CHAPTER 6

DESCRIPTIVE ANALYSES

6.1 INTRODUCTION

In this chapter, results of exploratory analysis of the TIMSS data sets from Korea and South Africa are presented. The exploratory analysis focuses on how comparable science education is in both countries by examining the contextual information data. The data drawn from the TIMSS 2003 background questionnaires was analysed closely, corresponding to descriptive statistics. The exploratory analyses here are significant in terms of description but not explanation of contextual information provided in TIMSS data sets. Description and explanation are different in terms of level of understanding. *To describe* is to draw a picture about what something is like, while *to explain* means to account for why it is as well as what it is like (Punch, 2009). Therefore, this chapter focused on the case in Korea and South Africa respectively, with the reasons behind the events is explored in Chapter 7, including the results of factor, reliability, and correlation analyses.

As a first step towards explanation, the chapter begins with TIMSS 2003 science achievement scores for Korea and for South Africa in Section 6.2. The wide gap between science achievements across the two countries is highlighted. The differences between student achievements in the two countries imply the different contextual background for each country, the contextual backgrounds having been represented in Section 6.3. Background information based on descriptive statistics was specified corresponding to student, classroom/teacher, and school/principal levels. Lastly, a conclusion is drawn in Section 6.4.

6.2 TIMSS SCIENCE ACHIEVEMENT SCORES IN KOREA AND SOUTH AFRICA

The two countries in question scored differently on the TIMSS science test. The weighted means of the student scores on the international TIMSS science test are presented in Table 6.1 (below). The scores were standardized with a mean of 500 and a standard deviation of 100. Korean students scored an average of 558 (1.6) while South African students achieved an average score of 244 (6.7). The differences in the average mean scores highlight the enormous gap in achievement in science of the two countries. The research should ascertain where this gap was and how it occurred, in order to answer the research questions.

Table 6.1 also indicates the number of students, science teachers, and schools tested. Although one intact classroom per school was sampled, many more teachers were sampled in Korea compared to schools sampled. Even though there is an integrated science curriculum in Korean schools, at the school level science teachers prefer to teach one or two major fields from this curriculum, which could include Physics, Chemistry, Earth Science, or Biology. For that reason, a class in each Korean school is likely to have more than one science teacher. However, one science teacher is likely to be assigned for a class with an integrated science curriculum in South Africa.

Table 6.1 ***Descriptive data for Korea and South Africa***

Country	Number of students	Number of teachers	Number of schools	Science achievement	
				Mean	SD
Korea	5,309	357	149	558	1.6
South Africa	8,952	255	255	244	6.7

6.3 EXPLORING THE DATA SETS

In this section, an overview of descriptive statistics and an overall picture of the data are presented for the two countries, prior to starting in-depth analyses by looking at the results of the descriptive statistics. This helped the researcher to familiarise herself with the data, and understand its structure and identify, where possible, pitfalls such as data that is not normally distributed, missing data, and more than 5% variations in the data that would potentially influence the choice of statistics applied.

6.3.1 STUDENT LEVEL

Frequencies in SPSS were run on the item level first to get an overview of items which could play an important role in the achievement of pupils in the two countries. These items include speaking the language of the test at home and being in possession of books and educational equipment. Specifically, 99% of Korean students tested always or almost always spoke the language of the test at home, in contrast to only 27% of South African students tested who always or almost always spoke the language of the test at home, as shown in Table 6.2 (below). Research indicates that speaking the test language at home correlates strongly with achievement, and this is particularly evident in the achievement of South African students (Howie, 2002).

Table 6.2 ***Often speak language of test at home***

		N	Always	Almost always	Sometimes	Never
% of students	Korea	4872	71(0.8)	28(0.8)	1(0.2)	0(0.0)
	South Africa	6680	18(1.7)	9(0.7)	57(1.7)	15(1.0)

Source: Martin, Mullis, Gonzalez & Chrostowski, 2004.
Note: () Standard errors.

Possessions such as books in the home and educational equipment also play a role in pupil achievement. The data revealed that 74% of Korean students tested had more than 26 books at home compared to only 25% of South African students tested (see Table 6.3, below).

Table 6.3 ***Number of books in your home***

		N	0-10 books	11-25 books	26-100 books	101-200 books	More 200 books
% of students	Korea	4873	15(0.7)	10(0.6)	33(0.8)	22(0.7)	19(0.8)
	South Africa	6573	44(1.3)	31(0.9)	14(0.7)	5(0.4)	6(0.5)

Source: Martin, Mullis, Gonzalez & Chrostowski, 2004.
Note: () Standard errors.

