



Making Connections and Taking Responsibility

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STUDENT ATTITUDES AND LEARNING ABOUT THE ENVIRONMENT

While knowledge and scientific understanding of the environment and geoscience are essential, if youths cannot make connections between their cognitive skills and real issues, or if they see the future too optimistically or pessimistically to address issues, then they may not be able to fully capitalise on their academic training in these topics.

A student's attitudes, behaviours, and future engagement with the environment are likely the result of multiple factors including knowledge, awareness and social expectations (Bybee, 2005). Education can help students make connections between the science they learn in school and real world problems and develop realistic attitudes towards solution strategies.

The PISA 2006 sample represents 15-year-olds who have grown up in a world with greater focus on environmental issues. Widespread public discussion about environmental issues and solutions has been prominent over the last several decades. For example, The Eurobarometer 300 report, published in September 2008, places global warming/climate change as the second most important global concern of the European public after poverty and lack of food or drinking water. Additionally, 67% of 15-24 year-old citizens of the European Union and 69% of students in the European Union believe that global warming/climate change is a serious problem affecting the whole world (EU, 2008).

This chapter reviews student attitudes towards the environment. It describes how familiar, responsible and optimistic students are towards a set of environmental issues. It then presents how aware students are of more complex environmental issues. The chapter also reviews how different student characteristics, such as gender or socio-economic background, are associated with attitudes. Lastly, it analyses the relationship between attitudes and performance in environmental science.

A recent household study in OECD countries shows that environmental attitudes and behaviour are intertwined. It also shows an association between education and environmental attitudes and behaviour (see Box 3.1).

Box 3.1 **The OECD Survey on Household Environmental Behaviour**

In 2008, the OECD Environment Directorate implemented a web-based survey of 10 000 households in ten OECD countries (Australia, Canada, Czech Republic, France, Italy, Korea, Mexico, Netherlands, Norway, and Sweden) in which respondents were requested to provide information on their environmental attitudes, behaviour and expenditures. The purpose of the study is to assess the role of environmental policy design, market factors, environmental sensitivity and norms, as well as socio-demographic characteristics on households' environment-related behaviour (e.g. propensity to recycle, willingness to pay for renewable energy, organic food expenditures).

The preliminary results from this survey show some interesting links between education and environmental attitudes. More educated individuals tend to report higher levels of concern for environmental issues. While this correlation is certainly due in part to confounding factors (such as the high correlation between income and educational achievement), empirical work currently underway as part of the project supports the finding that the level of education has a significant and positive effect on environmentally-responsible behaviour, and sometimes stronger than income.

The OECD survey also analyses the relationship between education and behaviour. For example, the evidence suggests that recycling and water saving behaviour is positively associated with education. The results also indicate that the more educated are more likely to be willing to pay a premium to use only "green" electricity. Willingness to pay for organic food is also found to increase with education.

More information on this project can be found here: www.oecd.org/env/cpe/consumption



MAIN RESULTS OF THIS CHAPTER

The vast majority of 15-year-olds in countries participating in PISA, regardless of family background, gender or immigrant background, report that:

- they are familiar with basic environmental issues;
- they feel a strong sense of responsibility for the state of the environment; and
- they would like others in their country to share such responsibility.

In contrast, only a minority of students report being optimistic about future improvements in the environment. As well as reporting familiarity with the most common environmental issues, many students also claim to have an understanding of more complex environmental challenges. This is more common with certain issues such as deforestation than with other such as genetically modified organisms.

Some aspects of attitudes towards the environment are associated with performance in environmental science:

- students' sense of responsibility for environmental issues appears to have no association with performance;
- students with lower performance tend to be more optimistic about the future of the environment; and
- students with higher performance tend to report greater awareness of complex environmental issues.

The associations with performance noted here do not tell us whether having certain attitudes help students understand environmental issues and hence perform well on environment-related questions; or whether conversely, high performance/understanding creates certain attitudes; or whether some other factors have a joint effect on performance and attitudes.

PISA AND STUDENT ATTITUDES TOWARDS ENVIRONMENTAL ISSUES

The PISA 2006 survey asked students and their parents about their attitudes towards the environment. Box 3.2 presents the actual questions. Questions 23, 24 and 25 in the student questionnaire, and questions 7 and 8 in the parent questionnaire relate to six selected environmental issues: *i*) Air pollution, *ii*) Energy shortages, *iii*) Extinction of plants and animals, *iv*) Clearing of forests for other land use, *v*) Water shortages, and *vi*) Nuclear waste.

First, students were asked from which source they had learned about these issues (Box 3.2, question 23). The question allowed students to respond that they were not sure what these issues are. This part of the question can be used to measure the proportion of students who feel informed and familiar with these environmental issues (those that did not mark this option but rather reported learning something about these issues from some of the proposed sources). Chapter 4 explores in detail students' answers to the whole question on the sources of student knowledge about environmental issues.

Additionally, students and parents were asked whether they felt responsibility for these issues (Box 3.2, question 24 for students and question 7 for parents) and how optimistic (Box 3.2, question 25 for students and question 8 for parents) they were that solutions would yield improvements over the next 20 years. Four indices (two for parents and two for students) are produced for these questions: the *index of student' (parents') sense of responsibility for environmental issues* and the *index of students' (parents') optimism regarding environmental issues*.¹

To gauge students' awareness and perceived understanding of some specific complex environmental challenges, students were asked how informed they felt and how much they could explain about the following five complex environmental challenges: *i*) The increase of greenhouse gases in the atmosphere, *ii*) Use of genetically modified organisms (GMO), *iii*) Acid rain, *iv*) Nuclear waste, and *v*) The consequences of clearing forests for other land use (Box 3.2, question 22). This index is referred to as the *index of student awareness of complex environmental issues*.



Box 3.2 Actual questions towards environmental issues

PISA 2006 Student Questionnaire

Q22 – How informed are you about the following environmental issues?

(Please tick only one box in each row)

		I have never heard of this	I have heard about this but I would not be able to explain what it is really about	I know something about this and could explain the general issue	I am familiar with this and I would be able to explain this well
ST22Q01	a) The increase of greenhouse gases in the atmosphere	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST22Q02	b) Use of genetically modified organisms (<GMO>)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST22Q03	c) Acid rain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST22Q04	d) Nuclear waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST22Q05	e) The consequences of clearing forests for other land use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q23 – From which source(s) did you mainly learn about each of these environmental issues?

