4

Relationships between Students' Learning Time and Performance

INTRODUCTION

This chapter examines the relationship between students' learning time and students' academic performance in PISA, both across and within countries. Do students who spend more time learning achieve higher scores? Is the amount of time spent learning more important than how that time is spent? In other words, is the quality of learning time as important as the quantity of learning time?

The section on regular school lessons examines how students' perceptions of the importance of subjects play a role in their performance. These perceptions are used as an indirect proxy for "perseverance", which was identified as one of the factors related to students' learning in Carroll's seminal model on school learning (Carroll, 1963). Other factors identified in Carroll's model, such as "aptitude", "quality of instruction" and "ability to understand instruction", are not examined, as the PISA 2006 data do not provide indicators for these factors. The section on out-of-school-time lessons analyses what types of lessons enhance learning without introducing inequities.

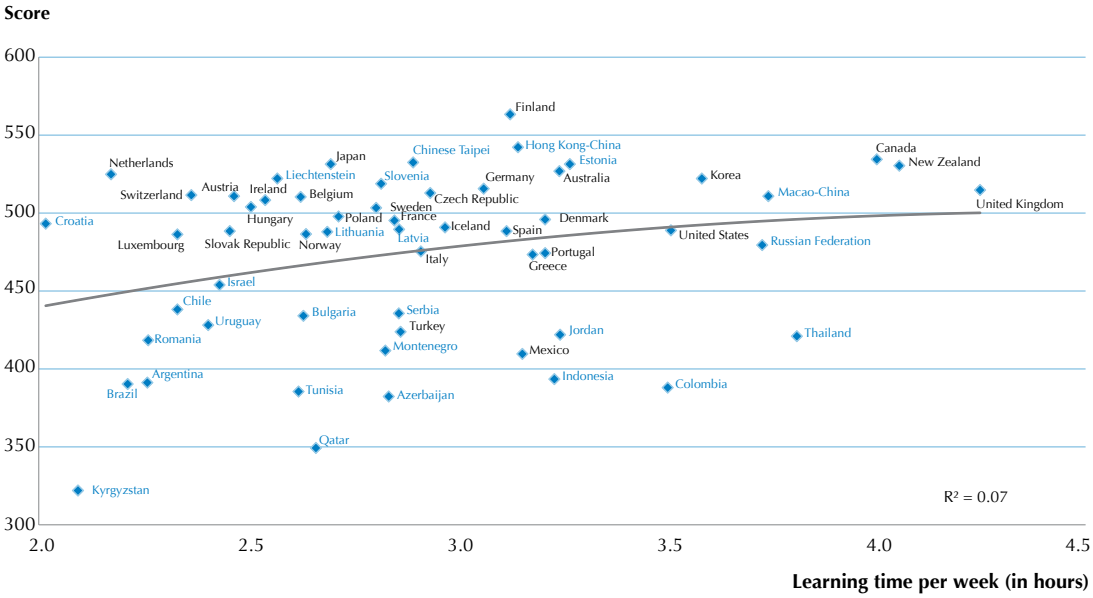
Since the analysis is based on cross-sectional data, it is difficult to determine the causality of the relationships. For example, students may spend more time in out-of-school-time lessons because these students themselves or their parents or teachers conclude that they need to attend extra classes to catch up with other students; and students may spend more time engaging in individual study because they need more time than other students to complete a certain number of tasks. Given the complexity of the relationship, the results in this chapter are carefully examined and interpreted, using relatively neutral terms such as "relationship" or "association". Terms such as "effect" or "impact", which imply a causal relationship, are generally avoided for the same reasons.

LEARNING TIME AND PERFORMANCE ACROSS COUNTRIES

What are the relationships between the average time students spend learning science, mathematics and the language of instruction and the country average performance in PISA 2006? Do countries where students spend more time learning tend to achieve higher scores? The time that students spend in regular school lessons is positively related to performance across countries in all three subjects (Tables 4.1a, 4.1b and 4.1c). Countries with longer average learning time in regular school lessons tend to achieve higher scores. This relationship is stronger in mathematics and reading than in science. About 25% of variation in performance in mathematics and reading across countries is explained by learning time in regular school lessons, while only 7% of the variation in science scores is explained in that way (Table 4.1b).

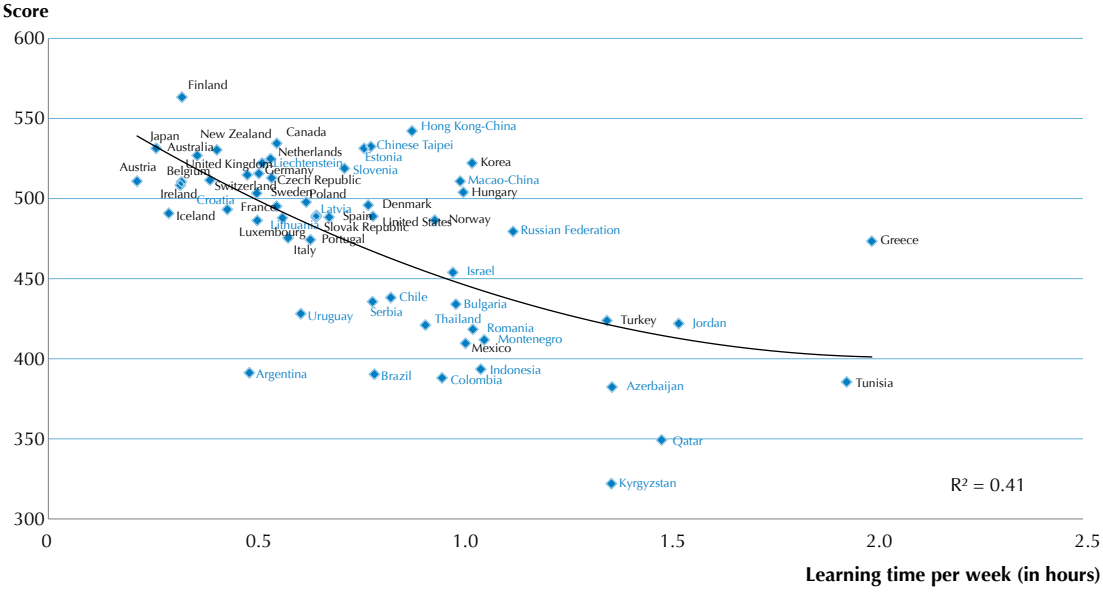
The time students spend in out-of-school-time lessons and the time spent in individual study are both negatively related to performance in science, mathematics and reading across countries. These relationships are strong, especially in science, as 41% of the cross-country variation in science performance can be explained by the country average learning time in out-of-school time lessons in science. That proportion is 23% in mathematics and 29% in reading. Meanwhile, 42% of the variation in science performance between learning time in individual study and performance can be explained by the country average learning time in individual study. That proportion is 14% in mathematics and 28% in reading (Table 4.1b).

Figure 4.1a
Cross-country relationship between performance in science and learning time in regular school lessons in science



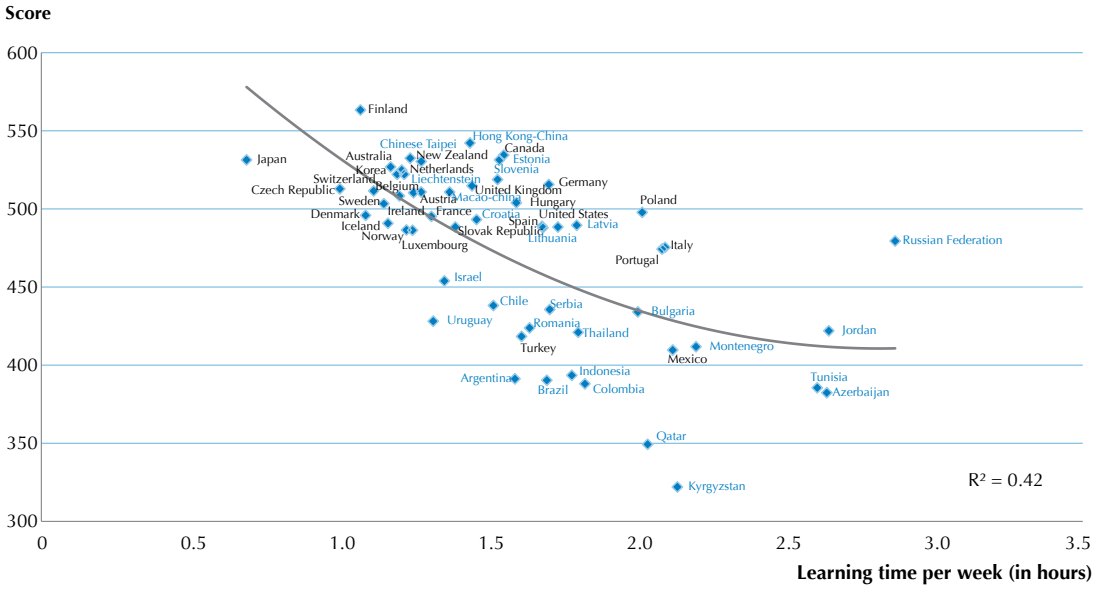
Source: *OECD PISA 2006 Database*, Table 4.1a.