Looking at other representative home possession, 97% of Korean students have a calculator, a computer, a study desk, and a dictionary at home, as opposed to the comparatively few South African students possessing these items (Table 6.4).

Table 6.4 ***Home possession***

		Calculator	Computer	Study desk	Dictionary
% of students	Korea	97(0.2)	98(0.2)	97(0.2)	99(0.1)
	South Africa	77(0.5)	36(0.6)	58(0.6)	70(0.6)

Note: () Standard errors.

Parents' educational level is another construct to consider, as discussed in Chapter 3. Only 11% of South African parents completed a first degree in contrast to 35% of Korean parents (Table 6.5, below). In literature, a significant relationship exists between the education level of parents and the achievement of their children (Von Secker, 2004). Within the two countries the education level of the mother is more important in South Africa, in comparison to the education level of the father's being more important in Korea (see Section 7.4).

Despite the importance of parents' educational level, as the South African data showed, more than 30% missing value in respect to parents' education level. These items were excluded from the further analysis.

Table 6.5 ***Highest educational level of parents***

		Finished university or equivalent or higher	Finished post-secondary vocational /technical education but not university	Finished upper secondary schooling	Finished lower secondary schooling	No more than primary schooling
% of students	Korea	35(1.2)	15(0.6)	41(1.0)	6(0.4)	3(0.4)
	South Africa	11(1.0)	13(0.7)	30(0.9)	18(0.7)	28(1.1).

Source: Martin, Mullis, Gonzalez & Chrostowski, 2004.
Note: () Standard errors.

As seen in Table 6.6 (below), students' educational expectations towards higher education are much higher in Korea (78%) than in South Africa (31%) which, as explored in Chapter 1, indicates Korean comparative enthusiasm for higher education. As was the case with parental educational level, students' educational expectations in South Africa were not retained for further discussion due to a high percentage of missing data.

Table 6.6 ***Students' educational aspirations***

		Finish university or higher	Finish upper secondary schooling	Finish lower secondary schooling	Finish primary schooling	I don't know
% of students	Korea	78(0.6)	6(0.3)	4(0.3)	2(0.2)	10(0.1)
	South Africa	32(0.6)	13(0.4)	9(0.4)	31(0.6)	15(0.5)

Note: () Standard errors.

TIMSS 2003 reported students' attitudes towards science by means of index (see Tables 6.7 and 6.8). The index of self-confidence in learning science was based on students' responses to four statements about science:

1) I usually do well in science
2) Science is more difficult for me than for many of my classmates
3) Science is not one of my strengths
4) I learn things quickly in science.

The index of valuing science was based on students' responses to seven statements about science:

1) I would like to take more science in school
2) I enjoy learning science
3) I think learning science will help me in my daily life
4) I need science to learn other school subjects
5) I need to do well in science to get into the university of my choice
6) I would like a job that involved using science
7) I need to do well in science to get the job I want.

Where students agreed a little or a lot on average across the four statements (seven statements for valuing science), they were assigned to the high level. When students disagreed a little or a lot on average, they were assigned to the low level. All other students were assigned to the middle level (Martin, Mullis, Gonzalez & Chrostowski, 2004).

Table 6.7 ***Index of students' self-confidence in learning science (SCS)***

		High SCS	Medium SCS	Low SCS
% of student	Korea	20(0.7)	42(0.7)	38(0.9)
	South Africa	45(1.1)	46(1.0)	9(0.4)

Source: Martin, Mullis, Gonzalez & Chrostowski, 2004.
Note: () Standard errors.

Overall, South African students tend to have a positive attitude towards science in contrast to the result which reveals that Korean students tend to display a negative attitude (Tables 6.7 and 6.8). It should be noted that this attitude is not referred to on the individual level, but on the country level. Shen and Tam (2008) argue that the negative attitudes towards subjects in the country level may reflect high academic standards in high-performing countries, and vice versa. Similarly, the Korean students' negative attitudes towards science may reflect an attitude towards study and this can be explained by the reality that parents push their children to study hard to enter prestigious universities, as discussed in Chapter 1.

Table 6.8 ***Index of students' valuing science (SVS)***

		High SVS	Medium SVS	Low SVS
% of student	Korea	19(0.7)	55(0.7)	26(0.8)
	South Africa	76(0.9)	19(0.7)	5(0.4)

Source: Martin, Mullis, Gonzalez & Chrostowski, 2004.
Note: () Standard errors.