(Please tick as many boxes as apply in each row)

		None of these, I am not sure what this is	My school	The TV, radio, newspaper or magazines	My friends	My family	The Internet or books
ST23QA1 to ST23QA6	a) Air pollution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(ST23QA1)	(ST23QA2)	(ST23QA3)	(ST23QA4)	(ST23QA5)	(ST23QA6)
ST23QB1 to ST23QB6	b) Energy shortages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(ST23QB1)	(ST23QB2)	(ST23QB3)	(ST23QB4)	(ST23QB5)	(ST23QB6)
ST23QC1 to ST23QC6	c) Extinction of plants and animals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(ST23QC1)	(ST23QC2)	(ST23QC3)	(ST23QC4)	(ST23QC5)	(ST23QC6)
ST23QD1 to ST23QD6	d) Clearing of forests for other land use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(ST23QD1)	(ST23QD2)	(ST23QD3)	(ST23QD4)	(ST23QD5)	(ST23QD6)
ST23QE1 to ST23QE6	e) Water shortages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(ST23QE1)	(ST23QE2)	(ST23QE3)	(ST23QE4)	(ST23QE5)	(ST23QE6)
ST23QF1 to ST23QF6	f) Nuclear waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(ST23QF1)	(ST23QF2)	(ST23QF3)	(ST23QF4)	(ST23QF5)	(ST23QF6)

Q24 – Do you see the environmental issues below as a serious concern for yourself and/or others?

(Please tick only one box in each row)

		This is a serious concern for me personally as well as others	This is a serious concern for other people in my country but not me personally	This is a serious concern only for people in other countries	This is not a serious concern to anyone
ST24Q01	a) Air pollution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST24Q02	b) Energy shortages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST24Q03	c) Extinction of plants and animals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST24Q04	d) Clearing of forests for other land use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST24Q05	e) Water shortages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST24Q06	f) Nuclear waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q25 – Do you think problems associated with the environmental issues below will improve or get worse over the next 20 years?

(Please tick only one box in each row)

		Improve	Stay about the same	Get worse
ST25Q01	a) Air pollution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST25Q02	b) Energy shortages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST25Q03	c) Extinction of plants and animals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST25Q04	d) Clearing of forests for other land use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST25Q05	e) Water shortages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ST25Q06	f) Nuclear waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



PISA 2006 Parent Questionnaire

Q7 – Do you see the environmental issues below as a serious concern for yourself and/or others?

(Please tick only one box in each row)

		This is a serious concern for me personally as well as others	This is a serious concern for other people in my country but not me personally	This is a serious concern only for people in other countries	This is not a serious concern for anyone
PA07Q01	a) Air pollution	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
PA07Q02	b) Energy shortages	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
PA07Q03	c) Extinction of plants and animals	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
PA07Q04	d) Clearing of forests for other land use	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
PA07Q05	e) Water shortages	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
PA07Q06	f) Nuclear waste	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4

Q8 – Do you think problems associated with the environmental issues below will improve or get worse over the next 20 years?

(Please tick only one box in each row)

		Improve	Stay about the same	Get worse
PA08Q01	a) Air pollution	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
PA08Q02	b) Energy shortages	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
PA08Q03	c) Extinction of plants and animals	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
PA08Q04	d) Clearing of forests for other land use	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
PA08Q05	e) Water shortages	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3
PA08Q06	f) Nuclear waste	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3

To distinguish between the different set of issues and to take into the account the stronger wording of question 22, the report emphasises that awareness measures whether students feel capable of explaining what these issues are and not just whether they have heard of them.

STUDENTS' FAMILIARITY WITH, RESPONSIBILITY FOR, AND OPTIMISM TOWARD GENERAL ENVIRONMENTAL ISSUES

Overall results

The following comparisons across countries should be interpreted with caution since students in different countries may not mean the same thing when they answer questions on attitudinal matters (see Box 3.3).

The vast majority of 15-year-old students report they know or have learnt something about environmental issues. Across OECD countries, on average less than 3% of students report they are not sure what "Air pollution" or "Extinction of plants and animals" is, around 5% report not being sure what "Water shortages" and "Clearing of forests for other land use" is, less than 10% do so for "Energy shortages", and 11% for "Nuclear waste" (Figure 3.1). Across OECD countries, a substantial proportion of students report a very high sense of personal and social responsibility towards these environmental issues (Figure 3.2). On the other hand, most students are not optimistic about improvements occurring over the next two decades (Figure 3.3). Only a minority of students (on average between 13 and 21%) believed that problems associated with environmental issues will improve in the next 20 years.



Box 3.3 Interpreting PISA attitudinal data

Most of the measures presented in this chapter summarise student responses to a series of related questions. Students' responses are reported in two ways, first in terms of percentages of students responding in a particular way, and second in the form of indices calculated from the responses.

In describing students in terms of their attitudes (e.g. awareness, optimism, or responsibility), indices were constructed on which the average OECD student (e.g. the student with an average level of awareness) was given an index value of zero and on which about two-thirds of the OECD student population were between the values of -1 and 1 (i.e. the index has a standard deviation of 1). Therefore, if countries have negative mean index values this does not necessarily imply that students responded negatively to the underlying questions. Rather in these countries, students responded less positively than students on average across OECD countries. Likewise, in countries with positive mean index values students responded more positively than on average in the OECD area.

Care must be taken when comparing both the percentages and the index values across countries as students may not always mean the same thing when answering questions about attitudes.

It is also important to bear in mind that in some of the participating countries where comparatively high percentages of students reported familiarity with environmental issues, significant proportions of 15-year-olds were not enrolled in formal education. In these countries, these higher percentages may be an inaccurate reflection of the 15-year-old population as a whole.

Air Pollution

As would be expected given its ubiquitous nature, air pollution is widely recognised as an environmental issue by 15-year-old students. On average, across OECD countries 98% of students are familiar with air pollution as an environmental issue. This varies little from 91% in the Netherlands to 99.5% in Finland. Among partner countries and economies, the range widens but in half of them or more at least 98% are familiar with air pollution.

Similarly, most 15-year-olds report feeling responsible for the issue of air pollution and view it as a threat to a healthy environment. On average across OECD countries, 92% of students say that they and others in their country must take responsibility for air pollution. This attitude is fairly consistent across countries, with the proportion ranging from 82% in New Zealand to 98% in the Czech Republic. In all but two (Kyrgyzstan and Romania) partner countries and economies over 90% of students felt a responsibility for themselves and/or other people for problems associated with this environmental issue.

Less than one fifth of students, however, are optimistic that air quality will improve over the next 20 years. On average among OECD countries, only 16% are optimistic, while in partner country Montenegro a full 44% of students are optimistic and in Liechtenstein only 12% are optimistic.

