5

PISA for Development Contextual Questionnaires Framework

This Chapter describes the framework and core content for the PISA for Development (PISA-D) contextual questionnaires, for both the school-based assessment and the out-of-school assessment. The Chapter presents the content and aims of the instruments for students who were in school and in Grade 7 or higher at the time of the assessment; who were in school but in a grade lower than Grade 7; and also for youths who were out of school. The Chapter also describes the teacher and school questionnaires that are used for the school-based assessment and the instruments used for the out-of-school population: a questionnaire for the parents or the person most knowledgeable about the youths, and a household observation questionnaire.

As noted in Chapter 1, the focus of the PISA contextual questionnaires is on understanding how measures of student performance at age 15 are related to various aspects of school and classroom practice as well as to other related factors, such as economic, social and cultural context. The PISA-D questionnaires include these aspects and also cover a broader set of well-being outcomes and risk and protective factors, taking into account differences in life experiences of children in middle- and low-income countries, both of those who are in school and those who are not.

The PISA-D questionnaire framework uses the Educational Prosperity model (Willms, 2015) as an over-arching framework. It incorporates lessons from other international studies, inputs from the participating countries and many elements from the PISA questionnaires.

A review of the experience of middle- and low-income countries participating in PISA 2000 to 2015 shows that the PISA questionnaires do not always capture the most relevant contextual factors for these countries. For example, questions about school infrastructure and teaching and learning materials are related to student performance in high-income countries, but are often unrelated to differences in performance in middle-income countries (Lockheed, Prokic-Breuer and Shadrova, 2015). In addition, the measure of economic, social and cultural status used by PISA does not adequately capture lower levels of parental education and income or the risk factors associated with poverty that are more frequent in low-income countries.

PISA-D enhances the contextual questionnaires to better measure factors that are more strongly related to student performance in middle- and low-income countries, while maintaining comparability with PISA on a set of core indicators. For example, the questionnaires collect more detailed data on students' language of instruction at school, language at home and their socio-economic status, as measured by home possessions and parents' education, literacy skills and participation in the labour force. The questionnaires also identify additional indicators of educational success beyond performance on the PISA test. These indicators comprise, for example, questions about educational attainment, health and well-being, and attitudes towards school and learning.

In addition to assessing student performance, PISA-D introduces an out-of-school assessment to collect data on youth who have not been eligible to sit the PISA school-based test. The out-of-school instruments gather much of the same data as the school-based instruments, as well as data on barriers to school attendance and factors that may impede students' progress through school.

The PISA-D school-based instruments include student, teacher and school questionnaires. In contrast, PISA distributes questionnaires to students and schools and offers countries four optional questionnaires, including a computer familiarity questionnaire, an educational career questionnaire, a parent questionnaire and a teacher questionnaire. The PISA-D instruments for the out-of-school population include a youth questionnaire (which is administered by an interviewer), a questionnaire for their parents or the person most knowledgeable about the youth, and a household observation questionnaire which is completed by the interviewer.

The Questionnaire Framework for PISA 2012 established the core questionnaire content that should be kept comparable across cycles to allow for continuous monitoring of education systems and identified four broad areas: outcomes, student background, teaching and learning processes, and school policies and educational governance (OECD, 2013). These four areas are all included in the PISA-D framework.

This chapter presents the framework for the PISA-D contextual questionnaires. The first section defines the core of the PISA-D contextual assessment, explaining 1) the Education Prosperity framework that shaped the enhancements made to the contextual questionnaires for PISA-D; 2) the approach to including the out-of-school population; and 3) the selection and organisation of the core content of the PISA-D instruments. The second section of this chapter explores the full breadth of policy issues to be covered, structured in 15 modules and one complementary category, and explains how the modules have been implemented in PISA-D. The second section also includes a comparison of the policy issues covered by PISA-D and PISA, highlighting similarities and differences.

DEFINING THE CORE OF CONTEXTUAL ASSESSMENT IN PISA-D

The PISA-D framework is an adapted version of the Education Prosperity approach. It takes into account the goals of PISA-D, lessons from past PISA cycles and other international studies, recommendations from research literature and the priorities of the participating countries. This overarching framework maintains that policy makers in middle- and low-income countries need to be informed principally on the Prosperity Outcomes, Foundations for Success and student-level demographic factors for monitoring performance of their education system and assessing equality and equity of outcomes that are described in this document. In addition, the questionnaires include several teacher, school and system-level

background measures that provide a context for the Prosperity Outcomes. The framework also proposes an approach for equality and equity for both the in-school and out-of-school populations.

This framework is discussed below, specifying the constructs and measures and providing arguments that support the choice of core content for PISA-D.

Educational Prosperity

The PISA-D questionnaire framework draws on the Educational Prosperity model (Willms, 2015), which follows a life-course approach to assessing children's outcomes, considering the effects of several factors over a student or youth's lifetime. The capacity of a society to develop young peoples' literacy skills and well-being depends on its ability to provide the right kinds of human and material resources to support healthy development from conception to childhood and beyond. Educational Prosperity refers to the success of the education system in developing children's cognitive skills and their social, emotional, physical and spiritual well-being. The term "prosperity" simply refers to the condition of experiencing success or thriving (Willms, 2015).

Educational Prosperity, as applied in PISA-D, considers development from conception to adolescence as the result of individuals' personal characteristics, their actions, their culture and the contexts in which they live (Mayer, 2009). It identifies a set of key outcomes, called "Prosperity Outcomes", for each of six stages of development, and a set of family, institutional and community factors, called "Foundations for Success", which drive these outcomes. The stages, which are described in Annex 5.A1, are prenatal, early development (ages 0 to 2), pre-primary (ages 3 to 5), early primary (ages 6 to 9), late primary and lower secondary (ages 10 to 15), and upper secondary (ages 16 to 18). Both the school-based and out-of-school components of PISA-D focus on the Prosperity Outcomes and the Foundations for Success for the fifth stage of the Educational Prosperity framework, while the out-of-school component also collects some data on earlier stages.

The approach has three explicit links to national and local policy and practice. First, it allows countries to align data collection with explicit goals at all levels of the system, from the minister and his or her staff to the front-line educators, students and parents. The challenge for countries is to maintain a focus on the alignment between data and policy goals. Second, the data collected with this approach has immediate implications for educational policies that involve decisions about the allocation of resources and its implications for equity. Countries will have reliable data on a wide set of Prosperity Outcomes as well as the foundation factors. With reliable data on differences across groups in outcomes and access to foundations, countries will be able to determine whether poor and marginalised populations are given equal opportunities to succeed at school and beyond. Third, the data collected will enable countries to set targets consistent with the SDG Education 2030 framework and monitor progress towards them. Many policy issues in middle- and low-income countries concern long-standing structural features of schools, such as the incidence of grade repetition or the choice of the language of instruction for minority groups. Making progress in reaching the SDG Education 2030 targets will require confronting these issues on the basis of solid evidence on how these structural features of education systems relate to the achievement and well-being of students on average and of specific groups at risk. Comparable data from other countries facing similar policy changes can also facilitate the identification of policy options that can yield the desired results. PISA-D provides an infrastructure for analysing relationships between trends in outcomes and policy changes. The descriptive evidence from PISA usefully complements experimental policy evaluations and more qualitative assessments of the implementation of policy reforms.