In terms of classroom practice (see Table 6.9, below), listening to a lecture-style lesson is the most likely to occur in both Korea (81%) and South Africa (82%), although science lessons can consist of many formats. Korean students reported group experiment (39%), writing explanations of what and why (45%), and working problems on their own (59%) as common practice in science classes. In contrast, South African students reported reviewing homework (81%), presenting their work to the class (78%), and relating what is learnt in class to daily life (77%) as common practice in their science classes.

Table 6.9 ***Students' reports on classroom practice***

	% of doing the activity about half of the lessons or more												
	Watch the teacher demonstrate an experiment or investigation	Formulate hypotheses or predictions to be tested	Design or plan an experiment or investigation	Conduct an experiment or investigation	Work in small groups on an experiment or investigation	Write explanations about what was observed and why it happened	Study the impact of technology on society	Relate what we are learning in science to our daily lives	Present our work to the class	Review our homework	Listen to the teacher give a lecture-style presentation	Work problems on our own	Begin our homework in class	Have a quiz or test
Korea	32(0.7)	17(0.5)	15(0.5)	21(0.7)	39(0.7)	45(0.7)	22(0.6)	37(0.7)	17(0.5)	37(0.7)	81(0.6)	59(0.7)	8(0.4)	21(0.6)
South Africa	72(0.6)	65(0.6)	65(0.6)	64(0.6)	71(0.6)	72(0.6)	69(0.6)	77(0.5)	78(0.5)	81(0.5)	82(0.5)	61(0.6)	57(0.6)	70(0.6)

Note: () Standard errors.

Most Korean students (99%) used a computer, while 68% of South African students reported so and 25% had never used it (see Table 6.10, below). Korean students mostly used computers at home (97%, 0.2) while South African students mostly used them at school (48%, 0.7).

Table 6.10 ***Have you ever used a computer?***

		Korea	South Africa
N		5309	6784
% of students	yes	99 (0.1)	68 (0.6)
	no	1 (0.1)	25 (0.5)

Note: () Standard errors.

The results on school climate revealed that South African students have more positive attitudes towards school compared to Korean, as shown in Table 6.11:

Table 6.11 ***Students' agreement on school climate***

		Like being school	Try to do their best	Teachers care about students	Teachers want students to do their best
% of students	Korea	72(0.6)	63(0.7)	68(0.7)	95(0.3)
	South Africa	93(0.3)	88(0.4)	88(0.4)	90(0.4)

Note: () Standard errors.

UNICEF (2000) proposed safety environment to children as one of the basic dimensions of quality education. Most Korean students perceived that school was safe, unlike South African students where only a few felt the same way:

Table 6.12 ***Student experiences on school safety***

		Something of mine was stolen	I was hit or hurt by other students	I was made to do things I didn't want	I was made fun of or called names	I was left out of activities by other students
% of students	Korea	24(0.6)	9(0.4)	12(0.5)	16(0.5)	2(0.2)
	South Africa	50(0.6)	33(0.6)	39(0.6)	52(0.6)	38(0.6)

Note: () Standard errors.

With respect to out-of-school activities (see Table 6.13, below), South African students are more likely to spend time playing sports or with friends, while Korean students undertake computer-related activities such as playing computer games or accessing the Internet.

Table 6.13 *Out-of-school activities*

	Average hours spent each day							
	Watch TV & videos	Play computer games	Play or talk with friends	Do jobs at home	Play sports	Read a books for enjoyment	Use the internet	Work at a paid job
Korea	1.7(0.03)	1.5(0.03)	1.8(0.03)	0.7(0.01)	0.7(0.02)	0.6(0.01)	1.7(0.03)	0.1(0.01)
South Africa	1.5(0.03)	0.7(0.02)	2.0(0.03)	1.8(0.03)	1.6(0.02)	1.6(0.03)	0.8(0.02)	0.8(0.02)

Source: Martin, Mullis, Gonzalez & Chrostowski, 2004.
Note: () Standard errors.

In terms of time on task or opportunity to learn, extra tutoring has shown an important relationship with student achievement, as reviewed in Chapter 3. As shown in Table 6.14 (below), more students in Korea (58%) take extra tutoring in science at least once a week, as opposed to 46% of South African students tested. In particular, the percentage of students who take extra tutoring in science 'every or almost every day' is much higher in Korea (36%) than in South Africa (25%).