Figure 4.1b
Cross-country relationship between performance in science and learning time in out-of-school-time lessons in science



Source: *OECD PISA 2006 Database*, Table 4.1a.

Figure 4.1c
Cross-country relationship between performance in science and learning time in individual study in science

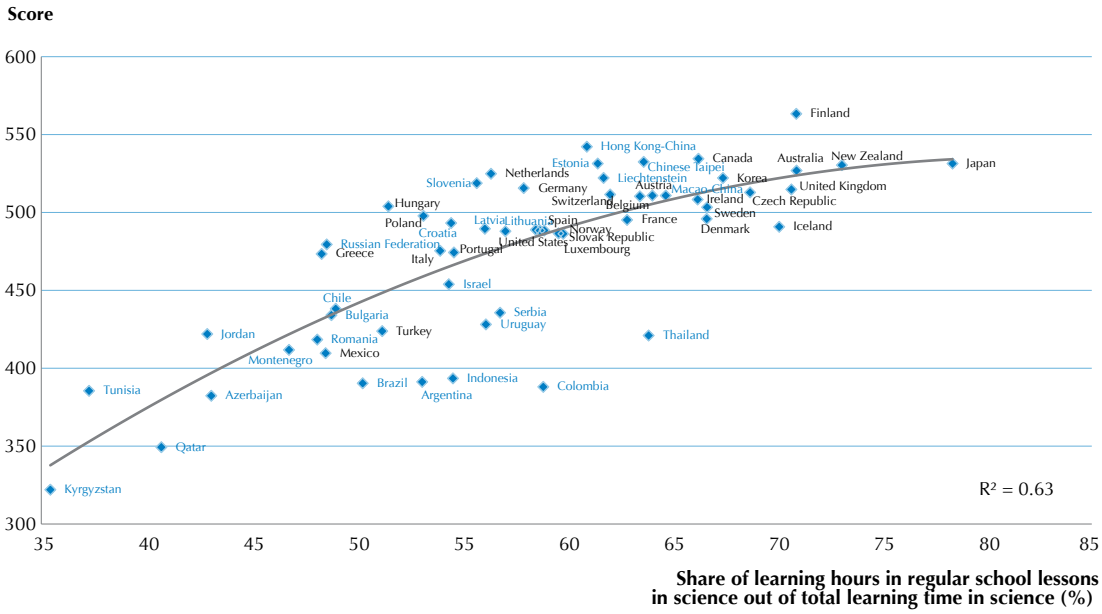


Source: *OECD PISA 2006 Database*, Table 4.1a.

Across countries, relative learning time in regular school lessons, which is equivalent to the proportion of absolute learning time in regular school lessons out of absolute total learning time (*i.e.* the time spent in regular school lessons, out-of-school-time lessons and individual study combined), is strongly related to performance. For example, 63% of the variation in science performance across countries can be explained by the proportion of learning time in regular school lessons in science out of total science learning time (Table 4.1c). Countries with a higher proportion of time allocated to regular school lessons tend to perform better. Countries with the lowest proportions of regular school lessons in science out of total science learning time – from 35% to 43% – including the partner countries Kyrgyzstan, Tunisia, Qatar, Jordan and Azerbaijan, perform between 322 to 422 score points in science, while countries with the highest proportions of science regular school lessons – from 71% to 78% – including the OECD countries Japan, New Zealand, Australia, Finland and the United Kingdom, perform between 515 to 563 score points in science (Table 4.1a). Similar relationships are observed in mathematics and reading.

In summary, students in high-performing countries spend less time, on average, in out-of-school-time lessons and individual study, and more time in regular school lessons than students in low-performing countries. This positive relationship between learning time in regular school lessons and performance is even more pronounced when the time students spend in regular school lessons is considered as a relative term, *i.e.* a share out of total time spent learning.

Figure 4.2
Cross-country relationship between performance in science and percentage of total learning time allocated to regular school lessons in science



Source: *OECD PISA 2006 Database*, Table 4.1a.

To explain the difference in performance across countries, the relative learning time in regular school lessons – a higher proportion of time spent in regular school lessons – is more important than the absolute learning time, or the overall length of learning time. This is true for each of three subjects as well as for the three subjects combined. For instance, Finland's absolute learning time in regular school lessons for science is 3.1 hours, which is equivalent to relative learning time of 71% of total learning time. In 10 OECD countries and 8 partner countries, the absolute learning time of regular school lessons for science is more than that of Finland. In all of these countries, except New Zealand, relative learning time is 71% or less. Although the absolute learning time spent in regular school lessons is longer in these countries, Finland achieves the highest scores in science among 57 countries (Table 4.1a). A possible explanation is that, even if countries have the same absolute length of learning time in schools, there is no guarantee that the same quality of education is provided to students across countries, particularly since factors such as the way schools and teaching are organised, student motivation levels, and schools' socio-economic status vary widely across countries. In high-performing countries, the biggest proportion of students' learning time – 70% to 80% of their learning time – happens within regular school lessons. In these countries, students may not need to spend more time in out-of-school-time lessons or studying by themselves if they receive sufficient education during regular school lessons. In low-performing countries, 50% or more of students' learning time happens outside regular school lessons. Students in these countries may need to supplement their learning by attending out-of-school-time lessons or studying by themselves. As learning outside regular school lessons tends to be less structured and less regulated, quality varies. Consequently, the large number of hours spent learning in out-of-school-time lessons or individual study do not necessarily lead to high performance.

In order to determine the relationship between quality of regular school lessons and countries' relative learning time, some characteristics of the school system that have an impact on educational quality are compared between countries with a high or low proportion of hours spent in regular school lessons. Countries were divided into two groups: those that spend a higher proportion of hours in regular school lessons in

science, mathematics and the language of instruction than the average across all participating countries (58%), and those that spend a lower proportion of hours (Figure 2.3). The system characteristics, such as the level of school resources, the level of school autonomy and accountability policies are examined, because an earlier PISA study identified them as having a significant positive relationship with students' performance (OECD, 2007). The indicators of school resources include human resources (*i.e.* the index of teacher shortage) and material resources (*i.e.* the index of the school's educational resources) reported by school principals. Higher values on these indices indicate higher rates of teacher shortage at a school and higher levels of educational resources. A school's autonomy is measured by the responsibility for tasks regarding resource allocation (*i.e.* the index of resource autonomy) and curriculum and assessment (*i.e.* the index of curricular autonomy) reported by school principals. Higher values indicate relatively higher levels of school responsibility and autonomy in these domains. These indices were standardised so that at the OECD level they have a mean of zero and a standard deviation of one. When standardised external examinations exist in some parts of the system, but not throughout the system (*e.g.* regional variations or variations between different types of education programmes), the proportion of students who are affected by such examinations are indicated by a value between 0 and 1. Higher values indicate a relatively higher proportion of standardised external examinations.

The analysis show that in countries where the proportion of hours spent in regular school lessons is low, schools tend to struggle more with teacher shortages and low quality of educational resources, compared with countries with a high proportion of hours spent in regular school lessons. Box 4.1 shows the average difference in the index of teacher shortage and the index of the quality of educational resources between countries where students spend less than 58% of their learning time in regular school lessons and countries where students spend 58% or more of their learning time in regular school lessons. Countries with a low proportion of hours spent in regular school lessons have higher levels of teacher shortage: their score on the index of teacher shortage is 0.35 standard deviation higher than countries with a high proportion of hours spent in regular school lessons. The difference in the index of the quality of educational resources is 0.76 standard deviation, so that, on average, schools in countries with a high proportion of hours in regular school lessons have better school resources than schools in countries where students spend less of their learning time in regular school lessons.

In addition, in countries where the proportion of regular school lessons is low, schools tend to have less autonomy on the allocation of resources, curriculum and assessment compared with countries with a high proportion of hours spent in regular school lessons. The difference in the index of resource autonomy and the index of curricular autonomy is 0.55 and 0.91 standard deviations, favouring countries with a high proportion of hours in regular school lessons. It could be inferred that teachers or principals in countries with a low proportion of hours spent in regular school lessons may be less motivated than countries with a high proportion of hours spent in regular school lessons, as principals and teachers are less likely to be involved in decision making in the areas of staffing, budgeting and instructional content.