Energy shortages

Most 15-year-old students are well aware of the issue of energy shortages. On average, 91% of students in OECD countries report to be familiar with energy as an environmental issue. Again, there is very little variation among OECD countries, and the same is true among partner countries and economies. But in this case the range is wider for OECD countries because in France 72% of students report being familiar with energy shortages, while the lowest proportion among partner countries is 84% in Brazil.



Figure 3.1
Students' familiarity with environmental issues

A	Air pollution
B	Energy shortages
C	Extinction of plants and animals
D	Clearing of forests for other land use
E	Water shortages
F	Nuclear waste

Percentage of students who report that they are familiar with or know something about the following environmental issues through different sources

	A	B	C	D	E	F
Australia	99	94	99	98	98	92
Austria	99	90	99	98	94	90
Belgium	98	81	96	94	89	84
Canada	99	90	98	97	94	89
Czech Republic	99	97	99	98	97	98
Denmark	97	91	98	97	92	90
Finland	99	92	100	97	96	94
France	97	72	95	91	84	80
Germany	98	92	99	97	93	87
Greece	95	89	96	79	95	88
Hungary	99	98	99	97	97	90
Iceland	98	87	97	96	96	90
Ireland	98	95	98	97	97	93
Italy	97	94	98	96	97	84
Japan	99	93	98	97	95	84
Korea	99	97	98	87	99	87
Luxembourg	97	80	97	94	87	81
Mexico	98	81	98	97	98	82
Netherlands	91	88	97	97	90	89
New Zealand	98	95	98	96	95	87
Norway	96	94	98	96	96	88
Poland	99	98	99	99	96	83
Portugal	99	93	99	98	96	93
Slovak Republic	99	98	98	95	98	96
Spain	99	96	99	96	99	92
Sweden	96	89	97	76	93	89
Switzerland	98	81	97	94	90	81
Turkey	98	97	98	97	96	97
United Kingdom	99	97	99	96	97	94
United States	98	95	98	97	95	91
OECD average	98	91	98	95	95	89
Argentina	97	87	97	93	93	76
Azerbaijan	91	90	95	92	92	85
Brazil	98	84	98	95	88	85
Bulgaria	96	96	97	97	96	91
Chile	97	93	96	89	94	80
Colombia	56	87	97	94	95	79
Croatia	99	98	100	98	99	98
Estonia	99	93	99	98	96	93
Hong Kong-China	99	99	99	99	96	85
Indonesia	97	97	98	96	97	70
Israel	92	88	93	87	95	73
Jordan	94	95	96	93	97	90
Kyrgyzstan	91	89	91	85	88	81
Latvia	99	91	99	99	93	92
Liechtenstein	99	88	99	97	93	81
Lithuania	99	94	100	97	93	87
Macao-China	99	99	99	98	99	80
Montenegro	93	91	93	92	94	85
Qatar	85	85	90	87	89	74
Romania	98	86	98	95	91	91
Russian Federation	99	96	98	99	95	96
Serbia	99	96	98	97	98	94
Slovenia	98	98	99	98	99	97
Chinese Taipei	100	99	99	99	100	96
Thailand	98	98	99	96	98	71
Tunisia	90	90	89	88	90	71
Uruguay	98	92	96	94	97	77

Source: OECD PISA 2006 Database, Table A3.1.


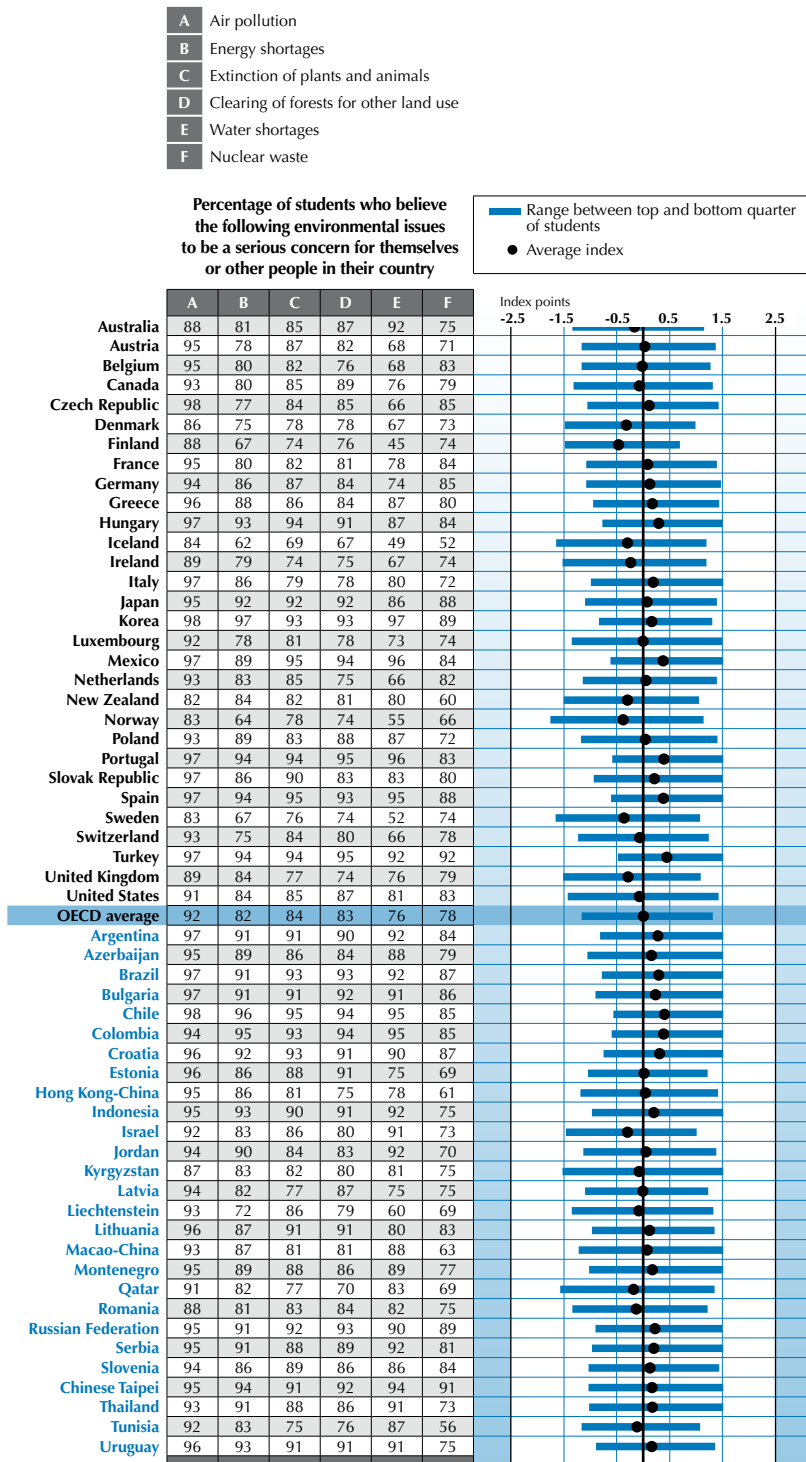
StatLink  <http://dx.doi.org/10.1787/562201383324>



Figure 3.2

Index of students' sense of responsibility for environmental issues



Source: OECD PISA 2006 Database, Table A3.2.