Table 6.14 *Frequency of extra science lessons*

		Every or almost every day	Once or twice a week	Sometimes	Never or almost
% of students	Korea	36 (0.01)	19 (0.01)	5(0.0)	40 (0.01)
	South Africa	25 (0.01)	21 (0.01)	30 (0.01)	24 (0.01)

Note: () Standard errors.

In terms of ethnicity, most Korean students were born in Korea and have grown up in this country, as shown in Table 6.15 (below). In contrast, some 67% of South African students were born in South Africa, which means the rest of the population (33%) are immigrants.

Table 6.15 ***Country of birth***

	Korea	South Africa
N	4865	8393
% of students	99(0.1)	67(0.5)

Note: () Standard errors.

6.3.2 CLASSROOM LEVEL

Taking a closer look at the frequencies regarding teacher background, there are a greater number of younger, less experienced male science teachers in South Africa than in Korea (Table 6.16, below). More specifically, 56% of teachers are under 39 years old in Korea, compared to 75% in South Africa. In terms of gender, South African schools are balanced, while Korean schools have many more female science teachers. Overall, South African science teachers see themselves as being under-prepared to teach, in contrast to Korean teachers who seem to be more educated and are trained to become science teachers.

Table 6.16 ***Science teachers' characteristics***

		Gender		age				Have full certificate*	Number of years of teaching
		female	male	29 years or under	30-39 years	40-49 years	50 years or older		
% of students[$]	Korea	66(3.4)	34(3.4)	15(2.6)	41(3.0)	40(3.6)	4(1.7)	99(0.2)	13(0.5)
	South Africa	49(4.1)	51(4.1)	24(3.2)	51(3.4)	20(2.8)	4(1.2)	53(4.4)	10(0.5)

Source: Martin, Mullis, Gonzalez & Chrostowski, 2004.
Note: () Standard errors.
** does not include provisional or emergence certificate.*
[$] % of students whose science teacher responded

As for teacher qualification (see Table 6.17, below), some 28% of students sampled were taught by South African teachers tested who had finished university, as opposed to 100% of Korean teachers tested. Completing four

years at university is compulsory for becoming a secondary school teacher in Korea. In contrast, completing post-secondary education satisfies the requirement of teacher qualification in South Africa.

Table 6.17 ***Highest educational level of science teachers***

		Beyond university degree	Finished university or equivalent	Finished post secondary education but not university	Finished upper secondary schooling	Did not complete upper secondary schooling
% of students[$]	Korea	25(2.9)	75(2.9)	0(0.0)	0(0.0)	0(0.0)
	South Africa	7(2.0)	21(3.0)	69(3.5)	2(1.2)	0(0.1)

Source: Martin, Mullis, Gonzalez & Chrostowski, 2004.
Note: () Standard errors.
[$] % of students whose science teacher responded

With respect to attitudes towards the subject of science (see Table 6.18, below), teachers in both countries strongly agree that teaching science should include:

- using more than one representation (98% in Korea, 95% in South Africa)
- solving science problems by hypothesizing, estimating, etc. (84% in Korea, 93% in South Africa)
- conducting scientific investigation by many ways (98% in Korea, 97% in South Africa)
- scientific theories changeable (95% in Korea , 78% in South Africa)
- modelling natural phenomena (76% in Korea , 92% in South Africa)

Both did not agree that science

- mainly involves memorizing (19% in Korea, 15% in South Africa)
- most scientific discoveries have no practical value (4% in Korea, 10% in South Africa)

However, there are some differences between the two countries. Most Korean science teachers tested disagreed that 'getting the correct answer is the main focus in an experiment' in contrast with the 55% of South African teachers tested who agreed with this belief. In addition, most South African teachers tested agreed that science teaching should be 'primarily for obtaining skill and knowledge' (88%). In contrast, just half of Korean teachers (51%) only agreed, with the rest disagreeing. South African teachers are more like to focus on scientific fact than scientific process.

Table 6.18 ***Teachers' attitudes toward science***

	The percentage of agreement with the statements below∮								
	More than one representation should be used in teaching a science topic	Solving science problems involves hypothesizing, estimating, testing, and modifying findings	Learning science mainly involves memorizing	There are many ways to conduct scientific investigation	Getting the correct answer is the most important outcome of a student's scientific experiment	Scientific theories are subject to change	Science is taught primarily to give students the skills and knowledge to explain natural phenomena	Modeling natural phenomena is essential to teaching science	Most scientific discoveries have no practical value
Korea	98(0.9)	84(2.3)	19(2.5)	98(0.9)	8(1.7)	95(1.4)	51(3.1)	76(2.7)	4(1.2)
South Africa	95(1.6)	93(1.8)	15(2.6)	97(1.2)	55(3.6)	78(3.0)	88(2.3)	92(2.0)	10(2.2)

Note: () Standard errors.