Countries where the proportion of hours spent in regular school lessons is low tend to have fewer standardised external examinations than countries where the proportion of hours spent in regular school lessons is high. For example, the proportion of this type of examination is 0.46 in countries where students spend fewer hours in regular school lessons, while it is 0.60 in countries where students spend more hours in those kinds of lessons. This result may not provide enough evidence to determine whether the schools' quality of education is regulated systemically or not, but it shows, to a limited extent, that countries where the proportion of hours spent in regular school lessons is low tend to be less regulated in assessing students' performance compared with countries where a high proportion of time spent in regular school lessons.

In short, compared with the countries with high relative learning time in regular school lessons, the countries with low relative learning time in these lessons turn out to have system characteristics that are related to low overall performance: lower levels of school materials and human resources, less school autonomy and lower proportions of standardised external examinations. Students in these countries may have to spend more time in out-of-school-time lessons or in individual study to compensate for any shortfalls in learning during regular school lessons.

The comparison between Figure 4.1a and Figure 4.2 and the results in Box 4.1 implies that it is the quality of regular school lessons, not the quantity of learning hours, that would explain more of the difference in performance across countries. A simple intervention to increase the number of school hours or to encourage students to spend more hours learning outside of regular school lessons would not be an effective way to improve performance in low-performing countries, especially for those countries that already have long hours of absolute learning time in regular school lessons. Instead, these countries including Italy, Mexico, Turkey, the Unites States, Azerbaijan, Indonesia, Jordan and Latvia (Figure 2.3) may need to consider improving the quality of education and providing an environment that is conducive to learning.

As the comparison in system characteristics shows, one way to improve the quality of education would be to reduce the levels of teacher shortage by employing more qualified teachers and increase schools' educational resources. Countries might consider encouraging principals and teachers to be more involved in decision making in the areas of staffing, budgeting and instructional content. In countries with insufficient accountability arrangements, greater use of standardised external examinations of student performance could be another way to improve the quality of learning time in regular school lessons.

Box 4.1. **Mean indices of teacher shortage and the school's educational resources, by share of learning time in regular school lessons out of the total learning time in science**

		Countries where students spend less than 58% of their learning time in regular school lessons in science (A)		Countries where students spend 58% or more of their learning time in regular school lessons in science (B)		Difference (A-B)	
		Mean	S.E.	Mean	S.E.	Mean	S.E.
Performance	Science	431.9	(0.7)	503.3	(0.5)	**-71.4**	(0.8)
	Mathematics	423.3	(0.8)	502.3	(0.5)	**-79.0**	(0.9)
	Reading	413.7	(0.9)	491.5	(0.6)	**-77.7**	(1.0)
School material	Teacher shortage	0.32	-(0.03)	-0.03	-(0.01)	**0.35**	-(0.03)
	Quality of educational resource	-0.88	-(0.02)	-0.12	-(0.01)	**-0.76**	-(0.02)
School autonomy	Responsibility for resource allocation	-0.59	-(0.01)	-0.04	-(0.01)	**-0.55**	-(0.02
	Responsibility for curriculum and assessment	-0.89	-(0.01)	0.02	-(0.01)	**-0.91**	-(0.01)
Accountability policies	Standards-based external examinations (ratio of existence)	0.46	(0.00)	0.6	(0.00)	**-0.14**	(0.00)

Source: *OECD PISA 2006 Database*, Table 4.1a.

LEARNING TIME AND PERFORMANCE WITHIN COUNTRIES

Cross-country analysis in the previous section has shown the importance of relative learning time in regular school lessons, but the relationship between learning time and performance within countries is different from the relationship between countries: within countries, the absolute length in learning time is more strongly related to performance than the relative learning time in regular school lessons. This may be because the quality of regular school lessons within countries does not vary as much as across countries.

This section compares average performance scores for the following six categories of students' learning time: "no time", "less than 2 hours per week", "2 to less than 4 hours per week", "4 to less than 6 hours per week", and "6 or more hours per week". Students who spend a moderate amount of hours learning are defined as those who spend two to six hours per week studying. Students who spend long hours learning are defined as those who spend six or more hours per week studying. Differences in performance among students who spend different amounts of time learning are also compared, with adjustments made for the socio-economic background of students and schools, and for learning time in out-of-school-time lessons and individual study.

LEARNING TIME IN REGULAR SCHOOL LESSONS AND PERFORMANCE

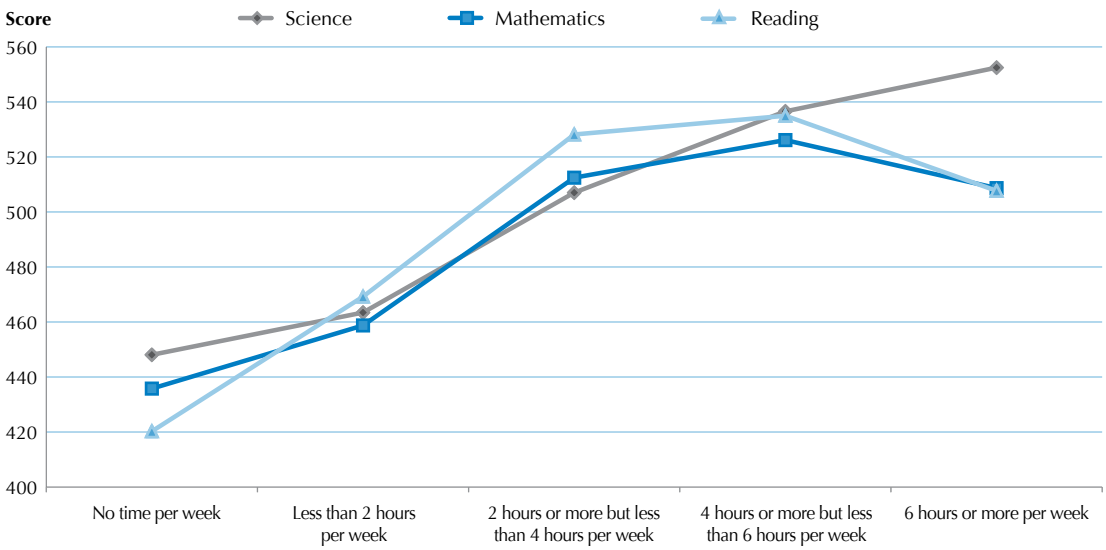
Science

In general, students who spend more time learning science in regular school lessons tend to achieve higher scores, as shown in Figure 4.3. Across OECD countries, students who spend less than two hours per week in regular school lessons in science tend to perform 15 score points higher in science than students who do not spend any time learning science in regular school lessons; students who spend two to less than four hours per week tend to perform 59 score points higher; students who spend four to less than six hours per week tend to perform 89 score points higher; and students who spend six or more hours per week tend to perform 104 score points higher (Table 4.2a).

Adjusting for the socio-economic background of students and schools, and for students' learning time in out-of-school lessons and individual study in science, the relationship between learning time in regular school lessons in science and performance in science is still positive. However, differences in scores are smaller when these other factors are taken into account (Table 4.2a).

The positive relationship between learning time in regular school lessons in science and performance in science is more evident in countries where students spend two or more hours per week in regular school lessons in science. In most countries, science performance improves steadily as learning time in regular school lessons increases beyond two hours per week. However, this improvement in science performance varies greatly across countries; in a few countries, the improvement is not steady. In France, the United Kingdom, Switzerland, the Slovak Republic, Belgium and Greece, a significant improvement in science performance goes hand-in-hand with an increase in learning time: students who spend six or more hours per week learning perform at least 140 score points higher than students who do not spend any time in regular school lessons in science. However, in a few countries, students who spend six or more hours per week learning science in regular school lessons perform lower than students who spend a moderate amount of hours. For example, in Norway and Mexico, students who spend six or more hours per week in regular school lessons tend to perform lower than students who spend a moderate amount of time learning (from four to less than six hours per week), and they perform at the same level as students who do not spend any time learning science in regular school lessons (Table 4.2a).

Figure 4.3
Within-country relationship between performance and learning time in regular school lessons, by subject (OECD average)



Source: *OECD PISA 2006 Database*, Tables 4.2a, 4.2b and 4.2c.

Mathematics

In general, there is a curvilinear relationship between learning time in regular school lessons and performance in mathematics, as shown in Figure 4.3. When students spend less than six hours per week in regular school lessons, there is a positive relationship between learning time and performance; but beyond six hours per week, students tend to perform lower than students who spend from two hours to less than four hours per week in regular school lessons. Across OECD countries, students who spend between 2 and 4 hours per week learning mathematics tend to perform 64 score points higher than students who do not spend any time learning mathematics in regular school lessons; students who spend between 4 and 6 hours per week tend to perform 78 score points higher; and students who spend more than 6 hours per week tend to perform 61 score points higher. This curvilinear relationship can be also observed after adjusting for the socio-economic background of students and schools, and for students' learning time in mathematics in out-of-school-time lessons and individual study (Table 4.2b).

