mexico and Turkey. Patterns of out-of-class lessons are similar. The prevalence of tutoring and extra lessons in some low-achieving countries suggests that extra efforts are being made by many students and by their parents to overcome low achievement. However, these efforts may not be yielding the expected payoff for individuals or helping to raise the level of achievement significantly for the country as a whole.

The second major area of student use of time measured in PISA is homework. The PISA student questionnaire contains items on hours per week spent on all homework and on mathematics homework. Similar to tutoring and extra classes, homework tends to be used more in countries with lower achievement overall. In the case of homework, the evidence suggests an overall beneficial effect within countries. Even adjusting for other variables, total homework time shows significant positive effects on achievement for almost all countries. Extra mathematics homework appears to be targeted to those that need it most as the within country relationship between extra mathematics homework and performance tends to be negative across systems. The small proportion of students reporting no mathematics homework tends to have higher achievement than those reporting some mathematics homework.

All of this presents a complex picture for the homework effect. Negative country-level correlations and the inordinate amount of time spent by students in some low-achieving countries on homework suggest that extra efforts in terms of mathematics homework used to compensate for limitations of schooling or to substitute for instruction by teachers can only have a limited positive effect. It also seems likely that in many high-achieving countries, and for high-achieving students in all countries, the mathematics teaching provided in school is sufficient to allow students to function well without extra homework. It is clear however that within each country, higher-achieving students are doing more homework overall.

Meta-cognitive strategies

Meta-cognitive strategies are generic approaches that students use in addressing a learning task. The three index variables that PISA uses for these strategies are memorisation/rehearsal, elaboration strategies and control strategies. Consistent with expectations, memorisation strategies tend to be less frequently used than either elaboration or control strategies. They tend to be used more by students in relatively low-performing countries, with students in Mexico, Brazil, Thailand and Tunisia saying that they use memorisation the most, producing a very high negative correlation between countries' use of memorisation and their performance in PISA. The within-country correlations with achievement are mostly close to zero, but with a few significant positive and negative values.

Students report using elaboration strategies more often than memorisation strategies. In most countries, the patterns of relationship are similar. On the standard scale, students in Mexico and Turkey, and the partner countries Brazil, Serbia, Thailand and Tunisia, show the highest positive levels

of use of this strategy, while those in Japan and Korea show the highest negative levels. Within-country correlations are mostly small but the between-country correlation is strongly negative. This tendency would seem to be confirmed by students' self-reports on control strategies, where again students in Mexico and the partner countries Brazil and Tunisia, along with those in Austria and the partner country Serbia, are the most likely to say they controlled their learning. Control strategies differ from the other two meta-cognitive strategies in that in some countries there is a correlation between the adoption of such strategies and performance, even after adjusting for other factors. However, this result applies to only one-half of these countries, and the correlation is negative as often as positive.

Co-operative and competitive learning situations

In this report indices of co-operative learning and of competitive learning strategies derive from student responses to PISA items asking whether students prefer working with others or helping others or whether they want to be the best or do better than others. Overall, a majority of students in most countries tend to agree with statements reflecting both of these strategies, suggesting that these strategies may not be opposites on a single continuum. Indeed, these indices correlate positively with each other in most countries. Students in Japan showed much less enthusiasm for either strategy than elsewhere in the OECD, while students in the partner countries Brazil and Tunisia were strongly positive on both. Students who engage in competitive learning tend to be among the higher achievers in many countries, but this effect disappears once other characteristics of these students have been taken into account. Co-operative learning does not correlate with achievement at either level.

TEACHING STRATEGIES

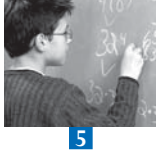
Disciplinary climate

Across the group of countries studied, disciplinary climate is the teaching and learning factor that has the strongest correlation with performance. This correlation remains positive and significant in most countries even after adjusting for other factors. Japan and the Russian Federation have the most positive disciplinary climate, and Brazil the most negative. Overall the average scores on this variable do not differ greatly across countries.

In contrast, within-country differences in disciplinary climate are a key issue. One of the most important findings of this study is that disciplinary climate is not only the teaching and learning factor with the closest link to performance, but also the one in which differences across schools are particularly high. (Although reported by students individually, this factor was aggregated to the school level.) Moreover, the correlation between disciplinary climate and achievement is much higher at the school than at the student level. These results show that if school systems are to provide equal learning opportunities to all of their students, it is very important to improve the disciplinary climate in those schools where it is poor.

Teacher support and student-teacher relations

The index of student-teacher relations comprises items that closely resemble those for teacher support, dealing with the extent to which students get along with teachers, whether teachers listen to students and whether teachers treat students fairly. A majority of students in most countries are



of the view that their teachers support them. However, there is more variation across countries in this factor than in disciplinary climate. The highest average levels of teacher support arise in Mexico and Turkey, and the partner countries Brazil and Thailand, while the lowest levels occur in Austria, Germany, Japan and Luxembourg. Teacher support correlates mainly negatively with achievement within countries and most of the model effects are negative, suggesting that support intentionally concentrates on weaker students. Several western European countries show positive effects for student-teacher relations while several eastern European countries, along with Mexico and the partner countries Thailand and Tunisia, show negative effects. One possible explanation for these findings is that in some countries teachers focus on those students who need it most, providing more support to low performing students.

CONCLUSION

This study shows that there are wide variations across countries in the average values of the PISA variables measuring teaching and learning strategies and in the level of diversity among schools in values of these variables within countries. There is some evidence of clustering of countries with similar cultural features or with similar school systems. For example, a few countries show consistent patterns of high diversity across schools, suggesting a highly decentralised school system. However, these clusters do not seem to be clearly linked to mathematics achievement. In some cases, the patterns indicate unusual teaching and learning patterns, such as the relatively high homework levels in some low-achieving countries, which appear to conflict with the overall results for these variables. In other cases, such as the high level of memorisation in some low-achieving countries, the between-country differences are consistent with the overall achievement effects for these variables. In general, the absolute values of the variables across countries appear to be of less importance than their relative values within countries.