∮ The percentage of agreement includes options, 'agree a lot' and 'agree'

Korean teachers tested (73%) are more likely to think that their schools are situated in a safe neighbourhood and thus they feel safe and secure at school (see Table 6.19, below). Korean teachers (62%) are less likely than South African teachers tested (81%) to think that their schools need major repairs. In contrast, fewer South African teachers (34%) agreed with the security policies

and practices of their school than Korean teachers tested (66%). A classroom in Korea ranges from 20 to 48 students whereas South African classrooms consist of seven to 95.

Table 6.19 ***Teachers' perception of safety in the schools***

	The percentage of agreement with the statements below§			
	This school facility is in need of significant repair	This school is located in a safe neighborhood	I feel safe at this school	This school's security policies and practices are sufficient
Korea	62(3.0)	73(2.8)	80(2.5)	66(3.0)
South Africa	81(2.8)	52(3.6)	52(3.6)	34(3.4)

Note: () Standard errors.

§ The percentage of agreement includes options, 'agree a lot' and 'agree'

With respect to content-related activities, there are some differences of interest between the two countries. As shown in Table 6.20 (below), South African teachers tend to ask their students to design or plan experiments, work in small groups, put events or objects in order, write explanations of what and why, study the impact of technology on society, and present their work to the class more often than their Korean counterparts. Both Korean (64%) and South African (78%) teachers seem to emphasize an activity such as 'relate what is being learned in science to our daily lives'.

Table 6.20 ***Teachers' reports on classroom practice***

	% of doing the activity about half of the lessons or more										
	Watch the me demonstrate an experiment or investigation	Formulate hypotheses or predictions to be tested	Design or plan an experiment or investigation	Conduct an experiment or investigation	Work in small groups on an experiment or investigation	Write explanations about what was observed and why it happened	Put events or objects in order and give a reason for the organization	Study the impact of technology on society	Learn about the nature of science and inquiry	Relate what is being learned in science to our daily lives	Present their work to the class
Korea	32(2.9)	38(3.1)	19(2.5)	32(2.9)	27(2.8)	38(3.1)	24(2.7)	17(2.4)	31(2.9)	64(3.0)	31(2.9)
South Africa	27(3.2)	33(3.4)	41(3.6)	36(3.5)	58(3.6)	54(3.7)	41(3.6)	32(3.4)	47(3.6)	78(3.0)	56(3.6)

Note: () Standard errors.

Regarding factors limiting teaching science, fewer Korean teachers tested overall answered the ‘a lot’ option than South African teachers, as compared in Table 6.21 (below). Specifically speaking, with respect to student-related factors, Korean teachers are more likely to choose disruptive students (11%) as the strongest limiting factor as opposed to South African teachers choosing students from a wide range of backgrounds (26%).

Table 6.21 ***Limitations on instruction due to student factors***

	% of an option 'a lot' chosen					
	Students with different academic abilities	Students who come from a wide range Of backgrounds	Students with special needs	Uninterested students	Low morale among students	Disruptive students
Korea	6(1.5)	4(1.2)	4(1.2)	7(1.6)	9(1.8)	11(2.0)
South Africa	24(3.1)	26(3.2)	13(2.4)	21(3.0)	17(2.7)	18(2.8)

Note: () Standard errors.

Related to resource factors, Korean teachers chose high student/teacher ratio (14%) as the most limiting factor, whilst South African teachers responded that using computer-related resources was mostly limited and thus the 'a lot' was more than 50% respectively, as shown in Table 6.22:

Table 6.22 ***Limitations on instruction due to resource factors***

	% of an option 'a lot' shortage							
	computer hardware	computer software	Support for using computers	Textbooks for student use	Other instructional equipment for students' use	Equipment for your use in demonstrations	Inadequate physical facilities	High student/teacher ratio
Korea	4(1.2)	4(1.2)	5(1.4)	2(0.9)	2(0.9)	3(1.1)	6(1.5)	14(2.2)
South Africa	56(3.6)	56(3.6)	55(3.7)	34(3.5)	46(3.6)	48(3.7)	48(3.7)	50(3.7)

Note: () Standard errors.