The general pattern observed in many countries indicates that students who spend long hours in mathematics in regular school lessons perform much lower than students who spend a moderate amount of hours. For example, in Spain, Norway, Luxembourg, Germany, the Netherlands and the partner country Croatia, students who spend 6 or more hours per week in regular school lessons in mathematics perform at least 44 score points lower than students who spend from 4 to less than 6 hours per week in lessons.

In only a few countries do students who spend a long time learning mathematics in regular schools lessons perform significantly better in mathematics than other students. For example, in Korea and the partner economies Chinese Taipei and Hong Kong-China, students who spend 6 or more hours per week in regular school lessons in mathematics perform at least 140 score points higher than students who do not spend any time in regular school lessons in mathematics.

Language of instruction

The relationship between the time students spend in regular school lessons and their performance in the language of instruction is generally curvilinear, as well, as shown in Figure 4.3. Reading performance increases steadily as learning time in regular school lessons increases up to six hours per week, but beyond six hours per week, the relationship becomes negative. For example, across OECD countries, students who spend two to less than four hours per week in lessons tend to perform 80 score points higher than students who do not spend any time learning the language of instruction in regular school lessons; students who spend four to less than six hours per week tend to perform 87 score points higher; and students who spend six or more hours per week in lessons tend to perform 60 score points higher. This relationship can also be observed when adjusting for the socio-economic background of students and schools, and for students' learning time in the language of instruction in out-of-school-time lessons and individual study (Table 4.2c).

When country-by-country data are examined, the results show that students in many OECD countries who spend long hours learning the language of instruction in regular school lessons achieve lower scores in reading than students who spend a moderate number of hours. In the Netherlands, Belgium, Austria and the partner country Croatia, students who spend six or more hours a week perform lower than students who spend from four to less than six hours per week by at least 50 score points. In the Netherlands and Austria, students who spend six or more hours per week perform lower than students who do not spend any time learning the language of instruction in regular school lessons (Table 4.2b).

However, in a few countries, including Greece, Hungary, Japan, Korea, Norway, Poland and the partner economy Chinese Taipei, students who spend a long time learning the language of instruction in school lessons achieve substantially higher scores in reading. In these countries, students who spend six or more hours per week in regular school lessons on the language of instruction perform at least 100 scores higher than students who do not spend any time in regular school lessons on the language of instruction.

Surprisingly, it appears that in many countries, students who spend a long time learning mathematics and the language of instruction in regular school lessons perform lower than students who spend a moderate amount of time learning in regular school lessons. One might argue that as the proportion of students spending a long time in regular school lessons in science is smaller than that of students who spend a long time in regular school lessons in mathematics and the language of instruction, the former are the students who are especially keen to study science. However, the results show that across OECD countries, about the same average proportion of students spend six hours or more per week in regular school lessons in all three subjects: 8% for regular school lessons in science and mathematics, and 9% for regular school lessons on the language of instruction (Tables 2.1a, 2.1b and 2.1c), although these percentages vary across countries. In Iceland and the partner economies Macao-China, Hong Kong-China and Chinese Taipei, the proportion of students spending six hours or more per week in regular school lessons in science is at least 12% less than the proportions of students spending six hours or more per week in regular school lessons in mathematics and in the language of instruction. But in Portugal and the partner country the Russian Federation, around 20% of students spend six hours or more per week in regular school lessons in science, while 10% or less spend six hours or more per week in regular school lessons in mathematics and in the language of instruction.

It is possible that students who spend a long time in regular school lessons in science do so for different reasons than students who spend a long time in regular school lessons in mathematics and in the language of instruction. One hypothesis is that the students who spend a long time in regular school lessons in science are those who choose to do so in optional courses, because they are interested in science, while students who spend a long time in regular school lessons in mathematics and in the language of instruction are obliged to do so for remedial purposes.

To investigate this hypothesis, students' interest in each subject domain and the types of courses they took were examined. The differences in the proportion of students who believe that to do well in each subject is "very important" were recorded between students who spend six hours or more per week and other students who spend less than six hours per week in regular school lessons. Results show that, in many countries, differences in proportions are consistently greater in science than in the other two subjects. This, in turn, indicates higher levels of commitment towards the subject among those students who spend more hours in science lessons compared with those who spend more hours on the language of instruction or mathematics. For example, in Iceland, the difference in proportion is 34 percentage points in science, while it is 6 percentage points for mathematics and 7 percentage points for the language of instruction (Table 4.3).

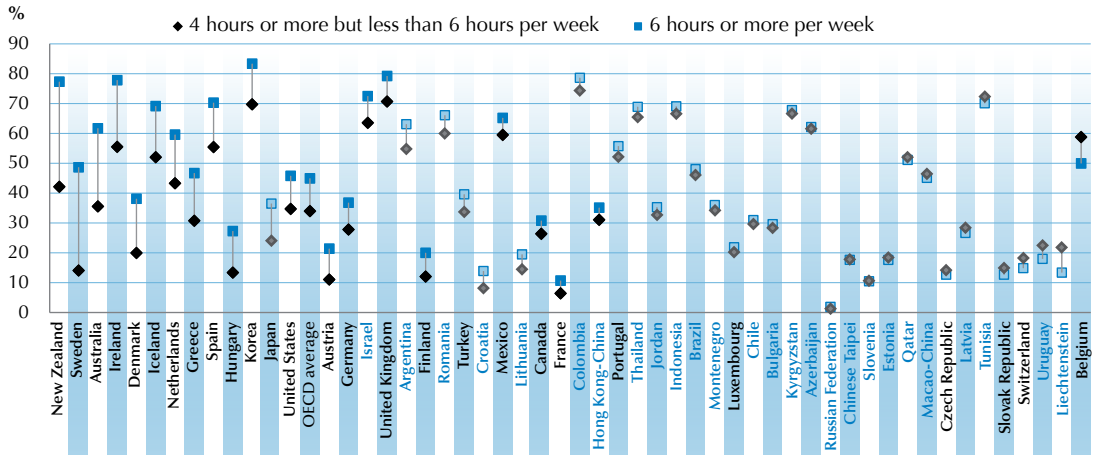
Differences in the proportion of students taking optional courses were also recorded between those who spend six hours or more per week and those who spend four to six hours per week in regular school lessons in science. This was done only for science, since students were asked whether they attended optional courses in science, such as optional biology, physics, chemistry courses, but not for mathematics and the language of instruction. Figure 4.4 shows that students who spend six hours or more tend to take more optional science courses, while students who spend four to six hours tend to take more compulsory science courses. This pattern is prominent especially in the OECD countries. On average across OECD countries, the difference in proportion of students who take optional courses is 11%, favouring students who spend 6 hours or more in regular school lessons. In New Zealand and Sweden, the difference in the proportion of students taking optional courses favouring students who spend 6 hours or more in regular school lessons is more than 30%, while in France and the partner country Colombia the difference is less than 5%.

This suggests that students who spend a long time in regular science classes believe that doing well in science is important, and tend to take more optional courses than students who spent a moderate amount of time in school lessons. These findings partly support the hypothesis that students who spend more time studying science are those who choose to spend more time in regular school lessons as optional courses. However, this conclusion is limited, given that the data concerning the proportion of students who take optional courses in regular school lessons is only available for the subject of science and not for mathematics or the language of instruction.

In many countries, schools typically tend to offer classes in mathematics and in the language of instruction as compulsory courses. Thus, students may be obliged to attend classes in mathematics and the language of instruction, and those students who are underperforming in mathematics or reading may be required to take more classes to catch up with other students. In turn, students who are obliged to spend a long time in regular school lessons perform lower than students who spend a moderate amount of time in regular school lessons in mathematics and the language of instruction.

It is, thus, somewhat misleading to conclude that spending a long time in regular school lessons is an inefficient way to achieve better performance if that conclusion is only based on the results for mathematics and reading shown in Figure 4.3. Educational curricula vary across countries, and the amount of time allocated to each subject across different grade levels differs greatly among countries. Rules and practices on how much choice students have in taking various regular school lessons vary across subjects and across education systems. In order to determine who are the students spending a long time in regular school lessons in mathematics and the language of instruction, and how students' choice of classes and their interest in subjects play a role in the relationship between learning time and performance, it is essential to conduct further study and collect relevant information on school curricula and practices.