StatLink <http://dx.doi.org/10.1787/562201383324>

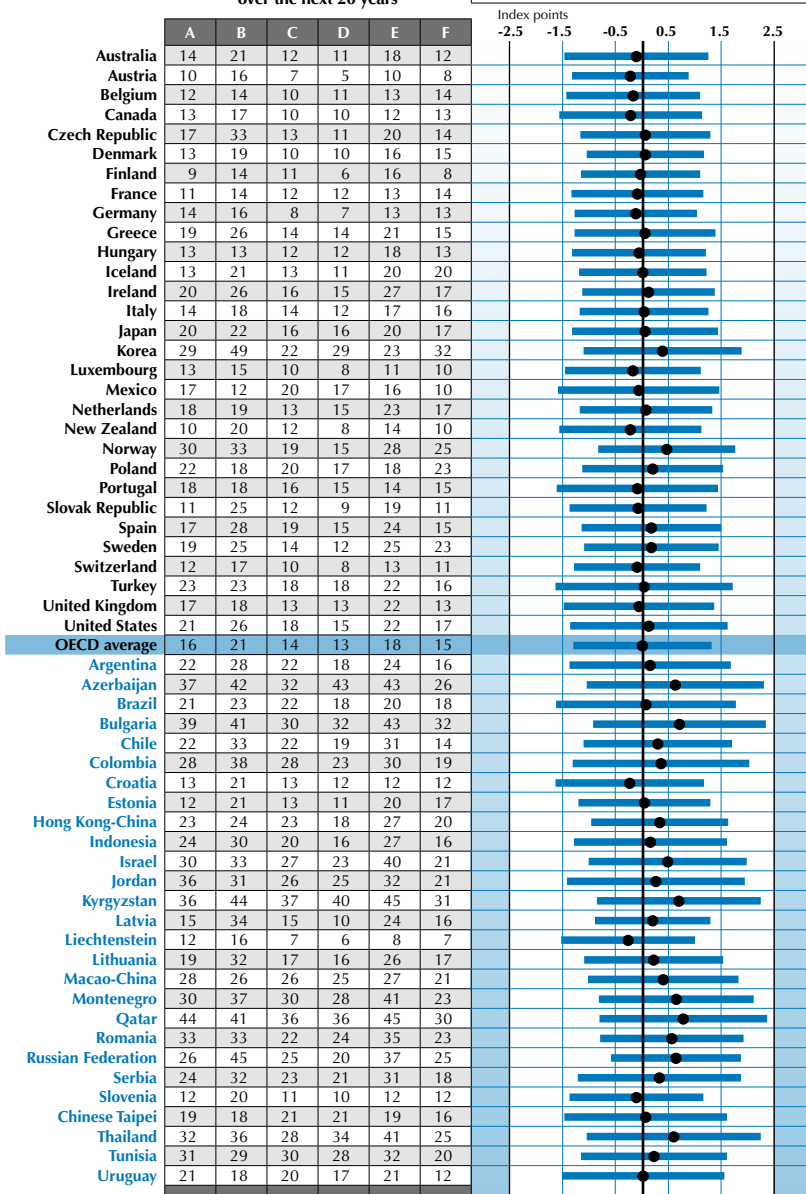


Figure 3.3
Index of students' optimism regarding environmental issues

- A Air pollution
- B Energy shortages
- C Extinction of plants and animals
- D Clearing of forests for other land use
- E Water shortages
- F Nuclear waste

Percentage of students who believe the problems associated with the environmental issues below will improve over the next 20 years

Range between top and bottom quarter of students
 ● Average index



Source: OECD PISA 2006 Database, Table A3.3.

StatLink <http://dx.doi.org/10.1787/562201383324>



A lower proportion of students felt responsibility towards energy shortages although the proportions are also high. On average in OECD countries, 82% of students claim responsibility for energy shortages. OECD countries with the highest proportion of students with a strong sense of responsibility for this environmental issue are Korea with 97%, and Portugal, Spain and Turkey, all with 94%. Similar proportions of students in partner countries and economies also feel responsible for this issue.

As with the issue of air pollution, relatively small proportions of students are optimistic about possible improvements in the energy supply over the next 20 years. Overall in OECD countries about one fifth of students are optimistic, though there is considerable variation across countries, from nearly one half (49%) of Korean students to only 12% in Mexico and 14% of students in each of Belgium, Finland and France. A similar range of optimism is evident among partner countries.

Extinction of plants and animals

Most students claim to be familiar with the extinction of species. On average among OECD countries 98% were familiar with this issue. Among OECD countries, country averages range from 95% in France to 100% in Finland. Among partner countries and economies, the range goes from 89% in Tunisia to 100% in Croatia and Lithuania.

Some 84% of students, on average across OECD countries, feel responsibility for the extinction of species, second only to the proportion feeling responsibility for air pollution. There is, however, a considerable range across countries from 95% of students in Mexico and Spain to 74% in Finland and Ireland feeling this way. Similar results and patterns occur among partner countries and economies.

On average only 14% of 15-year-olds in OECD countries are optimistic about improvements in the extinction of species over the next two decades, though the figures vary quite a lot across countries. At the high end, 22% of Korean student are optimistic, while only 7 and 8% of Austrian and German students respectively expressed optimism.

Clearing of forests for other land use

Nearly all 15-year-olds in both OECD countries and partner countries and economies report to be familiar with deforestation. Across OECD countries, 95% of students report being familiar with this topic. The lowest proportion among OECD countries is in Sweden, with 76% of students, and among partner countries and economies in Kyrgyzstan with 85%.

In addition, a substantial majority of students in OECD countries (83%) feel that they or others in their country should be responsible about deforestation. Partner countries and economies range from 94% of Chilean students expressing responsibility to 70% of students in Qatar.