On topic coverage, South Africa was reported as one of the countries where fewer than half of the topics covered in TIMSS 2003 were included in its eighth-grade curriculum (48%). As seen in Table 6.23 (below), only 16% of the 48% of topic coverage was reported for all or almost all students with 32% being reported for students who were more able (Martin, Mullis, Gonzalez & Chrostowski, 2004). TIMSS documented that having at least moderate coverage of the science topics is a prerequisite for high performance although high coverage in the intended curriculum does not of itself lead to high student achievement (Martin, Mullis, Gonzalez & Chrostowski, 2004). TIMSS also reported that there is a moderately positive relationship between inclusion in the intended curriculum and student achievement. For example, top performing countries such as Singapore or Japan had about 70% of the science topics in their intended curricula in TIMSS 2003. Exceptionally, Korea, although among top-performing countries, had only 52% of topic coverage (Martin, Mullis, Gonzalez & Chrostowski, 2004).

Table 6.23 ***TIMSS science topic coverage in the intended curriculum***

	% of TIMSS science topics intended to be taught up to and including Grade 8		
	Topics for all or almost all students	Topics for only the more able students	Not included in the curriculum through Grade 8
Korea	52	0	48
South Africa	16	32	52

Source: Martin, Mullis, Gonzalez & Chrostowski, 2004.
Note: () Standard errors.

Most teachers in both countries give students homework but in South Africa homework is reported to be given more often and more time is taken in completing it, as shown in Tables 6.24 and 6.25. South African students also reported the same way.

Table 6.24 ***Frequency of science homework***

		Every or almost every lesson	About half the lessons	Some lessons
% of teachers	Korea	9(1.9)	17(2.5)	74(2.9)
	South Africa	30(3.4)	25(3.2)	45(3.7)

Note: () Standard errors.

Homework is seen a good way to increase 'time on task' or 'opportunity to learn'. As mentioned in Chapter 1 and shown in Table 6.14 at the student level, many Korean students take extra tutoring after school and Korean teachers tend not to give much homework as it might be an extra burden on students.

Table 6.25 ***Time assigned for homework***

		Fewer than 15 minutes	15-30 minutes	31-60 minutes	61-90 minutes	More than 90 minutes
% of teachers	Korea	19(2.6)	56(3.3)	22(2.8)	2(0.9)	1(0.7)
	South Africa	7(1.9)	56(3.7)	26(3.3)	4(1.5)	7(1.9)

Note: () Standard errors.

As expected from the high percentage of frequency and time on science homework in Tables 6.24 and 6.25, South African teachers are more likely to monitor and use homework in lessons in many ways than Korean teachers (Table 6.26. below). The results concur with the classroom practice reported by students as shown in Table 6.9 (above).

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Table 6.26 ***Use of homework***

		% of teachers who use always or almost always				
		Monitor whether or not the homework was completed	Correct assignments and then give feedback to students	Have students correct their own homework in class	Use the homework as a basis for class discussion	Use the homework to contribute towards students' grades or marks
% of teachers	Korea	59(3.3)	15(2.4)	16(2.5)	8(1.8)	31(3.1)
	South Africa	89(2.3)	82(2.8)	25(3.2)	34(3.5)	38(3.6)

Note: () Standard errors.

In regards to testing or assessing (see Table 6.27, below), it is significant that almost fifty percent of Korean teachers tested (49%) responded that they addressed testing every two weeks or less. Judging from the researcher's experience in Korean schools, their response might include either students' portfolios that are graded and summed up to students' scores or formative assessment that might occur in every class. South African teachers tested mostly preferred about half constructed-response and half multiple-choice formats (73%), while Korean teacher tested were likely to use mostly a multiple-choice format (70%) (Table 6.28).

Table 6.27 ***Frequency of science tests***

		Every two weeks or less	About once a month	A few times a year or less
% of teachers	Korea	49(3.2)	37(3.1)	14(2.2)
	South Africa	24(3.1)	63(3.5)	13(2.5)

Note: () Standard errors.

Recently, the policy in Korea encourages teachers to increase constructed-response format and decrease multiple-choice format as constructed-response formats are proved to facilitate higher-order thinking ability.

Table 6.28 ***Item formats used by teachers in science test or examinations***

		Only or mostly constructed-response	About half constructed-response and half multiple-choice	Only or mostly multiple-choice
% of teachers	Korea	10(1.9)	20(2.5)	70(2.9)
	South Africa	17(2.7)	73(3.2)	10(2.2)

Note: () Standard errors.

6.3.3 SCHOOL LEVEL

Even a rough look of the data at the school level shows some differences between the two countries that are worth discussing. Firstly, as for community size where schools are located, more than 80% of Korean schools (83%, 3.2) tested are located in cities whose population is more than 50,000. In contrast, only 35% (3.4) of South African schools tested are so.