Figure 4.4
Difference in percentage of students who take optional science courses, by learning time in regular school lessons in science



Note: Differences that are statistically significant are marked in a darker tone.
Countries are ranked in descending order of the difference in percentage of students who take optional courses between students who spend 6 hours or more a week in school lessons and 4 to 6 hours a week in school lessons in science.
Source: *OECD PISA 2009 Database*, Table 4.4.

The role of students' motivation

When students can choose whether or not to participate in more science lessons in school, how does their motivation to learn science influence the relationship between learning time and performance? In PISA 2006, students were asked to report whether doing well in the subject of science was "very important", "important", "of little importance" or "not important at all" to them. The relationships between learning time in regular school lessons in science and performance in science are compared between students who reported that doing well in science was very important and other students who reported that doing well in science was not very important.

Figure 4.5 provides a comparison of students with different views on the importance of doing well in science. It shows that the relationship between learning time in regular school lessons in science and performance in science is similar when students spend less time learning, but the difference increases when students spend a long time learning. On average across OECD countries, among students who reported that doing well in science was very important, an increase of one hour in regular school lessons in science corresponds to an increase of around 26 score points in performance. Among students who reported that doing well in science was not very important, an increase of one hour in regular school lessons in science corresponds to an increase of around 22 score points in performance, after the socio-economic background of students and schools was taken into account. This means that when these two groups of students with different views on the importance of doing well in science are compared, the difference in performance increases by four score points for every additional hour a student spends learning science in regular school lessons. Consequently, there is a substantial difference in performance – 20 score points or more – between these students when they spend five hours or more per week in regular school lessons in science (Table 4.5a).

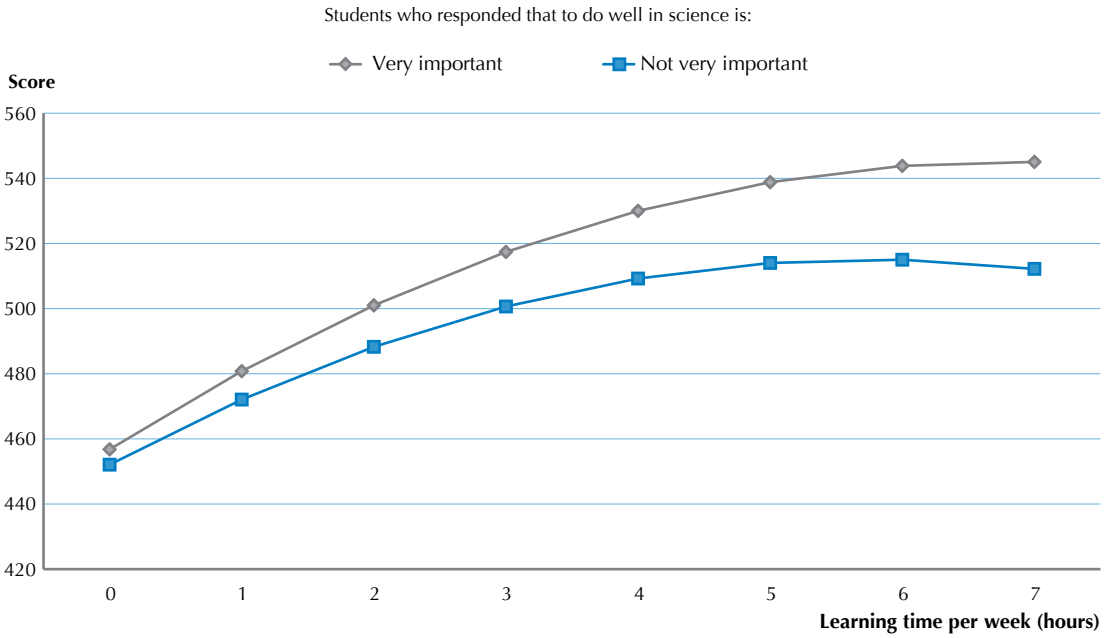
A similar pattern is observed in 19 OECD countries and 14 partner countries and economies. In France, Iceland, Portugal, Spain, New Zealand, Greece, the Czech Republic and the partner country Romania, the difference in performance between students with different views on science increases by six score points or more for every additional hour in regular school lessons in science.

When students in academic and vocational schools are analysed separately (Table 4.5b), the same kind of pattern appears, showing an increase in score points for every additional hour a student is in school. One might argue that this pattern could be the result of students' various motivations and reasons for attending each school type (academic or vocational), rather than students' different views on the importance of doing well in science. For example, students in vocational schools may be less likely to believe that doing well in science is important, while students in academic schools may be more likely to prioritise science in their lives. Perhaps students' different attitudes towards science were influenced by tracking. If so, then the resulting pattern would have strongly favoured academic students. However, when students with different views on the importance of doing well in science were compared, the difference in performance increased by four points in academic schools and by two points in vocational schools for every additional hour a student spent learning science in regular school lessons. Tracking was thus eliminated as a possible explanation for the different views of importance of science and science performance.

The resulting patterns imply that when students believe that doing well in science is very important, spending more time learning science in regular school lessons is a more efficient way of improving their performance. This result confirms what Carroll propounded: students' full engagement is one of the key factors for learning (Carroll, 1963). Thus, it is crucial to make the most of learning time and of students' quality of learning per hour, since it is not often feasible to increase the absolute number of learning hours because students have a limited amount of learning time in school. The more important task would be to enhance students' understanding of why it is important to learn a particular subject. That could help make learning time more efficient.

Figure 4.5

Relationship between performance in science and learning time in regular school lessons in science, by students' perception of doing well in science



Source: *OECD PISA 2006 Database*, Table 4.5a.

LEARNING TIME IN OUT-OF-SCHOOL-TIME LESSONS AND PERFORMANCE

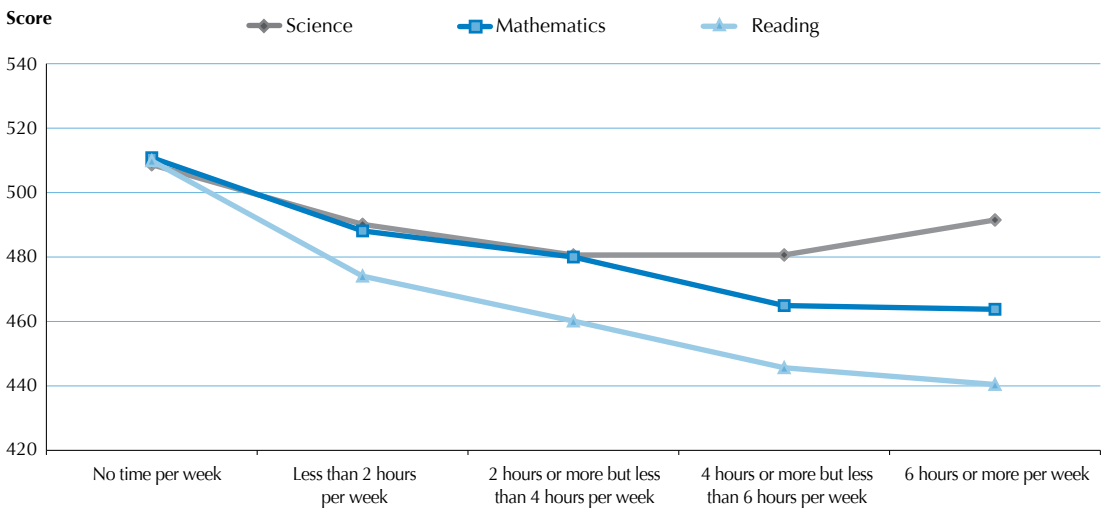
Science

The patterns reflecting the relationship between the out-of-school-time lessons and science performance are vastly different from those concerning regular school lessons. In science, there is a consistently negative relationship between learning time in out-of-school-time lessons and performance in most countries. In general, students who spend more time learning science in out-of-school-time lessons tend to perform lower in science, as shown in Figure 4.6. Across OECD countries, students who spend less than two hours per week in out-of-school-time lessons in science tend to perform 19 score points lower in science than students who do not spend any time learning science in out-of-school-time lessons; students who spend between two and six hours tend to perform 28 score points lower; students who spend six or more hours per week show little difference in performance from students who do not spend any time learning science. A similar relationship is observed even when adjusting for the socio-economic background of students and schools, and for students' science learning time in regular school lessons and individual study (Table 4.6a).

However, in Greece, Turkey and the partner countries and economies Azerbaijan, Hong Kong-China, Chinese Taipei, Thailand and Tunisia, students who spend time learning science in out-of-school-time lessons tend to achieve higher scores than students who do not spend any time learning science in out-of-school-time lessons. The relationship remains positive after adjusting for the socio-economic background of students and schools in all of these countries, except for Azerbaijan and Chinese Taipei, even though the positive differences become smaller. The relationship disappears in all countries except Turkey, however, when adjusting for learning time in regular school lessons and learning time in individual study, and for the socio-economic background of students and schools (Table 4.6a).