Out of these six selected environmental issues, students are least optimistic about declines in deforestation over the next two decades. Only 13% of students on average across OECD countries are optimistic about improvements. In partner countries and economies, however, students are generally more optimistic than their OECD peers that deforestation will decline.

Water shortage

Out of the six selected environmental issues, water shortage is the issue that OECD students are least likely to feel responsibility towards. The proportion of students who are familiar is still very high (95% across the OECD), with a range between 99% in Korea and Spain and 84% in France. The range is similar among partner countries and economies, between 100% in Chinese Taipei and 88% in Kyrgyzstan and Brazil.

On average, three-quarters of students in OECD countries feel that they and others in their country should be responsible for water resources. In some countries, such as Korea, Mexico, Portugal, Spain, Turkey, and



Australia over 90% of students feel responsible, while only 45% of Finnish students report feeling that way. Students responding that they feel responsible in partner countries and economies range from 95% in Chile and Columbia to 60% in Liechtenstein and 75% in Estonia and Latvia.

On average, only 18% of students in OECD countries are optimistic about future improvements in water resources. This optimism ranges from 10% of students in Austria to 28% in Norway, while in partner countries and economies it ranges from 8% in Liechtenstein to 45% in Kyrgyzstan and Qatar.

Nuclear waste

Out of the six selected environmental issues, nuclear waste is the issue that OECD students report to be least familiar with. On average, 89% of students in OECD countries report to be familiar with nuclear waste as an environmental issue, ranging from 80% in France to 98% in the Czech Republic. Among partner countries and economies, the proportions are similar, ranging from 70% in Indonesia to 98% in Croatia.

A smaller proportion (78% on average) feels that they and others in their country need to take responsibility for this issue and the proportion varies widely across countries, from 52% in Island to 92% in Turkey. Among partner countries and economies, the proportions are equally lower, ranging from 56% in Tunisia and Latvia to 91% in Chinese Taipei.

Student optimism about future improvements in the disposal of nuclear waste is similar to those for the other environmental issues. On average 15% of students in OECD countries are optimistic about this issue, ranging from about one third of Korean students to only 8% of Austrian students, while in partner countries and economies the range is from 32% in Bulgaria to 7% in Liechtenstein.

STUDENTS' AWARENESS AND SELF-PERCEPTION OF THEIR ABILITY TO UNDERSTAND COMPLEX ENVIRONMENTAL CHALLENGES

While environmental science and geoscience can assist students in understanding the environment at its most basic level, these fields of study should also help students apply their knowledge to the more complex issues created by the dynamic interaction between human society and the environment.

In addition to the six selected general environmental issues examined above, PISA 2006 asked students about their awareness and understanding of five complex environmental challenges (Box 3.2, question 22). These challenges involve a deeper appreciation for environmental issues and the science involved. The five complex issues were: *i*) The increase of greenhouse gases in the atmosphere, *ii*) Use of genetically modified organisms (GMO), *iii*) Acid rain, *iv*) Nuclear waste, *v*) Consequences of clearing forests for other land use. Again, results were summarised in an *index of students' awareness of complex environmental issues*.

Students' awareness of these complex environmental challenges varies significantly from challenge to challenge (Figure 3.4). The majority of students (73% on average) reported being aware of the consequences of the clearing of forests for other land use, the proportion being 80% or more in Poland, Turkey, Ireland, Canada, Australia, the Netherlands, Austria and Germany, as well as in the partner countries and economies Hong Kong-China, Chinese Taipei, Macao-China, Latvia, the Russian Federation, Estonia, Lithuania and Liechtenstein. Conversely, in Korea, Sweden and Greece only 42 to 50% of students were aware of these consequences.

On average, around 60% of students were aware of the acid rain and greenhouse gas challenges. In France, Iceland, Mexico, Switzerland and Turkey, and partner countries Argentina, Azerbaijan, Chile, Indonesia, Israel, Kyrgyzstan, Qatar, Romania and Tunisia, students were less aware of these challenges with fewer than 40% of students reporting awareness of one or both of these issues. In contrast, at least 80% of students were aware of acid rain in Greece, Ireland and Poland, and in the partner countries and economies Hong Kong-China, Croatia, Chinese Taipei and Slovenia (Figure 3.4).