Prosperity Outcomes

The framework for PISA-D conceptualises success as something cumulative, emphasising that development at age 15 is a product of children's environments and experiences since birth. The PISA contextual questionnaires framework emphasises understanding how measures of student performance, attitudes and beliefs at age 15 are related to various aspects of student background and school and classroom practice. The PISA-D framework proposes a wider set of cognitive and non-cognitive outcomes and foundation factors to better measure the life experiences of in- and out-of-school of children in middle- and low-income countries. The Prosperity Outcomes include measures of academic performance, educational attainment, attitudes towards school and learning, and health and well-being.

The Educational Prosperity model was adapted to fit with the needs of the PISA-D participating countries, taking account of analysis of the results of middle- and low-income countries in PISA questionnaires, reviews of relevant international and regional studies and consultation with representatives of the participating countries.

The Educational Prosperity model distinguishes four processes that determine how success accumulates from one stage to the next: biological embedding, Foundations for Success, cumulative development and institutional selection. The Foundations for Success are described below, while a description of the other processes and the effects associated with each of the processes along the Educational Prosperity pathway are available in Annex 5.A1.

Foundations for Success

The Foundations for Success are factors that affect children's outcomes at each stage of development. For example, from age 2 to age 5, children's development is affected by parents' engagement with the child and intra-family relations, as well as by the quality of care at home and in early childhood centres. They are considered to be universal in that they are necessary conditions for success at each stage of development. The selection of the foundation factors was based on theory and a large body of research that provides evidence of the effects of each factor on student outcomes.

Three additional criteria were considered in determining which factors to include as Foundations for Success: the factors must be potent, proximal *and* pervasive. A "potent" factor is one that has a strong correlation with an outcome or set of outcomes. For example, the quality of classroom instruction is arguably the most important driver of student outcomes during the schooling period (Anderson, 2004; Rosenshine, 2010; Kyriakides, Christoforou and Charalambous, 2013; Creemers and Kyriakides, 2006).

A "proximal" factor is close to the outcome in the sense that its relationship with the outcome is not mediated through some other factor. For example, the quality of classroom instruction has a direct, positive relationship on student outcomes, without any intervening factors. "Principal leadership" is also an important factor and several studies have shown that it is correlated with student outcomes. However, it is not proximal because the "effects" of principal leadership are mediated through the school-related foundations factors, namely inclusive context, quality instruction, learning time and material resources. Thus, a jurisdiction may allocate resources to improving principal leadership, but this would only result in improved outcomes if it leads to improvements in quality instruction, increased learning time and so on.

A "pervasive" factor is positively correlated with a wide range of outcomes, although the strength of the correlation may vary with each outcome. For example, the effects associated with an "inclusive school context" not only affect student's academic performance, but also their educational attainment, their health and well-being, and their social, institutional and intellectual engagement.

Equality and equity

The terms "equality" and "equity" have been used by researchers and policy makers to denote several different concepts. These include, for example, the achievement gap between low- and high-status groups, differences in access to schooling, and the segregation of students into different types of schools and school programmes. Willms (2011) argued in the OECD's *Education at a Glance* (OECD, 2011), that equality and equity should be defined as separate concepts and measured with a consistent approach.

PISA-D defines inequality as differences among sub-populations in the distribution of their educational outcomes, while the measure of equity, a normative concept, requires also an assessment of fairness based on the observed differences among sub-populations in their access to the resources and schooling processes that affect schooling outcomes. Equality is therefore measured by the differences among groups in the distribution of Prosperity Outcomes, which are performance, attainment, health and well-being, and attitudes towards school and learning. Equity, on the other hand, also has to do with ensuring that all children benefit in the same way from school, and requires measures of whether children from different groups have fair access to the five Foundations for Success, which are inclusive environments, quality instruction, learning time, material resources, and family and community support. Unfair access to the foundation factors increases inequalities in outcomes. For example, not providing the right level of support to disadvantaged children to attend schools regularly will inevitably result in socio-economic inequalities in attainment and performance.

If we consider equality and equity in reading performance for students from differing socio-economic backgrounds, for example, equality is assessed by examining the relationship between reading performance and socio-economic status (SES), while equity is assessed by also examining the relationship between SES and the foundation factors that are considered core to learning how to read.

The PISA-D questionnaires collect information on several demographic factors that impact equality and equity and are relevant to both the in- and out-of-school populations. The framework focuses in particular on gender, SES and poverty, language, urban/rural status, immigrant background and disability. This model is characterised in Figure 5.1 (modified from Willms et al., 2012).

Figure 5.1 ▪ **A model for assessing equality and equity**
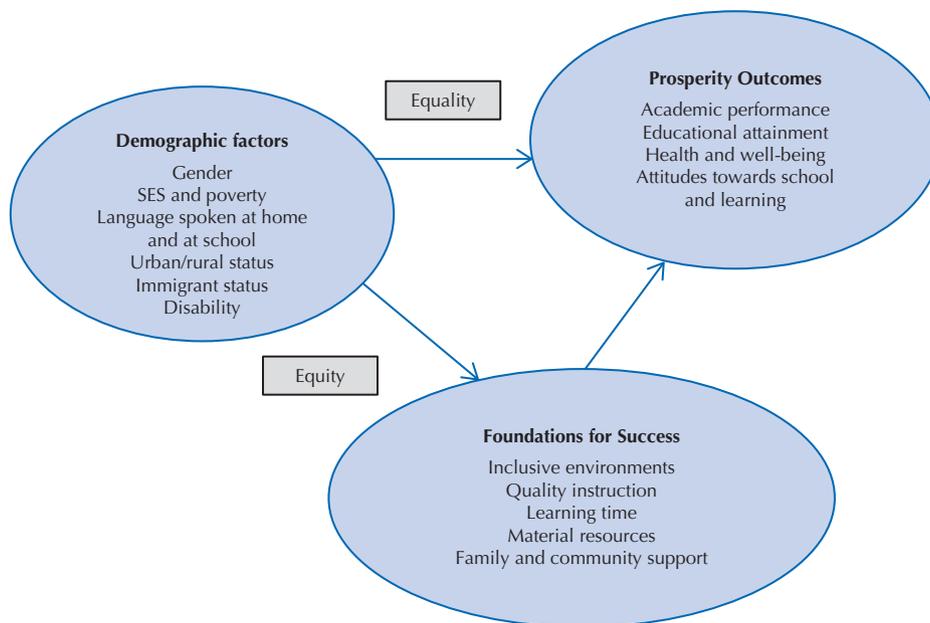
Source: Modified from Willms, J.D. et al. (2012), "Assessing Educational Equality and Equity with Large-Scale Assessment Data: Brazil as a case study", Technical Notes No. IDB-TN-389, Inter-American Development Bank.