Figure 4.6

Within-country relationship between performance and learning time in out-of-school-time lessons, by subject (OECD average)



Source: *OECD PISA 2006 Database*, Tables 4.6a, 4.6b and 4.6c.

Mathematics

In mathematics as in science there is a consistently negative relationship between learning time in out-of-school-time lessons and performance in most countries. In general, students who spend more time learning mathematics in out-of-school-time lessons tend to perform less well in mathematics, as shown in Figure 4.6. Across OECD countries, students who spend less than 2 hours per week in out-of-school-time lessons in mathematics tend to perform 23 score points lower in mathematics than students who do not spend any time learning mathematics in out-of-school-time lessons; students who spend 2 to less than 4 hours per week tend to perform 31 score points lower; students who spend 4 to less than 6 hours per week tend to perform 46 score points lower; and students who spend 6 or more hours per week tend to perform 47 score points lower. A similar relationship is observed even when adjusting for the socio-economic background of students and schools, and for students' mathematics learning time in regular school lessons and individual study (Table 4.6b).

Some positive relationships between learning time in out-of-school-time lessons in mathematics and performance in mathematics are found in a few countries, including Greece, Korea, the Slovak Republic, Turkey and the partner countries and economies Chinese Taipei and Tunisia. After adjusting for learning time in regular school lessons and individual study, in addition to the socio-economic background of students and schools, only a slight positive relationship can be observed in Korea, Turkey and the partner economy Chinese Taipei.

Language of instruction

In most countries, there is also a consistently negative relationship between learning time in out-of-school-time lessons and performance in the language of instruction. In general, students who spend more time learning the language of instruction in out-of-school-time lessons tend to perform lower in reading, as shown in Figure 4.6. Across OECD countries, students who spend less than 2 hours per week in out-of-school-time lessons in the language of instruction tend to perform 36 score points lower in reading than students who do not spend any time learning the language of instruction in out-of-school-time lessons; students who spend 2 to less than 4 hours per week tend to perform 50 score points lower; students who spend 4 to less than 6 hours per week tend to perform 64 score points lower; and students who spend 6 or more hours per week tend to perform 69 score points lower. A similar relationship is observed even when adjusting for the socio-economic background of students and schools, and for students' learning time on the language of instruction in regular school lessons and individual study (Table 4.6c).

However, there are some positive relationships between learning time in out-of-school-time lessons in the language of instruction and performance in reading in Korea and the Slovak Republic, even after the socio-economic background of students and schools are adjusted for. After adjusting for learning time in regular school lessons and individual study, and for the socio-economic background of students and schools, only a slight positive relationship can be observed: in Korea, students who spend 2 to less than 4 hours per week tend to perform 12 score points higher than students who do not spend any time learning the language of instruction in out-of-school-time lessons, while in the Slovak Republic, students who spend less than 2 hours per week in out-of-school-time lessons on the language of instruction tend to perform 7 score points higher than students who do not spend any time learning the language of instruction in out-of-school-time lessons.

Performance by different types of out-of-school-time lessons

Since PISA is a cross-sectional study, it is difficult to determine the causality of the relationships. Thus the results of this examination of the relationship between the specific types of out-of-school-time lessons and performance should be interpreted with caution. The difference in performance between students who do not take any out-of-school-time lessons and those who attend one type of out-of-school-time lesson cannot be conclusively attributed to the effectiveness of the out-of-school-time lessons.

Seven types of out-of-school-time lessons are defined according to two factors: size of lessons and affiliation of instructors. Students are thus grouped into one of the following three categories: those who attend one-to-one lessons only, group lessons only, or both one-to-one and group lessons. Students are also grouped into one of the following three categories: those who attend out-of-school-time lessons with an instructor who is a teacher at the students' schools (*i.e.* with a school teacher) only, out-of-school-time lessons with an instructor who is not a teacher at the students' schools (*i.e.* with a non-school teacher) only, or both out-of-school-time lessons with school and non-school teachers. Consequently, students are grouped into nine mutually exclusive types. As in many countries, there are very few students who attend the type of "one-to-one lessons only with a school teacher only" and the type of "one-to-one-lessons only with both school and non-school teachers", these two types are merged and labelled as "others". For the rest of seven types of out-of-school-time lessons, student's average performance is computed and compared with the performance score for students who do not attend any of these types of out-of-school-time lessons.

Below are the seven different types of out-of-school-time lessons with the variable names presented in brackets:

- one-to-one lesson with a non-school teacher [TYPE1];
- group lesson with a school teacher [TYPE2];
- group lesson with a non-school teacher [TYPE3];
- group lesson with both school and non-school teachers [TYPE4];
- both one-to-one lessons and group lessons with school teachers [TYPE5];
- both one-to-one lessons and group lessons with non-school teachers [TYPE6]; or
- both one-to-one lessons and group lessons with both school and non-school teachers [TYPE7].

Students' performance in science, mathematics and reading are considered simultaneously, since the questions regarding the different types of out-of-school-time lessons were not asked separately by subject, but for subjects that students were learning at school in general. A structural equation model developed for this analysis is presented in the annex.

As shown in Figure 4.7, students who attend out-of-school-time lessons generally perform less well than students who do not attend out-of-school-time lessons in all types of out-of-school-time lessons, except students who attend "group lesson with a non-school teacher" and "group lesson with a school teacher".

As presented in Box 4.2, among these seven different types of out-of-school-time lessons, the type of "group lesson only with a non-school teacher" shows the most consistent positive relationship with performance across countries, after holding constant the socio-economic background of students and schools. Suppose that there are two students from families with similar socio-economic backgrounds in schools with similar socio-economic backgrounds. One of the students does not take any types of out-of-school-time lessons, while the other student is involved in a "group lesson with a non-school teacher". The latter student performs

better than the former in seven OECD countries and nine partner countries and economies (Table 4.7). Students who are involved in "group lessons only with a non-school teacher only" perform around 20 score points or higher in Turkey, Greece, Korea, Australia, Poland and in the partner countries and economies Chinese Taipei, Bulgaria, Hong Kong-China and Kyrgyzstan.

Students who are involved in a "group lesson with a school teacher" also tend to achieve higher scores than students who do not take any type of out-of-school-time lessons, after adjusting for the socio-economic background of students and schools. This positive relationship can be observed in five OECD countries and five partner countries and economies: Korea, the United Kingdom, Poland, Italy, Turkey and the partner countries and economies Kyrgyzstan, the Russian Federation, Lithuania, Bulgaria and Chinese Taipei (Table 4.7).

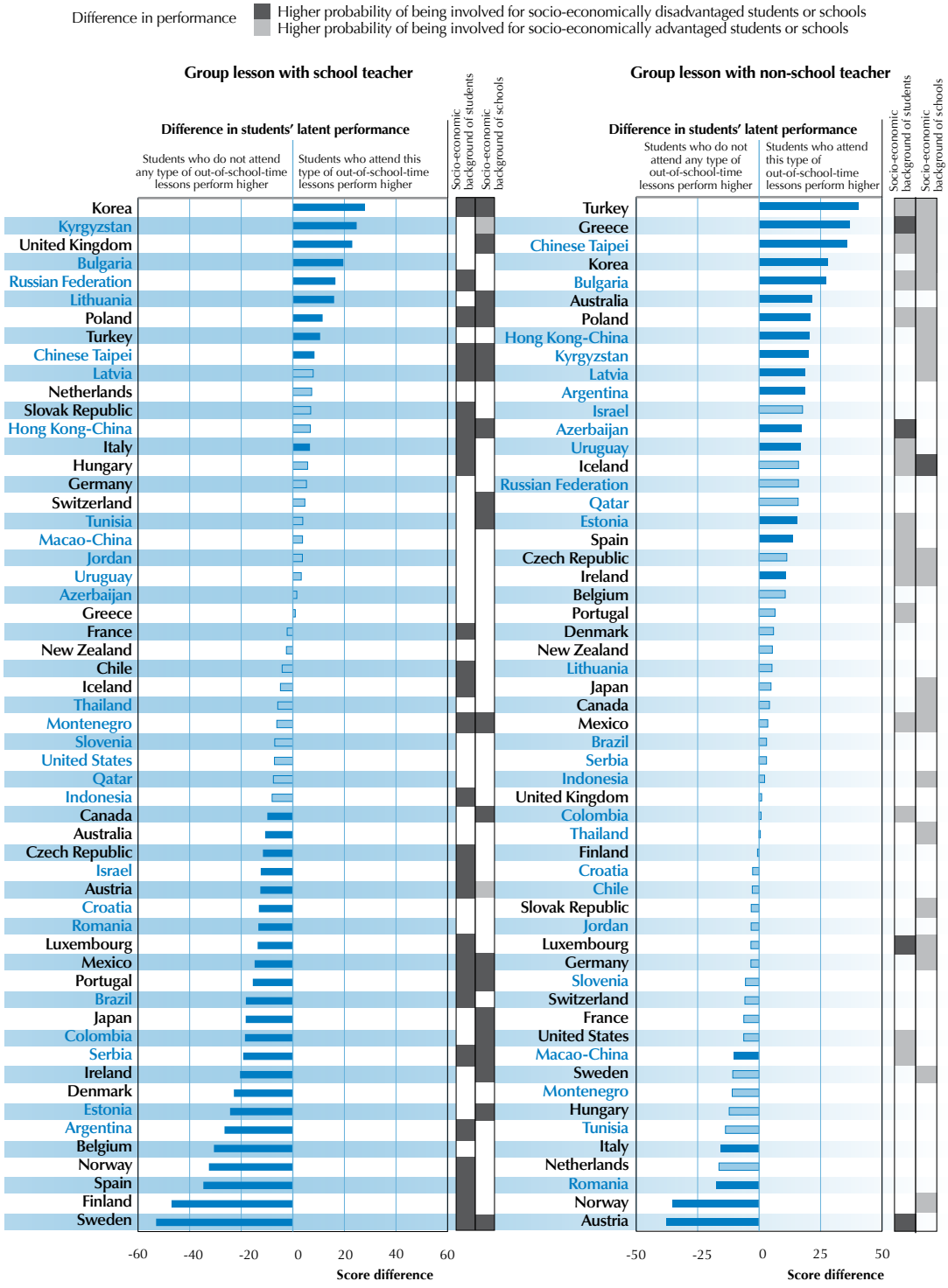
Box 4.2. **Summary of performance difference by seven types of out-of-school-time lessons**