From a perspective of stability of student body, Korean schools seem to be more stable than South African schools, as shown in Table 6.29 (below). Specifically, most Korean schools tested (99%) had fewer than 5% of their students absent, in contrast to 62% in South Africa. In addition, all Korean schools tested reported that the students in their schools had still been enrolled since the start of the school year. This, by contrast, was the case in only 59% of schools tested in South Africa.

Table 6.29 ***Mobility and stability of student body***

		Less than 5% of students absent from school	More than 96% of students still enrolled since the start
% of schools	Korea	99(0.9)	100(0.0)
	South Africa	62(3.4)	59(3.5)

Note: () Standard errors.

In light of student achievement, demographic characteristics, including student economic background is considered an important factor, as reviewed in Chapter 3. Almost 86% of schools tested in South Africa stated that more than 50% of their students came from economically disadvantaged homes, as opposed to only 10% in Korea, as shown in Table 6.30.

Table 6.30 ***The percentage of students in their schools coming from economically disadvantaged homes***

		0-10 %	11-25%	26-50%	More than 50%
% of schools	Korea	32(4.1)	41(4.3)	17(3.3)	10(2.6)
	South Africa	4(1.4)	3(1.2)	7(1.8)	86(2.5)

Note: () Standard errors.

As expected from examining the student level, some 14% of principals tested in South Africa reported that more than 90% of their students used language of test as their native language, and 78% of principals tested responded that that fewer than 50% of their students had language of test as the native language, as seen in Table 6.31 (below). In sharp contrast, most of principals (99%) in Korea reported more than 90% of their students had language of test as the native language.

Table 6.31 ***Students who have test language as 1st language***

		The percentage of student who have <language of test> as their native language			
		More than 90%	76-90%	50-75%	Less than 50%
% of schools	Korea	99(0.9)	-	-	-
	South Africa	14(2.7)	3(1.3)	5(1.7)	78(3.2)

Note: () Standard errors.

Some 99% (0.9) of the principals tested in Korea had been principals for less than 5 years. By contrast, South African principals tested had a wide range of experience as principal, ranging from 1 to 22 years. This can be explained by the different contexts that older and more experienced teachers can be a principal by passing some processes and it leads to short-term principals just before being retired in Korean schools. Unlike Korea, it seems that professional and trained staff can be a principal for longer periods in South African schools.

In both countries, schools expected parents to become more involved in school-related activities (Table 6.32). Of significance is that Korean schools expected parental involvement less as to 'raise funds for the school' and 'volunteer for school projects' than in other activities. It is very unusual to see raising funds for the school in Korea as the government supports schools financially. Most school projects in Korea are led by teachers or staff in schools other than parents or students.

Table 6.32 ***Schools' expectation for parents' involvement***

		Attend special events	Raise funds for the school	Volunteer for school projects, etc.	Ensure that children complete homework	Serve on school committee
% of schools	Korea	86(3.0)	36(4.1)	50(4.3)	83(3.2)	82(3.3)
	South Africa	95(1.6)	91(2.0)	91(2.0)	94(1.7)	100(0.0)

Note: () Standard errors.

With respect to science teachers in schools, both Korea (99%, 0.01) and South Africa (95%, 0.02) do not use incentives to retain or recruit science teachers. However, 52% (3.6) of principals tested in South Africa reported that it was somewhat or very difficult to fill Grade 8 teaching vacancies for science, as opposed to 13% (2.9) in Korea.

Table 6.33 ***The most frequent student behaviours occurring in Korean schools***

	Violating dress code			Classroom disturbance		
	Never or rarely	Monthly or weekly	Daily	Never or rarely	Monthly or weekly	Daily
% of schools	71(3.9)	15(3.1)	14(3.0)	69(4.0)	12(2.8)	19(3.4)

Note: () Standard errors.

In terms of students 'behavioural problems, the principals tested in Korea reported that 'violating dress code' (14%) and causing 'classroom disturbance' (19%) occurred daily the most often in schools (see Table 6.33). South African principals tested considered 'arriving late at school' (48%) and 'absenteeism' (27%) as the most frequent behaviours in schools daily (see Table 6.34).

Table 6.34 ***The most frequent behaviours occurring in South African schools***

	Arriving late at school			Absenteeism		
	Never or rarely	Monthly or weekly	Daily	Never or rarely	Monthly or weekly	Daily
% of schools	28(3.2)	24(3.0)	48(3.6)	31(3.3)	42(3.5)	27(3.2)

Note: () Standard errors.