When discussing equity it is important to always consider fairness and equality together with the need for quality. For example, a risk of policies focusing on equality without quality would be an education system where students from all social backgrounds have access to equally low quality education and perform equally poorly.

Assessing the out-of-school population

The first benchmark to assess equality and equity is whether all children are given the same opportunities to be in school and stay in school to acquire the skills they need for life. One of the unique features of PISA-D is that it gathers information on how many youths are in school at ages 14 to 16 and the reasons why some youths have left school at that age. It also allows for the combination of data for the in-school and out-of-school populations.

PISA is aimed at 15-year-old students that are in Grade 7 or above, leaving a large population of middle- and low-income countries out of the assessment. PISA-D incorporates these youth in the assessment through the out-of-school component which is conducted through a household survey. This component assesses 14-16 year-olds that are either not in school or in school but in Grade 6 or below, which represents approximately one-third of youth in the participating countries. Through its two components PISA-D includes students who are in school (those in Grade 7 or above through the school-based component, those who are in Grade 6 or below through the out-of-school component) and youth who are not in school. The youth who are out of school include those that have never enrolled and those with some schooling, ranging from a few months to several years.

Box 5.1 **Definition of access to schooling**

The term "access" in education generally refers to whether schooling is freely available to children in a jurisdiction. The emphasis is on the *provision* of schooling, and it is incumbent upon governments and educational institutions to ensure that schools are available locally and that educational policies do not create barriers for attending school. In practical terms, however, access is gauged simply by measures of school attendance (e.g. UIS, 2006). This approach takes into account not only the supply of schooling, but also the cultural, social, religious, political and economic factors that affect the demand for schooling. In striving to improve school attendance, several governments have turned to demand-side initiatives, such as providing free meals, cash transfers to families which are conditional on their child's attendance, and vouchers designed to increase school choice (Patrinos, 2007). Some definitions of access also incorporate the *quality* of school provision and in some cases are attached to a desired outcome. For example, the UN Sustainable Development Goal 4.1 states: "By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes" (UN, 2016). The statement calls not only for equal opportunities to attend school, but also equality of outcomes (relevant and effective learning outcomes) and equity of school provision (quality primary and secondary education).

The Educational Prosperity model and the approach taken in PISA-D identify two types of access: access as an outcome, which depends on both demand and supply and measured by attainment and learning outcomes; and access as a condition for success, which depends on supply and is measured by the Foundations for Success related to the quality of schooling.

The PISA-D framework includes four key aspects of school quality: inclusive environments, quality instruction, learning time and material resources. A pre-requisite to benefit from all school-related Foundations for Success is to be in school, therefore, access pertains to equity: do children from various sub-populations differ in their access to inclusive environments, quality instruction, learning time and material resources?

The PISA-D framework also includes academic performance and educational attainment, which refers to the extent to which children participate in school at various stages of their life-course. Thus, access also has to do with equality: do children from various sub-populations differ in their distribution of attainment and performance?

PISA-D also includes measures pertaining to the barriers to attending school for out-of-school children, which can help discern the extent to which access is predominantly a supply- or demand-side issue for each country.

In general, out-of-school youth tend to be poorer than those attending school – many of them are in the lowest quintile. They are mainly from rural settings, and more likely to be girls. Youth with disabilities and those belonging to minority ethnic, linguistic or religious groups are also more likely to be out-of-school. All of these factors are usually confounded with poverty (Carr-Hill, 2015).

PISA-D's approach to measuring economic, social and cultural status (ESCS) and poverty is especially important for the out-of-school population, as poverty is one of the main reasons, if not the main reason, for being out of school. Both the students and out-of-school youth are asked an extensive set of questions relevant to poverty and language spoken at home. The youth questionnaire also includes several questions relevant to the demand for schooling, including questions about their work experience and support for their family as well as questions concerning perceived barriers to schooling.

The life-course approach assumes children's attainment is determined by various events and family circumstances that begin at conception and continue through to age 15. The questionnaire completed by the person most knowledgeable about the youth asks about some elements of their early life-course foundations, such as the nutrition and health of the biological mother during pregnancy, and the engagement of the family during the preschool years. This provides data about the first four stages of development relevant to the accumulated effects of these factors on school attendance at ages 14 to 16.

Selecting and organising the core content

The instruments

The questionnaires for the school students include: a student questionnaire with 49 questions, a teacher questionnaire with 33 questions administered to the majority of teachers in each school, and a school questionnaire with 28 questions administered to the school principal.

The questionnaires for the out-of-school youth include: a questionnaire for the youth with 77 questions that is administered by an interviewer, a questionnaire for the person most knowledgeable about the youth with 19 questions, and a household observation questionnaire completed by the interviewer with 14 questions.

The distribution of questions across the elements of the Educational Prosperity model is shown in Figure 5.2, with black stars indicating questions that can be linked with PISA 2015 and blue stars indicating questions that are new to PISA-D.

Figure 5.2 ▪ **Questions in the PISA-D contextual questionnaires**

	School-based assessment			Out-of-school assessment		
	Student	**Teacher**	**School**	**Youth**	**Person most knowledgeable about the youth**	**Household**
Prosperity Outcomes						
Educational attainment	****			**********_*****	***	
Health and well-being	****			****		
Attitudes towards school and learning	*			**	*	
Foundations for Success						
Inclusive environments	****	**	****	***		
Quality instruction	***	*	*			
Learning time	*****	*	**			
Material resources		******	*****			
Family and community support	*	*	**	*	*	
Demographic factors to assess equity and equality						
Gender	*			*		
Socio-economic status and poverty	********_**********_**		**	**********_**********_**********_**********_**	********	*******
Language spoken at home	****	***		****		
Urban/rural status			*			
Immigrant status	*			***		
Disability	*			**		
Context factors		**********_*********	*******_****		******_	*******
Total	**49**	**33**	**28**	**77**	**19**	**14**

Note: Black stars indicate questions that come from the main PISA assessment; blue stars indicate questions new to PISA-D.

The questions for the PISA-D questionnaires were drawn mainly from PISA, and complemented with questions from other international and regional studies or developed in consultation with the PISA-D participating countries. The criteria for selecting and developing items included: their fit with the Educational Prosperity model; relevance, as confirmed through analysis of the results of middle- and low-income countries in PISA questionnaires; reviews of relevant international and regional studies; consultation with representatives of the participating countries; and maintaining links with PISA 2015.