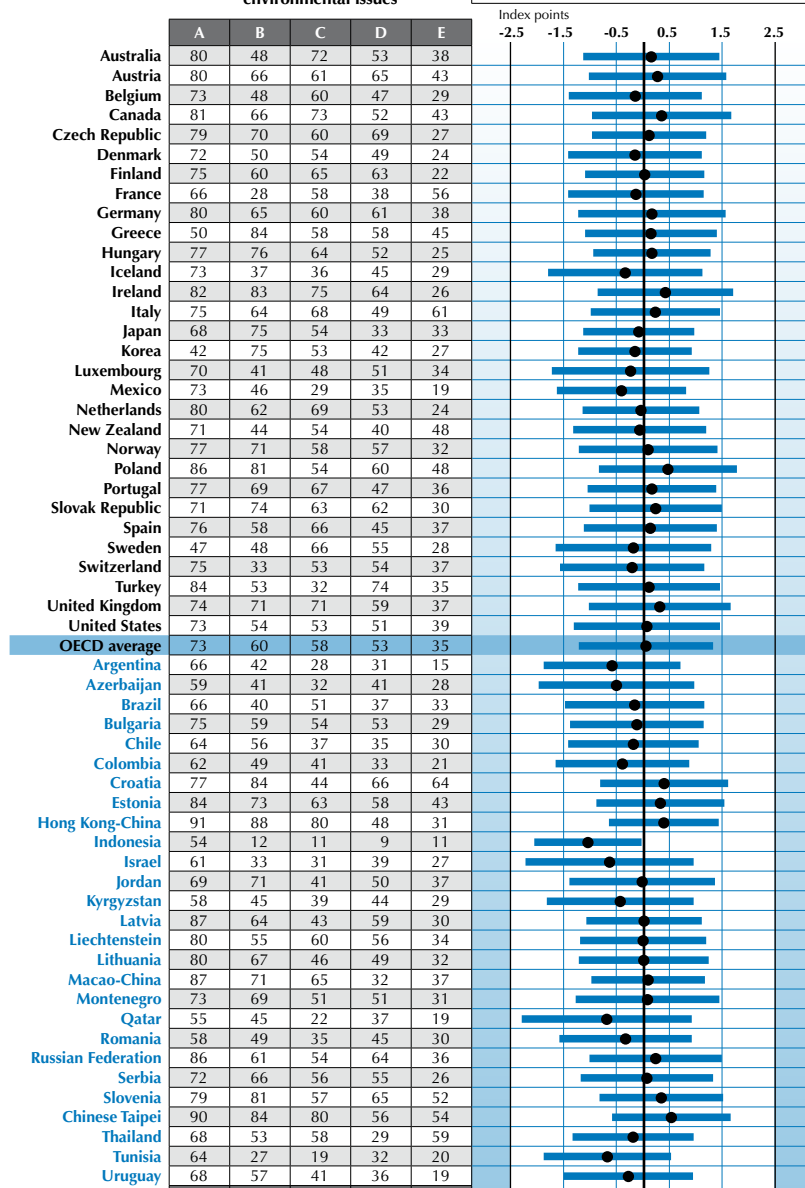
Figure 3.4

Index of students' awareness of more complex environmental issues

- A The consequences of clearing forests for other land use
- B Acid rain
- C The increase of greenhouse gases in the atmosphere
- D Nuclear waste
- E Use of genetically modified organisms (GMO)

Percentage of students who report that they are familiar with or know something about the following environmental issues

Range between top and bottom quarter of students
Average index



Source: OECD PISA 2006 Database, Table A3.4.

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In general, fewer students were aware of nuclear waste as an environmental challenge, with an average of 53% across the OECD. This contrasts with the 89% of students discussed earlier who were familiar with nuclear waste as one of the six environmental issues. The difference in the wording of questions in the two parts of the questionnaire helps explain these results. The 53% who indicated that they were aware of nuclear waste as an environmental challenge were indicating that they know about and could explain nuclear waste, while the 89% were indicating that they know about and had learned something about nuclear waste. Students in Turkey, the Czech Republic and Austria, and in partner countries Croatia and Slovenia, had the highest awareness of the nuclear waste challenge, with at least 65% of students aware of this issue (Figure 3.4).

A minority of students were aware of the genetically modified organisms (GMO) challenge: on average, 35% of students were aware of GMO. However the proportion was over 50% in Italy and France, as well as in the partner countries and economies Croatia, Thailand, Chinese Taipei and Slovenia (Figure 3.4).

ARE STUDENTS' CHARACTERISTICS RELATED TO THEIR ATTITUDES TOWARDS THE ENVIRONMENT?

Parents' attitudes towards the environment

As part of the PISA 2006 assessment, 16 countries complemented the perspectives of students with data collected from parents and environment-related parent indices are available for 15 countries.² Parents were asked about their sense of responsibility for and optimism about progress with the six selected environmental issues (Box 3.2, questions 7 and 8).

Like their 15-year-old children, parents felt that these six issues were their responsibility. In all 15 countries over 90% of parents reported this. Parents also had levels of optimism similar to those of their children (Figure 3.5 and Figure 3.6).

Figure 3.5

Parents' sense of responsibility for environmental issues

- A Air pollution
- B Energy shortages
- C Extinction of plants and animals
- D Clearing of forests for other land use
- E Water shortages
- F Nuclear waste

Percentage of parents who believe the following environmental issues to be a serious concern for themselves or other people in their country

	A	B	C	D	E	F
Bulgaria	99	95	96	98	95	95
Colombia	98	97	97	97	98	90
Croatia	99	98	98	97	95	97
Denmark	96	90	92	89	86	86
Germany	99	96	97	94	87	97
Hong Kong-China	97	87	75	75	81	70
Iceland	94	66	81	78	64	78
Italy	99	95	91	89	91	90
Korea	99	98	95	95	96	95
Luxemburg	98	95	94	92	91	92
Macao-China	96	91	83	84	92	75
New Zealand	95	97	95	92	93	80
Portugal	98	98	97	97	98	93
Qatar	94	88	84	68	90	77
Turkey	99	95	96	97	94	95

Source: OECD PISA 2006 Database, Table A3.5.


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Figure 3.6


Parents' optimism regarding environmental issues

A	Air pollution
B	Energy shortages
C	Extinction of plants and animals
D	Clearing of forests for other land use
E	Water shortages
F	Nuclear waste

Percentage of parents who believe the problems associated with the environmental issues below will improve over the next 20 years

	A	B	C	D	E	F
Bulgaria	24	29	16	18	21	24
Colombia	20	30	20	19	21	15
Croatia	10	11	8	9	6	9
Denmark	10	7	4	8	4	13
Germany	15	6	4	5	4	9
Hong Kong-China	22	20	20	17	23	20
Iceland	3	7	3	6	3	8
Italy	9	10	8	8	7	8
Korea	28	28	20	26	18	27
Luxemburg	12	9	7	7	6	7
Macao-China	31	26	26	26	29	25
New Zealand	12	9	7	6	6	9
Portugal	11	12	13	12	10	9
Qatar	37	43	32	28	40	26
Turkey	22	28	12	14	19	12

Source: OECD PISA 2006 Database, Table A3.6.

StatLink  <http://dx.doi.org/10.1787/562201383324>

Not surprisingly, students' and parents' perceived responsibility and optimism for the six selected environmental issues are generally correlated, although in some countries more than in others (Table A3.7).

Gender differences in attitudes towards resources and the environment

In general, male and female students had similar attitudes toward the environment, although there were some gender differences in particular countries (Table A3.8). In OECD countries, males tended to be more aware of and more optimistic about environmental issues than females.

Females tended to report a higher sense of responsibility towards the environment than males, though differences were generally small. The greatest differences in this regard were in Finland, Poland, Sweden and Turkey. In 16 OECD countries and 9 partner countries and economies, females reported a higher sense of responsibility for environmental issues (Table A3.8).

Socio-economic background and attitudes towards resources and the environment

Students' optimism about future improvements and awareness and understanding of the five complex environmental challenges are both related to the socio-economic background of students (Table A3.9). In contrast, the sense of student responsibility for the six selected environmental issues is generally not related to the socio-economic background of students, as measured by the ESCS index (index of Economic, Social and Cultural Status).

In all OECD countries and most of the partner countries and economies, students of families with a more advantaged socio-economic background are more likely to report being aware and having some understanding of the complex environmental challenges (greenhouse gases, GMO, acid rain, nuclear waste and deforestation). Very large differences in awareness among socio-economic groups occur in Belgium,



France, Luxembourg and Portugal, as well as in the partner country Chile. Although the differences were not as large as those related to awareness, students from more advantaged socio-economic backgrounds also tended to be more pessimistic about future improvements in the six selected environmental issues (air pollution, energy shortage, species extinction, deforestation, water shortage and nuclear waste).