The table below presents the number of countries that show a significant difference, either negative or positive, between the average performance of students who attend a certain type of out-of-school-time lesson and the average performance of students who do not attend any type of out-of-school-time lesson. The number of OECD countries is indicated in brackets. For example, regarding "one-to-one lessons only with non-school teacher only", in 32 countries (of which 20 are OECD countries), students who attend this type of out-of-school-time lesson tend to perform lower than students who do not attend any type of out-of-school-time lesson. However, in three countries (of which two are OECD countries), students who attend this type of out-of-school-time lesson tend to achieve higher scores than students who do not attend any type of these lessons.

		Affiliation of instructors					
		School teacher		Non-school teacher		Both school and non-school teachers	
		Negative	Positive	Negative	Positive	Negative	Positive
Size of lessons	One-to-one lesson			32(20)	3 (2)		
	Group lesson	22 (15)	10 (5)	5(3)	16 (7)	47 (27)	2(1)
	Both one-to-one and group lessons	46 (25)	1 (0)	30 (20)	6 (4)	55 (29)	1(1)

Source: *OECD PISA 2006 Database*, Table 4.7.

Figure 4.7
Difference in students' latent performance, by different types of out-of-school-time lessons



Note: Differences that are statistically significant are marked in a darker tone.
Countries are ranked in descending order of the difference in students' latent performance.
Source: *OECD PISA 2006 Database*, Table 4.7.

While out-of-school-time lessons can enhance learning, these lessons could also reinforce inequalities, since they vary across socio-economic groups. Which types of out-of-school-time lessons enhance learning without introducing inequities? And in which countries are they found?

When focusing on the countries where the "group lesson with a school teacher" or "group lesson with a non-school teacher" types are related to better performance, different patterns emerge in the way these lessons mediate the relationship between students' socio-economic background and performance. The "group lesson with a school teacher" tends to reduce the impact of socio-economic background on performance, since socio-economically disadvantaged students are more likely to attend this type of lesson (*i.e.* negative logit scores in Table 4.7) and are, in turn, more likely to achieve higher scores than students who do not participate any out-of-school-time lesson. The results show that, out of ten countries in which there are positive relationships between performance and the "group lesson with a school teacher", socio-economically disadvantaged students and/or schools tend to be more involved in this type of lesson than socio-economically advantaged students and/or schools in seven of these countries: Korea, the United Kingdom, Poland, Italy and the partner countries and economies the Russian Federation, Lithuania and Chinese Taipei. Only in Kyrgyzstan does this type of out-of-school-time lesson reinforce inequity, as socio-economically advantaged schools tend to be more involved in these lessons and tend to achieve higher scores (Table 4.7).

In contrast, the "group lesson with a non-school teacher" tends to reinforce the impact of socio-economic background on performance, since socio-economically advantaged students are more likely to attend this type of lesson (*i.e.* positive logit scores in Table 4.7) and are, in turn, more likely to achieve higher scores than those students who do not participate in any out-of-school-time lessons. Consequently, the difference in performance between socio-economically advantaged and disadvantaged students and/or schools is magnified by this type of out-of-school lesson. The results show that out of 16 countries that show a positive relationship between performance and "group lesson with a non-school teacher", more advantaged students and/or schools tend to be involved in this type of out-of-school-time lessons in 12 countries and economies.

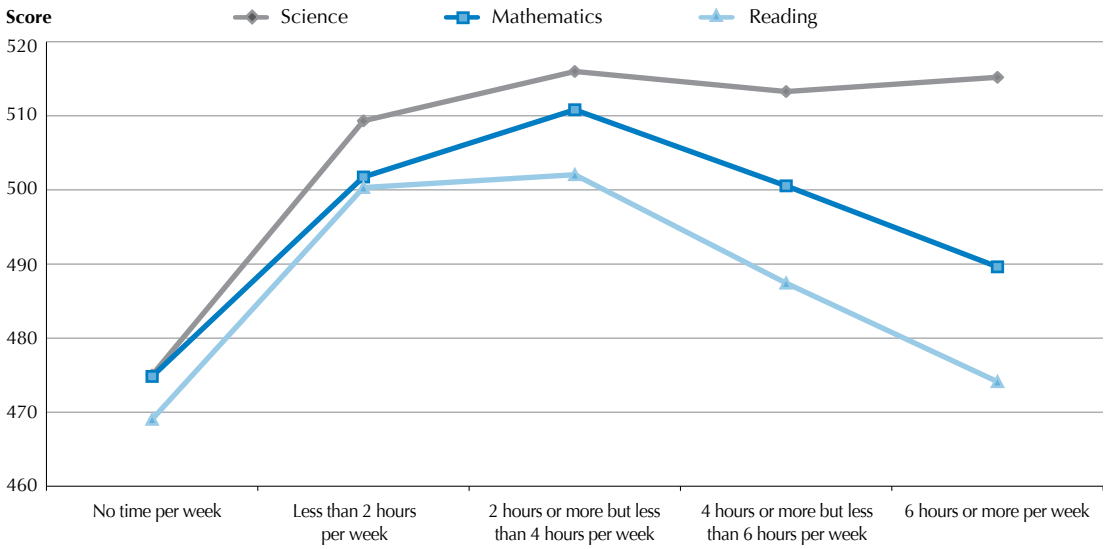
LEARNING TIME IN INDIVIDUAL STUDY AND PERFORMANCE

Science

In most countries, students who spend more time engaged in individual study of science achieve higher scores than students who do not spend any time in individual study of science. As shown in Figure 4.8, across OECD countries, students who spend less than 2 hours per week in individual study of science tend to perform 34 score points higher in science than students who do not spend any time in individual study of science; students who spend 2 to less than 4 hours per week tend to perform 41 score points higher; students who spend 4 to less than 6 hours per week tend to perform 38 score points higher; and students who spend six or more hours per week tend to perform 40 score points higher (Table 4.8a).

Even though students who spend time in individual study of science outperform those who do not, in some countries, spending more time in individual study is not necessarily related to better performance. The relationship between learning time in individual study of science and performance in science is not linear; often the relationship shows a steep increase up to four hours per week, but then decreases slightly. Students who spend a moderate amount of time, around two to four hours per week, tend to achieve the highest scores and perform better than students who spend six hours or more per week.

Figure 4.8
Within-country relationship between performance and learning time in individual study, by subject (OECD average)



Source: *OECD PISA 2006 Database*, Tables 4.8a, 4.8b, and 4.8c.

Mathematics

As with the study of science, students who spend a moderate amount of time in individual study in mathematics tend to achieve the highest scores, while students who spend a long time in individual study in mathematics do not perform as well as those who spend a moderate amount of time. This pattern is more prominent for individual study in mathematics than for individual study of science. As shown in Figure 4.8, across OECD countries, students who spend less than two hours per week in individual study in mathematics tend to perform 27 score points higher in mathematics than students who do not spend any time in individual study in mathematics; students who spend two to less than four hours per week tend to perform 36 score points higher; and students who spend four to less than six hours per week tend to perform 26 score points higher. But students who spend six or more hours per week do not tend to achieve higher scores (Table 4.8b).