All the items in the questionnaires were tested in a field trial. Questions were not retained for the main study if their psychometric properties (e.g. reliability, unidimensionality, completion of items and consistency across cultures) were inadequate. When there were two versions of a particular question, only one question was usually retained. To be retained for the main study, questions also had to meet at least one of the following conditions:

1. Relevant to the measurement of ESCS common to PISA 2015 or new measures required to extend the scale to lower values of ESCS and to collect information on poverty

2. Required for a measure of material resources

3. Relevant for comparability with PISA 2015

4. Required for coverage of all domains of the Educational Prosperity framework

5. Relevant to the classification of students into the six key sub-populations.

CORE CONTENT FOR ASSESSING EDUCATIONAL PROSPERITY

As noted above, the conceptual framework for the PISA-D questionnaires includes 15 modules. These include four Prosperity Outcomes, five Foundations for Success, and six student demographic background factors relevant to assessing equality and equity (see Figure 5.2 above). It also includes a set of teacher, school and system-level questions grouped under the category of context information that complement the variables included in the Educational Prosperity approach.

The content of these modules is discussed below.

Assessing Prosperity Outcomes

As noted above, Prosperity Outcomes include: academic performance, educational attainment, health and well-being, and attitudes towards school and learning. These are each described briefly below.

Academic performance

The measures of academic performance in PISA-D are based on the assessments of performance in reading, mathematics and science. The frameworks for these assessments are described in Chapters 2, 3 and 4.

Educational attainment

Educational attainment – how far students go in school – is a key outcome for middle- and low-income countries that sits alongside measures of academic performance. Many of the key policy questions of middle- and low-income countries pertain to students' and families' demand for education, which depends on students' early learning experiences and their perceptions of its relevance, quality and long-term benefits. In many middle- and low-income countries, students do not attend school beyond the primary level.

A salient feature of middle- and low-income countries is that the distribution of 15-year-old students stretches well below Grades 9 or 10. Another salient feature is that even though formally education might be compulsory, a large proportion of 15-year-old youth have dropped out. The primary aim in measuring attainment is to gain a better understanding of students' pathways to their current level of attainment and to also understand the reason for abandoning school, when this has happened.

Information about attainment is collected through all PISA-D questionnaires except for the teacher questionnaire and the household observations questionnaire, which is answered by the out-of-school youth interviewer. Like PISA, the PISA-D student and out-of-school youth questionnaires include questions about grade, grade repetition and early childhood education attendance (this is asked in the parent's questionnaire for the out-of-school component); and the school questionnaire asks about grade retention policies and academic support services. PISA-D further investigates the experience of students and out-of-school youth with questions about long-term absenteeism and the reasons for it, such as being sick or having to look after others. Also unique to PISA-D, the parent questionnaire asks about factors that could hinder the youth's completion of compulsory education.[1]

The approach used by PISA-D to assess educational attainment is inspired by the framework set out by UIS and UNICEF (2005), which have been used to characterise the entire school-age population. In PISA-D they will be used to describe the levels of attainment of age 15 youth who are in school and 14-16 year-olds who are out of school.

Data from students' current grade level, or in the case of out-of-school students the last grade completed, as well as data on students' birthdate, will be used to construct an ordinal variable describing five levels of attainment (the first three levels are used for the in-school component and the last two for the out-of-school component):

1. **On-track.** Students are in their expected grade, given their birthdate; that is, they started school on schedule and have not repeated a grade. In most cases, this would be Grades 9 or 10.

2. **One year below expected grade.** These students have usually repeated a grade or were out of school for a prolonged period. They would typically be in Grades 8 or 9.

3. **Two or three years below expected grade.** In most cases, these students have repeated two or three grades, but some may have started late or simply faded in and out of school for a year. They would typically be in Grades 7 or 8.

4. **Enrolled in school but are four or five grades below the expected grade.** In most cases, these students will have repeated more than three times, but some may have started late or simply faded in and out of school for one year or more. They would typically be in Grades 5 or 6.

5. **Not attending school.** These students are not attending school, and the highest grade they attained will be described.

Health and well-being

The concept of well-being is very broad, and typically refers to the quality of people's life. Diener (2006) defines subjective well-being as "an umbrella term for the different valuations people make regarding their lives, the events happening to them, their bodies and minds, and the circumstances in which they live" (p. 400). PISA 2015 uses the following definition of well-being that extends beyond students' subjective appraisal of their life quality: "Students' well-being refers to the psychological, cognitive, social and physical functioning and capabilities that students need to live a happy and fulfilling life" (OECD, 2017).

This module is based on the New South Wales Department of Education and Communities framework for student well-being (New South Wales Department of Education and Communities, 2015) that considers the following five domains: emotional, physical, social, cognitive and spiritual well-being. The health and well-being module focuses on the first two of these domains, while social and cognitive well-being are included in other modules. Spiritual well-being is not included in the PISA-D framework.

Emotional well-being is the affective component of well-being – people's reactions to their experiences. It can be positive, such as people's overall rating of their happiness as used in the World Happiness Report (Helliwell, Layard and Sachs, 2012); or negative, such as people's feelings of anxiety, depression or fear. As in PISA, the PISA-D student and out-of-school youth questionnaires ask about general life satisfaction. PISA-D includes measures of anxiety and depression and questions about their physical and mental health during the past year.

Children's physical health is the key element of physical well-being. It is particularly important in middle- and low-income countries, as children's health in these countries is more often compromised in ways that affect their educational outcomes – due to hunger; physical and emotional abuse; chronic illnesses such as asthma, bronchitis, diabetes or epilepsy; and acute illnesses that cause children to miss school and fall behind. While PISA collects information on students' nutrition and physical activity, PISA-D asks about respondents' overall perception of their health and about their mental health during the past year. The parental questionnaire for the out-of-school youth also asks about the youth's prenatal and early experiences; about the mother's health during pregnancy, the conditions and any complications of the mother's birth experience, how the youth was fed during the first six months of life, and whether the youth had any health problems during the first five years of life.

Social well-being pertains to students' sense of belonging and their connectedness to others. In this framework, it is covered by elements of the attitudes towards school and learning and inclusive environment modules, primarily focusing on students' sense of belonging at school and their connectedness to others at school.

One of the elements of cognitive well-being is academic performance. In this framework this is covered as a Prosperity Outcome in its own right.

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Box 5.2 **Well-being in PISA 2015 and PISA-D**

According to the Framework for the Analysis of Student Well-Being in the PISA 2015 Study (Borgonovi and Pál, 2016), the five dimensions of students' well-being captured in PISA 2015 are:

Cognitive well-being: The cognitive dimension of students' well-being refers to the skills and foundations students have to participate effectively in today's society, as lifelong learners, effective workers and engaged citizens. It comprises students' proficiency in academic subjects, their ability to collaborate with others to solve problems and their sense of mastery of school subjects. In PISA 2015 it is assessed as the level of subject-specific skills and competencies students have acquired, measured through the PISA tests; and their self-belief in those subjects, measured through the questionnaires.

In PISA-D this is assessed through the tests and included in the academic performance module, which is considered a Prosperity Outcome.

Psychological well-being: The psychological dimension of students' well-being includes students' evaluations and views about life, their engagement with school, and the goals and ambitions they have for their future. In PISA 2015 it includes students' self-reported psychological functioning, and covers life satisfaction – students' overall evaluation about life in general – and three aspects of education related to psychological functioning: 1) the goal setting and emotions related to *students' career and educational expectations*; 2) *achievement motivation* related to students' appreciation of the educational opportunities they have, an engagement with learning and an interest in acquiring knowledge; and 3) *test and learning anxiety*.