With respect to severity of behaviour, Korean principals tested reported that 'physical injury to other students' (6%) and 'Intimidation or verbal abuse of other students' (4%) were the most serious behavioural problems in Korean schools, as seen in Table 6.35:

Table 6.35 ***The most serious student behaviours occurring in Korean schools***

	Intimidation or verbal abuse of other students		Physical injury to other students	
	Not or minor problem	Serious problem	Not or minor problem	Serious problem
% of schools	96(1.7)	4(1.7)	94(2.0)	6(2.0)

Note: () Standard errors.

Compared to Korean results, more than 30% of South African schools tested reported that 'arriving late at school' (39%) and 'absenteeism' (37%) were considered mostly as serious problems along with 'vandalism' (34%), as indicated in Table 6.36:

Table 6.36 ***The most serious student behaviours occurring in South African schools***

	Arriving late at school		Absenteeism		Vandalism	
	Not or minor problem	Serious problem	Not or minor problem	Serious problem	Not or minor problem	Serious problem
% of schools	61(3.5)	39(3.5)	63(3.4)	37(3.4)	66(3.4)	34(3.4)

Note: () Standard errors.

TIMSS made an index of availability of school resources for science instruction in order to measure the extent of school resources. Indexes were based on principals' average response to 11 questions, including five questions about general shortages and six science instruction-related shortages: instructional materials; budget for supplies; school buildings and grounds; heating/cooling and lighting systems; and instructional space; science laboratory equipment and materials; computers for science instruction; computer software for science instruction; calculators for science instruction; library materials relevant to science instruction; and audio-visual resources for science instruction. Schools having on average lower than 2 are assigned to high level. Where schools have

on average greater than or equal to 3, they are assigned to low level. Schools with all other possible combinations of responses are assigned to medium level (Martin, Mullis, Gonzalez & Chrostowski, 2004). As described in Table 6.37, Korea indicated only 2% of students tested had low index value in sharp contrast to 39% of students tested in South Africa.

Table 6.37 ***Index of availability of school resources for science instruction (ASRSI)***

		High ASRSI	Medium ASRSI	Low ASRSI
% of students[&]	Korea	30(4.0)	67(3.9)	2(1.0)
	South Africa	9(2.0)	52(3.5)	39(3.5)

Source: Martin, Mullis, Gonzalez & Chrostowski, 2004.
Note: () Standard errors.
[&] % of students whose principal responded

Related to computer resources, South African principals tested indicated that the total number of computers in schools used for educational is on average nine with a standard deviation of 18 while Korean schools tested reported that there are on average 55 (SD, 33) computers in schools (see Table 6.38). Specifically, 55% (3.5) among schools tested in South Africa had no computers available for science instruction. This is in agreement with the result from the teacher level that over 86% (2.5) of South African teachers have no or little access to computers for use in science lessons, in sharp contrast to some 88% (2.0) of Korean teachers tested who have computers available for their science lessons.

Table 6.38 ***The number of computers in schools available for science instruction***

		Mean	SD
% of schools	Korea	55	33
	South Africa	9	18

In relation to the Internet access, as expected from computer availability, 60% of the cases of South Africa were missing, and among the responses the accessibility also shows low percentages as described in Table 6. 39:

Table 6.39 ***Computers access to the Internet for educational purposes***

		All	Most	Some	None
% of schools	Korea	83(3.2)	16(3.2)	1(0.9)	-
	South Africa	22(4.7)	2(1.6)	9(3.2)	67(5.3)

Note: () Standard errors.

6.4 CONCLUSION

This chapter explored TIMSS data by looking at the proportions of responses collected on various levels of Korea and South Africa. The exploration focused on description other than explanation of the differences between Korean and South African results. A descriptive exploration helps one take a snapshot of the science education of the two countries and items influencing student achievement in a broad sense. Exploration started with comparing the science achievements in TIMSS 2003. There was a wide gap between the two countries. As exploration on contextual backgrounds progressed across levels, the differences become distinguishable.

Korea and South Africa showed differences in many aspects at each level. Specifically, there are large differences in student language at home, parental educational level, students' expectation to higher education, attitudes towards science, out-of-school activities, and ethnicity at the student level. The differences of interest at the teacher level include teacher background characteristics, limitations on instruction, topic coverage, homework, and assessment. Principals tested in both Korea and South Africa show such differences as stability/mobility of students, student background, community

size, and resources. The explanation on the differences is detailed in the next chapter.