In some countries, students who spend a long time in individual study in mathematics tend to perform even lower than students who do not spend any individual study time. For example, in Switzerland, Austria, Luxembourg, the Czech Republic and Iceland, students who spend six or more hours per week in individual study in mathematics tend to perform lower, by 28 to 72 score points, in mathematics than students who do not spend any time in individual study. In Switzerland, the Czech Republic, Sweden and the partner country Israel, students who spend from four to less than six hours per week in individual study in mathematics tend to perform lower, by 24 to 40 score points than students who do not spend any time in individual study.

Language of instruction

Students who spend a moderate amount of time in individual study in the language of instruction achieve higher scores than students who spend a long time in individual study. In general, the relationship between learning time in individual study in reading and performance in reading show a mountain shape, as shown in Figure 4.8. Across OECD countries, students who spend less than two hours per week in individual study in the language of instruction tend to perform 31 score points higher in reading than students who do not

spend any time in individual study on the language of instruction; and students who spend from 2 to less than 4 hours per week tend to perform 33 score points higher. But students who spend four or more hours per week do not tend to achieve higher scores (Table 4.8c).

In ten OECD countries and nine partner countries and economies, students who spend six or more hours per week in individual study in the language of instruction achieve higher scores than students who do not spend any time in individual study. However, in Austria, Switzerland, Germany, Luxembourg, Ireland and the partner countries Israel and Argentina, students who spend 6 or more hours per week in individual study in the language of instruction tend to perform lower than students who do not spend any time in individual study, by 24 to 105 score points.

In all three subjects, students who spend up to four hours per week more in individual study tend to achieve higher scores, but beyond four hours per week, students do not necessarily achieve higher scores in proportion to the time they spend. This may be because of differences in characteristics between students who spend a long time in individual study and those who spend a moderate amount of time. For example, students who spend long hours in individual study are often the students who need more time than other students to complete a certain number of tasks. Students may also spend a long time in individual study because their teachers give them additional assignments in order to catch up with other classmates. Thus, there is not enough evidence to conclude that the efficiency of learning time diminishes after a certain amount of time dedicated to individual study.

DO STUDENTS WHO STUDY LONGER PERFORM BETTER?

Across countries, relative learning time in regular school lessons, which is equivalent to the proportion of absolute learning time in regular school lessons out of absolute total learning time, which includes time spent in regular school lessons, out-of-school-time lessons and individual study, is strongly related to performance. Countries with a higher proportion of time allocated to regular school lessons tend to perform better. Students in high-performing countries spend less relative time, on average, in out-of-school-time lessons and individual study, and more relative time in regular school lessons than students in low-performing countries.

Compared with the countries with high relative learning time in regular school lessons, the countries with low relative learning time in these lessons turn out to have system characteristics that are related to low overall performance: less human and material resources, less school autonomy and lower proportions of standardised external examinations. The evidence implies that it is the quality of regular school lessons, not the quantity of learning hours, that explains more of the difference in performance across countries.

Within countries, the absolute length of learning time in regular school lessons is more strongly related to performance than relative learning time in regular school lessons. This is because the quality of learning time in regular school lessons within countries does not vary as much as across countries.

Students who spend a long time in regular school lessons in science do better than those who spend a shorter amount of time in regular science classes, but the same is not true in mathematics and the language of instruction: students who spend a long time learning these two subjects in regular school lessons perform less well than students who spend a moderate amount of time in regular school lessons. One hypothesis for this difference among the three subjects is that the students who spend a long time in regular school lessons in science are those who choose to do so in optional courses, because they are interested in science, while students who spend a long time in regular school lessons in mathematics and in the language of instruction are obliged to do so for remedial purposes. In addition, when students in regular school science lessons believe that it is very important to do well in science, they use their time in school classes more efficiently to

perform better. These results imply that when students believe that doing well in science is very important, spending more time learning science in regular school lessons is a more efficient way of improving their performance.

Students who spend a long time in out-of-school-time lessons tend to perform lower in all three subjects. However, in the two specific types of out-of-school-time lessons, "group lesson with a non-school teacher" and "group lesson with a school teacher", students in several countries tend to achieve higher scores than students who do not attend any out-of-school-time lessons.

While "group lessons with a non-school teacher" seem to lead to better student performance, these types of out-of-school-time lessons sometimes reinforce educational inequity. "Group lessons with a school teacher", however, seem to provide both quality and equity in some countries. Socio-economically disadvantaged students are more likely to be involved in these types of lessons and tend to achieve higher scores than students who do not take any type of out-of-school-time lessons.

Students who spend up to four hours per week more in individual study in science, mathematics and reading tend to achieve higher scores, but beyond four hours per week, students do not necessarily achieve higher scores in proportion to the time they spend. This may be because of differences in characteristics between students who spend a long time in individual study and those who spend a moderate amount of time. For example, students who spend long hours in individual study are often the students who need more time than other students to complete a certain number of tasks.

POLICY IMPLICATIONS

For policy makers

Improve quality of in-school lessons

Across countries, absolute learning time in schools is positively, but weakly, related to performance, but relative learning time in schools – the proportion of time spent in school classes relative to other learning activities – is more strongly related to performance. The implication of this finding is that the quality of school lessons leads to better overall student performance.

Given these findings, simply adding hours to the school day or encouraging students to spend more time in after-school lessons or individual study would not automatically help low-performing countries improve their test scores. Instead, these countries should explore ways to improve the quality of school lessons. One way of doing so would be to improve the quality of teachers. Training to at least a minimum standard of subject knowledge and confidence in working with students should be required of all teachers. Resources for education should be bolstered to the greatest extent possible to ensure the quality of education. Countries could also consider giving schools more autonomy in staffing, budget and curriculum decisions. This will give school officials greater incentive to make the most of the resources available to them. In addition, developing an independent system to assess student performance would improve accountability in individual schools and help raise the quality of education among all schools within the country.

An in-depth study of how regular school lessons are structured – including when in the day classes are held, class size, length of school day and school term, the length and frequency of vacation time – could assist policy makers in developing a schedule of school lesson time that is most effective for learning.

Promote learning activities that foster equity

In several countries, students who attend after-school group lessons tend to achieve higher scores than students who do not attend any out-of-school-time lessons.

But there is a difference in equity between those out-of-school-time lessons taught by a school teacher and those taught by a non-school teacher. While group lessons with a non-school teacher seem to be related to high performance, they could reinforce educational inequity, since socio-economically advantaged students are more involved in this type of out-of-school-time lesson and consequently achieve higher scores. Group lessons with a school teacher, however, offer both quality and equity. Socio-economically disadvantaged students are more likely to be involved in this type of out-of-school-time lesson and tend to achieve higher scores than students who do not take any type of out-of-school-time lesson. This is the case in Korea, the United Kingdom, Poland, Italy and the partner countries and economies the Russian Federation, Lithuania and Chinese Taipei. An in-depth study of how these lessons with a school teacher are organised in these countries would help policy makers develop recommendations on offering similar kinds of lessons in other countries.

...

For school administrators, teachers, parents and students

Motivate students

The relationship between learning time and performance within countries is different from that between countries. Here, the absolute length of learning time in regular school lessons is more strongly related to performance than relative learning time in school, probably because the quality of learning time in regular school lessons does not vary much between schools within countries.

In many countries, students who spend more time in regular school lessons in science tend to achieve higher scores, while students who spend more time in regular school lessons in mathematics and the language of instruction achieve lower scores than students who spend a moderate amount of time. One possible explanation for these different relationships is that students tend to have the flexibility to choose whether they spend more time in science classes, while they tend to be obliged to attend mathematics classes and classes on the language of instruction.

Students who have more freedom to choose optional courses tend to take classes in subjects that interest them. The study shows that when students believe it is very important to do well in science, they use their learning time in school more efficiently and effectively, and so achieve higher scores. Teachers, schools, and policy makers could not only encourage students to spend more time in learning, but also develop measures to help change attitudes. As resources permit, schools could offer more optional courses for those students who show an interest in exploring their required subjects more deeply or in broadening the range of subjects they study. Parents could emphasise the importance of learning each subject, perhaps by explaining how mastery of those subjects will broaden their children's future job opportunities, enable them to participate fully in society and enrich their lives.

The importance of learning science should be emphasised to all students, but particularly to boys, students from socio-economically disadvantaged backgrounds, those in rural schools, in public schools and in vocational schools, as these students tend to spend less time in school science classes.