As in PISA, the PISA-D student and out-of-school youth questionnaires ask about general life satisfaction and PISA-D includes a measure of emotional distress (severe anxiety and depression) and questions about their physical and mental health during the past year in the health and well-being module. Concerning education related elements, PISA-D explores educational attainment in greater depth than PISA by asking students and out-of-school youth about long-term absenteeism and the reasons for it. PISA-D further investigates the experience of out-of-school youth with questions about whether they work, their profession, hours worked per week, and wage or salary. The out-of-school component also gathers information about youth's engagement in reading and writing literacy activities, such as how often they read a newspaper, magazine or book, write a text or email, etc.

Physical well-being: The physical dimension of students' well-being refers to students' health status, engagement in physical exercise and the adoption of healthy eating habits. PISA 2015 covers two aspects of students' lifestyles: physical activity and eating habits.

PISA-D focuses on physical health and assesses it as part of the module on health and well-being.

Social well-being: The social dimension of students' well-being refers to the quality of their social lives including their relationship with their family, their peers and their teachers (positive or negative), and how they perceive their social life in school (positive or negative), and how they perceive their social life in school. PISA 2015 measures students' sense of belonging at school and their relationships with their teachers, their peers and their parents.

PISA-D assesses social well-being within the attitudes towards school and learning and inclusive environment modules, primarily focusing on students' sense of belonging at school and their connectedness to others at school.

Material well-being: Material resources make it possible for families to better provide for their children's needs and for schools to support students' learning and healthy development. Households who live in poverty find it difficult to ensure that their children have access to the educational and cultural resources they need to thrive in school and to realise their potential. Research shows a strong link between material well-being in childhood and different dimensions of well-being in adulthood. Providing adequate resources to children is important, not only because it is a pre-requisite for successful development, but also because teenagers in poverty do not have adequate living and learning conditions to fulfil their personal goals. PISA contains a rich set of information on the types of resources students have at home and, most importantly, at school: human resources, material resources and extracurricular activities.

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Box 5.2 [continued] **Well-being in PISA 2015 and PISA-D**

PISA-D assesses material well-being through the socio-economic status and poverty module, and also through questions on schools' material resources. In both cases it creates new questions to better address the needs of middle-income countries.

The PISA 2015 questionnaire design does not attempt to clearly articulate and identify input and outcome indicators for the five well-being dimensions, so some dimensions focus on well-being inputs and others on outcomes, without an integrated measurement approach. This is coherent with PISA-D classifying some of the PISA 2015 well-being factors as Prosperity Outcomes, others as Foundations for Success, and others as demographic factors related with equity and equality.

Attitudes towards school and learning

The PISA studies have examined students' interest and motivation in reading, mathematics and science, and their participation in activities related to the subject. For example, the OECD report, *Reading for Change: Performance and Engagement across Countries* examined students' motivation and interest in reading, and the time students spend reading for pleasure and reading diverse material (OECD, 2002). PISA has also considered "engagement" more broadly, to refer to students' attitudes towards schooling and their participation in school activities (Willms, 2003).

Several studies have considered engagement to be a predictor of educational performance and attainment, and there is strong evidence that engagement is correlated with both performance and attainment (Willms, 2003). However, in PISA-D it is considered an important outcome in its own right, a Prosperity Outcome alongside performance and attainment. A strong case can be made that the direction of causation is reversed (from performance to engagement) at certain stages of the school system. For example, children who do not make a successful transition from learning-to-read to reading-to-learn are more likely to become disaffected with school during the late primary and lower secondary years. Moreover, engagement is seen "as a *disposition* towards learning, working with others and functioning in a social institution" (Willms, 2003, p. 8), and as such is a key Prosperity Outcome that leads to lifelong learning and the likelihood of becoming a productive member of society.

Like PISA, the PISA-D student and out-of-school youth questionnaires include a measure of institutional engagement, providing information on general attitudes towards school and learning outcomes, as well as attitudes towards learning activities. Out-of-school youth are asked about attitudes towards school and learning based on their experience when attending school; and their parents are asked about their attitudes towards education as well.

The out-of-school component also gathers information about youth's engagement in reading and writing literacy activities, such as how often they read a newspaper, magazine or book, write a text or email, etc.

Assessing the Foundations for Success

As noted earlier in this chapter, the Foundations for Success are factors that affect children's outcomes at each stage of development. They are considered to be universal in that they are necessary conditions for success at each stage of development. The selection of the foundation factors for PISA-D was based on theory and a large body of research that provides evidence of the effects of each factor on student outcomes. The factors selected for PISA-D are: inclusive environments, quality instruction, learning time, material resources, and family and community support. These factors are each described briefly below. Some of the elements included in each factor are core to the factor, while other elements can be considered as supporting content.

Inclusive environments

Inclusive environments are classrooms, schools and broader communities that value and support inclusion. "Inclusion is a process of addressing and responding to the diversity of needs of all learners through increasing participation in learning, cultures and communities, and reducing exclusion within and from education. It involves changes and modifications in content, approaches, structures and strategies, with a common vision which covers all children of the appropriate age range and a conviction that it is the responsibility of the regular system to educate all children" (UNESCO, 2005, p. 13). UNESCO's (2009) policy guidelines provide a schema for measuring aspects of inclusion relevant to teachers' and principals' attitudes and values.

Inclusive environments are places in which all students can succeed. *All* means learners across the categorical boundaries of disability, social class, gender, ethnicity, national origin, sexual orientation and religion. *Succeed* means succeeding in terms of learning, as well as in terms of physical, social, emotional and spiritual outcomes (Willms, 2009). The provision of inclusive environments is a foundation for Educational Prosperity in middle- and low-income countries as it concerns the opportunities for children with disabilities; children from ethnic, linguistic and religious minorities; and girls to have equal access to schooling and a complete school experience, including opportunities to learn, engage in the social life of the school, and feel accepted by their peers and teachers.

Inclusive classroom and school practices affect students' sense of belonging at school, their participation in the social life of the school and their opportunities to learn. A reason for abandoning school is negative attitudes and responses to diversity as well as a failure to provide necessary accommodations to meet special learning needs. The metrics also need to capture the attitudes and practices of teachers and principals. Inclusion requires teachers to be ambassadors for inclusion in their community by embracing and celebrating diversity, becoming skilled at meeting the needs of students with special needs and using new approaches to assessing learning (Riehl, 2000). At the system level, inclusion is concerned with the extent to which students from different sub-populations or ability are segregated into different schools or school programmes.

For the school-based component, PISA-D collects information on inclusion from students, teachers and school principals. For the out-of-school component, it collects this information from the youth questionnaire, asking youth to describe their experience when they attended school.