Immigrant background and attitudes towards resources and the environment

Even without accounting for socio-economic background, there are only small to moderate differences in attitudes towards the environment between native students and students with an immigrant background among the 33 countries (including 20 OECD countries) with reliable data for 15-year-olds with an immigrant background (based on more than 30 students and more than 3% of the sampled students) (Table A3.10). In ten OECD countries native students reported higher levels of awareness and understanding of the five complex environmental challenges than students with an immigrant background. Similarly, there are 10 OECD countries where natives are less optimistic. There are almost no differences in terms of students' sense of responsibility for environmental issues.

ARE ATTITUDES RELATED TO THE ENVIRONMENTAL SCIENCE PERFORMANCE INDEX?

The relationship between attitudes and performance is a topic that is taken up by a number of reports based on PISA data. Chapter 3 of the PISA 2006 initial report for example presents evidence on attitudes and performance in science. The report, *Top of the Class: High Performing Learners in PISA 2006* (OECD, 2009b), shows that top performing students on the PISA science scale tend to be engaged learners who care about and enjoy learning science. An earlier report, *Student Engagement At School, a Sense Of Belonging And Participation* (Willms, 2003), showed that student engagement is closely associated with performance in reading, which for example, helps to explain the performance advantage of females over males in reading.

This section investigates whether variability in student attitudes to environmental issues is associated with variability in student performance on the environmental science performance index (see Table A3.11 for simple correlations).³ For each attitudinal index and country, this section presents two sets of results. First, it presents the observed relationship between the environmental science performance index and student attitudes. The model shows the score point change on the environmental science performance index that is associated with a change of one standard deviation in the value of the attitudinal index. Second, the section discusses the relationship between attitudes and performance after accounting for student and school demographic and socio-economic background (Table A3.14).⁴ A summary of the background model is in Table A3.12 and Table A3.13.

Figure 3.7 indicates the score point change on the environmental science performance index that is associated with a change of one unit on the standard deviation on the attitudinal index (responsibility, optimism, and awareness) after accounting for student and school background. Separate graphs are provided for each of the three attitudinal indices.

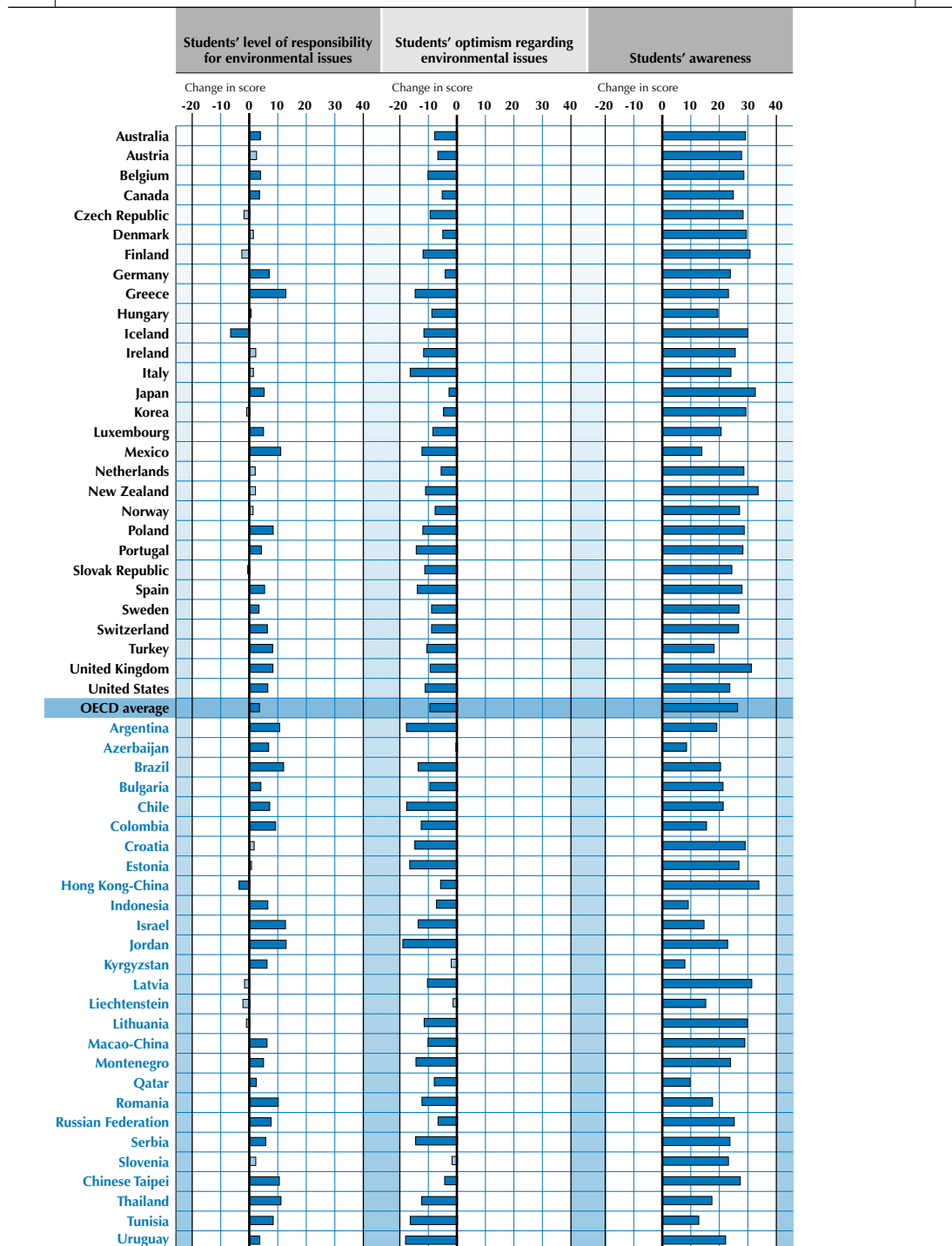
Students' sense of responsibility towards environmental issues

For most countries there is no strong association between the *index of students' sense of responsibility for environmental issues* and their environmental science performance index, after accounting for student and school characteristics (Figure 3.7 and Table A3.14). When there is a relationship, its direction varies from country to country. In some, for example France and Greece, *students' sense of responsibility for environmental issues* is positively associated with the environmental science performance index, while in others, such as the Czech Republic and Iceland, the relationship is negative. The results suggest that, in most countries, feeling responsible about environmental issues is not necessarily related to having knowledge about them.



Figure 3.7

Relationship between students' attitudes and environmental science performance after accounting for student and school background



Note: Statistically significant values are marked in darker colour.