 As in PISA, PISA-D asks students to report on their sense of belonging at school. PISA-D further explores school climate with questions to students about the safety of their school, whether they feel safe at school and whether they have been sexually harassed at school; out-of-school youth are asked these same questions based on their experiences when they attended school.

PISA-D asks teachers a set of questions about their attitudes and practices towards teaching students with low literacy levels. Both PISA and PISA-D ask school principals about school policies concerning how students are admitted to the school and grouped for instruction as well as about the diversity of the school. PISA-D also asks about their attitude towards grade retention.

Quality instruction

Quality of instruction is the most important driver of student performance, but arguably the most difficult to define and measure. Anderson (2004) defined effective teachers as "those who achieve the goals they set for themselves or which they have set for them by others (e.g. ministries of education, legislators and other government officials, school principals)." (p. 22). His model assumes that teachers are aware of, understand and actively pursue goals; that they teach with a purpose – to facilitate learning – material which they consider worthwhile; and that their goals are concerned directly or indirectly with student learning. This perspective, that effective teachers are goal-oriented, is evident in virtually all of the contemporary models of effective instruction (Coe et al., 2014).

The "delivery of the lesson" and "interacting with students" are at the centre of Anderson's (2004) conceptual framework of teacher effectiveness. Four other elements of his framework – standards, learning units, classroom climate and culture, and classroom organisation and management – have effects that are mediated through lesson delivery and teacher-student interactions. All six elements have direct effects on student learning and engagement. Teachers' characteristics – including their professional knowledge, expectations and leadership, and students' characteristics, including their aptitudes, prior knowledge, and attitudes and values – are positioned behind the six core elements of the framework. In the language of Educational Prosperity presented above, they are distal factors that have their effects through the proximal core elements, and thus are included as contextual factors and not as a foundation for success in the PISA-D framework.

This module is assessed through questions to students, teachers and school principals and is not assessed for the out-of-school component. Similar to PISA, the PISA-D student questionnaire includes measures on student-teacher interactions and assesses the classroom learning climate. PISA-D adds new questions on lesson delivery to gather information on the structure of lessons and teaching practices in mathematics lessons. PISA-D adds questions about their practices for teaching less able students. PISA-D also asks school principals about teachers' behaviours that could negatively impact on classroom climate.

Learning time

Learning time in middle- and low-income countries differs from that of high-income countries in several ways. In many cases, children of middle- and low-income families start school at a later age, they miss many days of school during the primary school period, and they are more likely to repeat grades. Many children work in part-time jobs outside the home from an early age. Moreover, there appears to be considerable variation in class time devoted to the three core PISA subjects, and curriculum coverage is not as deep. How learning time is measured in main PISA has changed through the cycles.

The school-based component of PISA-D captures learning time in and out of school. Similar to PISA, the PISA-D student questionnaire asks about reasons for loss in learning time due to student truancy. PISA-D also asks students for information on reasons for reduced teaching time. PISA-D asks teachers about the reasons they are absent and school principals about their policies regarding teacher absenteeism. PISA-D also asks school principals about the reasons for and amount of instructional time lost during the last year, as does PISA. This module is not assessed for the out-of-school component.

Material resources

Studies based on the Latin American Laboratory for Assessment of the Quality of Education (LLECE) data by Murillo and Román (2011) and Willms and Somers (2001) suggest that in middle- and low-income countries school resources have substantial effects, even after taking into account the socio-economic characteristics of students. PISA-D's school-based component used a schema set out by Murillo and Román (2011), which distinguishes between basic services, didactic facilities and didactic resources:

- *Basic services* at the school include factors such as potable water, sewage services, bathrooms, electricity and telephones.
- *Didactic facilities* refer to places other than the classroom for teaching and learning. These include, for example, school libraries, gymnasiums, art and music rooms, science laboratories, computer rooms and sports fields.
- *Didactic resources* can include very basic materials, such as textbooks and blackboards, through to computers in the school, laptop computers for students and teachers, and quality books in the library.

Whereas PISA asks about principals' perceptions of school resources (lack of or inadequate physical infrastructure and educational material) and collects information on the availability of information and communication technology resources and Internet connectivity, PISA-D questions to school principals focus on the availability and condition of specific elements of school infrastructure (such as walls, windows, etc.) and facilities (such as toilets, classrooms, etc.) as well as the availability of textbooks. The questions in PISA-D also distinguish between the availability of didactic facilities and resources and teachers' use of didactic facilities and resources.

Family and community support

For children, few relationships in life are as significant and enduring as the relationship with their parents or the adults who raised them. The nature and extent of family and community support differs among countries, not only because of cultural differences, but also due to the large number of children living in poverty in many of the partner countries. But families – whether small, nuclear families, or extended families – invariably are the first social unit in which children learn and develop. And while good parenting can take different forms and be shaped by various social and cultural forces, it always involves providing children with the support, care, love, guidance and protection that set the conditions for healthy physical, mental and social development.

PISA questionnaires include questions pertaining to family's static cultural capital, about the relations between parents and children, and between parents and other parents.

In consultations with countries participating in PISA-D there was a demand for questions about community support. Small and Newman (2001) describe two over-arching connections between community and families that are relevant for developing measures of community support. One considers the socialisation of children, with neighbourhoods moulding children into certain behavioural patterns. The other pertains to the access of resources that support parents in raising their children. This could include, for example, literacy programmes, recreation facilities and programmes, or interventions to combat drug use and violence. In PISA there have been few questions traditionally about the communities or neighbourhoods of students, though PISA 2015 includes a question to school principals about whether they identify and integrate resources from the community to strengthen school programmes, family practices, and student learning and development.

For PISA-D, the community comprises local neighbourhoods nested within the school catchment area, which is defined with geographic boundaries or by the area from which the school draws its students.

PISA-D asks both students and out-of-school youth about the types of communication they have with their parents or someone in their family, whereas PISA asks about the student-parent relationship in terms of emotional warmth, stimulation, etc.

PISA-D asks teachers about families' involvement at school and asks school principals about how parent and community members or organisations contribute to the school, whereas PISA gathers information about school policies for parental involvement. PISA-D also asks parents of out-of-school youth about the type of support they provided to the youth in their early years, while PISA countries that distribute the optional parent questionnaire ask parents of PISA students about the support they provided to their children at the beginning of primary education and at age 15. PISA also asks parents about their participation in school-related activities and whether there are factors that have prevented them from participating in the activities.

Student-level demographic factors for assessing equality and equity

PISA-D focuses on the following measures pertaining to students' and families' backgrounds that are particularly relevant for low- and middle-income countries: gender, socio-economic status and poverty, the language spoken at home and the language of instruction at school, urban/rural status, immigrant status and disability. Though ethnicity is a variable related with being out-of-school, it was not included as one of the five demographic factors because it is embedded within poverty, immigrant status, language spoken at home and language of instruction.

Gender

Like PISA, the PISA-D question on gender simply asks students and youth whether they are male or female. PISA-D does not capture data about gender identity or sexual orientation.

Socio-economic status and poverty

Socio-economic status (SES) refers to the position of a person or family in a hierarchical social structure, based on their access to, or control over, wealth, prestige and power (Mueller and Parcel, 1981; Dutton and Levine, 1989). Numerous studies have shown that a person's position on an SES hierarchy is related to a wide range of outcomes pertaining to their physical, economic and social well-being. SES affects people's educational opportunities, their access to certain labour markets, their exposure to health and crime risks, and their lifetime earnings.

The literature on child development in middle- and low-income countries focuses mainly on the risk factors associated with poverty, especially during the prenatal period and the early years. These include, for example, poor nutrition during pregnancy, a lack of stimulation during the early years, and stressful living conditions.

The measure of SES in PISA, called the index of economic, social and cultural status (ESCS) does not adequately capture lower levels of education and lower levels of income and wealth for the majority of students in middle- and low-income countries. PISA-D extends this measure to lower levels of SES, keeping the link with the PISA measure. PISA-D also gathers specific information on poverty, and explores the possibility of developing a separate measure of it relevant to Educational Prosperity.

The PISA-D student and out-of-school youth questionnaires include a large number of questions pertaining to family SES and poverty, including the long-standing questions used in PISA which assess the highest educational level of the parents, the highest occupational status of parents, and an index of home possessions, which has been adjusted to middle- and low-income countries. The questionnaires also include new questions designed to capture youth's experience of poverty, including questions about material possessions, parents' education and engagement in literacy activities, and more detailed information about their parents' occupation. PISA-D further investigates the experience of out-of-school youth with questions about whether they work, their profession, hours worked per week, and wage or salary. Information about school meals is collected through the PISA-D school questionnaire.

Poverty is expected to be a fundamental characteristic of the out-of-school population. Unique to PISA-D, parents provide information about the out-of-school youth's food security during the youth's first two years of life and whether the youth has received any government support for schooling. The household observation questionnaire includes questions about the youth's housing and neighbourhood.

Language spoken at home and language of instruction

In several middle- and low-income countries, the students' first language differs from the language of instruction at school. Also, in some countries, the language of instruction during the primary grades, when children are learning to read, differs from the official language of instruction after the third or fourth grade. A further issue, which is more difficult to capture with a survey, is that in some schools, the teachers use the students' native language, or some combination of the native language and the official language of instruction.

PISA asks students, "What language do you speak at home most of the time?" This construct is extended for PISA-D in both the school-based and out-of-school components to include questions about the language of instruction at school and the language they first learnt to read. In addition, teachers are asked about which language they use during their lessons, as well as which language they use when talking with students.

Urban/rural status

The school questionnaire includes a variable pertaining to the size of the community, which can be used to determine the school's rural status. Living in a rural area versus a larger community is sometimes confounded with other student-level demographic factors and the analyses will enable to discern this. For the out-of-school component the urban/rural status information was collected during the sampling process using each country's administrative classification of regions as urban or rural.

Immigrant status

The measure of immigrant status is based on a long-standing approach used in PISA which is based on questions of students and youth about where they and their parents were born.

Disability

PISA-D is the first PISA study to include self-reported measures pertaining to disability. The questions follow contemporary approaches to disability, which emphasise the extent to which a disability limits people in doing certain activities in a particular environment. For example, students are asked about whether a disability limited their participation in school activities, while out-of-school youth are asked about whether they have a disability or medical condition that limits their daily activities. Out-of-school youth who report having a disability are also asked about the nature of the disability.

Context factors

The school and teacher questionnaires of the in-school component of PISA-D also gather data on other teacher, school and system-level background variables that are expected to help explain student outcomes but are not included in one of the previous modules. Some of the questions used to assess these variables come from PISA 2015 and others were created to fit the needs of middle- and low-income countries.

Like PISA, PISA-D asks teachers about their age and sex, qualification, employment status, educational background, years of experience and professional development activities. PISA-D gathers new information about whether the teacher teaches multi-grade classrooms, holds multiple teaching jobs or works other jobs in addition to teaching, and a number of factors relevant to their pre-service training, SES, and health and well-being. Also unique to PISA-D, the teacher questionnaire asks about the proportion of students in their class that lack the literacy and numeracy skills to learn the curriculum.

As policy makers have limited direct impact on teaching and learning processes, information on school-level factors that help to improve schools, and thus indirectly improve student learning, have high priority. To meet policy requests directly, PISA also needs to address issues related to governance at the system level. School principals in both PISA and PISA-D are asked numerous questions on resources and management, including type of school (public vs. private, distinguishing between types of private schools), number of students, average class size, school management and funding, as well as how many full- and part-time teachers work at their school. PISA-D adds questions on school location and nearby hazards. Like PISA, the PISA-D teacher questionnaire asks about school leadership at the school where they work and job satisfaction. PISA-D adds a question about their satisfaction with specific aspects of their job, such as benefits and pay.

As in PISA, the contextual information collected through the PISA-D questionnaires is complemented by system-level data on contextual variables in educational systems. The system-level questionnaire used in PISA was adapted for use by PISA-D countries, and both versions capture data on the structure of national programmes, national assessments and examinations, instructional time, teacher training and salaries, educational finance (including enrolment), national accounts and population data (UIS, 2016).

For the out-of-school component there is no data collected on teachers and school-level background variables, however the system-level data can provide relevant contextual information. Some background variables are also collected about the person who answers the "person most knowledgeable about the youth" questionnaire.

Note

1. While PISA offers an optional parent questionnaire, it is distributed to the parents of students sitting the PISA test in school and focuses on the parents' perceptions of and involvement in their child's school, their support for learning at home and school choice; and it acquires information on basic characteristics of the early childhood education and care arrangements of PISA participants, and reasons for attending or not attending early childhood education and care.

Annex 5.A1

Annex 5.A1 presents descriptions of the key elements of the six stages of development and the processes that determine how success accumulates from one stage to the next.

Key elements of each of the six stages of development

Prenatal period

The Prosperity Outcomes at this stage are a healthy pregnancy and delivery. The Foundations for Success include four family factors: nutrition, no exposure to toxins, the mother's physical health and the mother's emotional health. A number of studies have shown that poor nutrition during the prenatal period modifies the development of the unborn child, leading to low birth weight and a greater susceptibility to coronary heart disease, obesity and diabetes later in life (Barker, 1994; Barker and Sultan, 1995). The exposure of the foetus to environmental toxins or to alcohol or drugs can also compromise the healthy development of the unborn child (Nelson and Panksepp, 1998). The mental and physical well-being of the mother also plays a key role (Liu et al., 1997). The prevalence of healthy pregnancies and deliveries can be increased through the provision of prenatal care and primary health care.

At this stage and in subsequent stages, the framework includes social capital and resources. The term "social capital" is intended to capture positive socialising forces, such as trust among community members, social ties and networks connecting people, the presence of strong adult role models, and actively engaged citizens.