Source: OECD PISA 2006 Database, Tables A3.14.

StatLink <http://dx.doi.org/10.1787/562201383324>



Students' optimism regarding environmental issues

Students' optimism regarding environmental issues is negatively related to the environmental science performance index (Figure 3.7 and Table A3.14). The lower students perform in environmental science, the more optimistic they are that the situation will improve over the next two decades. The association, however, does not distinguish if lack of knowledge leads to optimism, or if it is the other way around, or if there are other factors driving this relationship. On average in OECD countries, an increase of one unit on the index corresponds to a decrease of around 14 score points on the environmental science performance index. Once student and school characteristics are considered the estimated effect is smaller (on average in OECD countries 10 score points) but still significant in most countries.

Among OECD countries a strongly negative relationship was found in France and Italy and this was also the case in partner countries Chile and Argentina. Among OECD countries the relationship is weakest in Japan, Korea and Canada. Again, these results should be interpreted with caution as questions asking students about optimism could be answered differently in different countries.

Students' awareness of complex environmental issues

The index of *students' awareness of complex environmental issues* is positively related to the environmental science performance index in all countries involved in PISA 2006 (Figure 3.7 and Table A3.14). This association does not show whether this is because students' awareness of complex environmental issues influences their performance on the environmental science index, whether higher performing students tend to be more aware, or whether there are third factors influencing the relationship. Taking into account student and school characteristics leads to a less pronounced relationship but the association does not disappear.

On average in the OECD countries an increase of one unit of the awareness index is associated with an increase in the environmental science performance index of 35 points when none of the background variables are accounted for, and an increase of 26 points after accounting for the background variables. This suggests that individual and school factors play an important role in the relationship between students' awareness and performance.

The strength of the relationship between awareness and the environmental science performance index varies across countries. Among OECD countries the relationship is weakest in Canada, Mexico and Turkey, and strongest in Belgium, France, Japan, the Netherlands and New Zealand. Such comparisons should be interpreted cautiously, however, because they may simply reflect cross-cultural differences in the way students from different countries answer attitudinal questions.

STUDENT ATTITUDES: CONCLUSIONS AND IMPLICATIONS

Students across the world appear to be taking a strong interest in environmental issues, and accept they need to take responsibility for environmental outcomes.

However, it is also clear that awareness of environmental issues varies considerably from one issue to another. While almost all students report familiarity with some basic environmental issues such as air pollution, and the majority with some more complex issues like the consequences of forest clearing for land use, only about one in three say that they are familiar with issues around genetically modified organisms. The PISA results allow each country to note which environmental issues its students appear to be engaged in, and which they may need to learn more about.



It is hard to draw firm conclusions about associations between environmental attitudes and performance in PISA, because the survey does not demonstrate cause and effect. However, it is worth noting that high levels of student awareness of the environment and high levels of proficiency in environmental science do go together, suggesting that an effective curriculum puts joint emphasis on learning about why the environment matters and on building understanding of the scientific phenomena involved. The negative association between performance and student optimism may point to the need for schools to give students with lower performance more information than they are now getting on the environmental risks that lie ahead.

The lack of association between socio-economic background and student attitudes shows that students from all backgrounds are taking an interest in environmental issues, and schools do not have to make extra efforts to persuade disadvantaged children that these issues are important, just to ensure that they do not fall behind in acquiring the knowledge and skills required to become proficient in addressing these issues.



Notes

1. Note that in the report *PISA 2006: Science Competencies for Tomorrow's World* (OECD, 2007) the same index was referred to as the *index of students' level of concern for environmental issues*.
2. These countries were Denmark, Germany, Iceland, Italy, Korea, Luxembourg, New Zealand, Poland, Portugal, and Turkey, as well as the partner countries and economies Bulgaria, Colombia, Croatia, Hong Kong-China, Macao-China, and Qatar. This report analyses data from all these countries except Poland, for which parent environment-related indices were not estimated due to data problems. In examining the results from the PISA parent questionnaire, it should be noted that in some countries non-response was considerable. Countries with considerable missing data in the parent questionnaire are as follows (the proportion of missing data is shown in brackets): Portugal (11%), Italy (14%), Germany (20%), Luxembourg (24%), New Zealand (32%), Iceland (36%) and Qatar (40%).
3. These indices were also analysed in the main PISA report (OECD, 2007, chapter 3). However, "students' sense of responsibility for environmental issues" was previously called "students' level of concern for environmental issues". The name of this index was changed but the measures remain the same.
4. The first model reflects a simple regression model that predicts the environmental science performance index based on the attitudinal index alone. The linear regression model was applied with survey weights rescaled giving equal weight to each country. Thus, each country's sample contributes similarly to final estimates regardless of the actual number of students tested. The background model includes variables at both the individual and the school level. At the individual level, it includes six student level variables that are already known from PISA 2006 to relate to student science performance: age, gender, immigrant status, language spoken at home, whether either parent has a science-related career, and socio-economic background. At the school level, the background model includes school size, whether the school is located in a rural area or small town or alternatively in a city, and the average socio-economic background of the students attending the school. This model builds on the analysis presented in Chapter 5 of *PISA 2006: Science Competencies for Tomorrow's World* (OECD, 2007). Note, however, that age and whether either parent has a science-related career or not were not included in the background model analysed in chapter 5 of the PISA 2006 initial report. The following four factors are all dummy variables as follows: student gender (equals 1 for females), immigrant status (equals 1 for native students), and language spoken at home (equals 1 if the language differs from the language of the test), and parent career (equals 1 if either of parents has science related career). ESCS and ESCS squared were both included in the model to adjust for possible non-linearities in the relationship between student socio-economic background and student performance. Student age was expressed in years (with months reflected as decimals). The missing values for student level variables were replaced by the school average of the missing variable. If school average was also missing, then country average was imputed. In the final regression dummy variables indicating all imputed missing observations were also included. This simple solution for missing data problem was employed in the analysis for the initial report and seems to be sufficient because of very small number of missing observations. Both location factors are dummy variables: rural equals one for schools located in villages or small towns (with fewer than 15 000 people), city equals one for schools in cities with more than 100 000 people. The control group is other towns and cities of medium size. No data is available for France in the school variables. France is therefore not included in any analysis that considers these variables.



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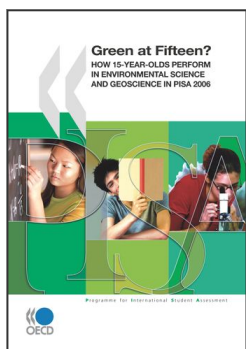
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