Early development (birth to age 2)

The Prosperity Outcomes at this stage include language, cognitive and physical development. The key family foundations include: breast-feeding and nutrition, the mother's physical and emotional health, parenting skills and intra-family relations. These factors can be supported with positive post-natal care and primary health care.

Pre-primary (ages 3 to 5)

The Prosperity Outcomes at this stage includes skills in five domains: awareness of self and environment, cognitive development, language and communication, physical development, and social skills and approaches to learning. These outcomes are consistent with frameworks set out by UNICEF and the United States Congress (Shepard, Kagan and Wurtz, 1998).

Three of the most important family factors affecting children's development in these domains are family involvement, especially reading to the child, positive intra-family relations and parenting styles (Willms, 2002). Children whose parents adopt an "authoritative" parenting style, which incorporates being responsive to the child's needs but also involves setting expectations for positive behaviour, tend to have better outcomes in these domains (Tramonte, Willms and Gauthier, 2013).

Attendance in high-quality early childhood and care programmes has positive short-term outcomes and enduring long-term benefits (Burchinal, Howes and Kontos, 2002; Currie, 2001; Peisner-Feinberg et al., 2001; Ramey and Ramey, 1998; Schweinhart and Weikart, 1998), especially for children from less advantaged backgrounds (Burchinal et al., 2000). Several large national studies and many smaller local studies suggest that high-quality child care experiences are related, albeit modestly, to child outcomes, even after adjusting for factors such as socio-economic status and parental child-rearing attitudes and practices (Howes, Phillips and Whitebook, 1992; Peisner-Feinberg and Burchinal, 1997; Zill, 1999). Interventions are more effective when early learning programmes take place within a general framework of anti-poverty

and community development (Kagan and Zigler, 1987) and when programmes promote family engagement alongside high-quality learning experiences for children (Bertram et al., 2002). Programmes for children should be intensive, year-long and conducted by appropriately trained professionals (Leseman, 2002).

Early primary (ages 6 to 9)

After children enter school, there is another critical period that has a dramatic effect on their attainment and performance at age 15. The timely transition from learning-to-read to reading-to-learn, which for most children occurs at about age 8 or 9, is essential to academic success, school attainment and well-being (Snow, Burns and Griffin, 1998). During the primary school years, from kindergarten to Grade 3, considerable emphasis is placed on the development of reading skills. Of course, children learn subject-matter content and acquire a wide range of skills while they are learning to read. But after Grade 3 there is a tacit assumption that children can read fluently and comprehend curricular materials in subject domains such as health, social studies and science. The curriculum changes: students are expected to learn the languages of subject domains and use that language to think critically, solve problems and create new knowledge. The demands for strong reading skills increase as students make their way into the higher grades. Students who lack fundamental reading skills fall further and further behind.

Late primary and lower secondary (ages 10 to 15)

After age 10, during the late primary and lower secondary years, the relationship between early reading skills and future literacy skills is solidified (Francis et al., 1996; Kozminsky and Kozminsky, 2001), as is the relationship between early literacy and social and emotional outcomes (Coleman and Vaughn, 2000). This is the "reading-to-learn" period, during which students require strong literacy skills in all subjects in order to make inferences, monitor comprehension and use higher-order skills, such as previewing, predicting and summarising (O'Reilly and McNamara, 2007). Students who have not made the transition from learning-to-read to reading-to-learn are unable to handle the demands for understanding increasingly complex subject-matter content (Morris, Bloodgood and Perney, 2003).

Upper secondary (ages 16 to 18)

Completing secondary school is a key outcome at this stage. Longitudinal studies that have followed students through to the school-leaving age have identified a number of demographic and school-related factors related to completion (Barrington and Hendricks, 1989; Crane, 1991; Ensminger and Slusarcick, 1992; Fagan and Pabon, 1990; Gilbert et al., 1993; Janosz et al., 1997; Rumberger, 1983; Wehlage and Rutter, 1986). Literacy skills, grade repetition, attendance, engagement and positive behaviours are among the most important determinants, and nearly all studies emphasise the role of family socio-economic status and parental engagement.

Processes that determine how success accumulates from one stage to the next

Biological embedding

Children's potential for success at school is affected by factors during the prenatal period that contribute to a healthy pregnancy and a healthy delivery. Recent advances in neurobiology, molecular biology and genomics have provided compelling evidence that children's early experiences interact with their genetic disposition in ways that affect brain development as well as other neurological and biological systems associated with healthy child development (Boyce, Sokolowski and Robinson, 2012). Some of these biological processes are "biologically embedded" during the prenatal period through epigenetic processes in which chemical signatures are attached to genes that predispose the child to either vulnerability or resilience (Boyce and Kobor, 2015).

At birth, children have billions of neurons; during the course of early development the neurons form connections called synapses in response to environmental stimuli. As this occurs, many of the neurons that are not being used are pruned away. This process of synapse formation and neuron pruning – the sculpting of the brain – is more rapid during certain *critical periods* of the first two or three years of life (McEwan and Schmeck; 1994; Cynader and Frost, 1999). The notion that children's early experiences are biologically embedded is gaining further support from research showing that the development of children's endocrine and immune systems are also influenced by children's environments during the early years (Barr, Beek and Calinoiu, 1999; Gunnar, 1998; McEwan, 1998).

Foundations for Success

See the "Foundations for Success" section of Chapter 5.

Cumulative development

Children's development and success is cumulative. For example, children develop their literacy skills in a cumulative way as they move from one stage to the next. The rate at which they develop these skills depends on the strength and duration of their exposure to the family, institution and community factors that comprise the Foundations for Success in the Educational Prosperity model. For example, a child's literacy skills at age 15 depends on his or her literacy skills at age 8, which is strongly affected by the quality of instruction the child received during the primary grades. The increase in the child's literacy skills from ages 9 to 18 depends on the quality of instruction he or she received during the late primary and secondary school years.

Institutional selection

When students are successful at one stage of development, their life-course may be altered if they are selected into certain classes, school programmes or schools. For example, children who have strong reading and language skills are more likely to be streamed into classes or school programmes where they benefit from positive peer interactions, a higher quality of instruction and other factors that enable them to develop their skills at a faster pace. On the other hand, children who experience learning difficulties at a particular stage are more likely to be streamed into lower ability classes and have less access to the factors that improve their skills.

Figure 5.A1.1 shows the effects associated with each of the four processes along the Educational Prosperity pathway. The outcomes at birth are affected by the Foundations for Success (light blue arrows), which to some extent are biologically embedded (dark blue arrows) through epigenetic processes. The age 2 outcomes are determined by a cumulative effect (grey arrows) and the Foundations for Success associated with that stage, which include a foundation effect (light blue arrows) and an effect that is biologically embedded through the sculpting of the brain during critical periods (dark blue arrows). We assume there are no institutional selection effects at this stage. The age 5 outcomes are also determined by cumulative effects, foundation effects and prior biologically embedded effects. In addition, there can be an institution selection effect (white arrows) if children's outcomes at age 5 are to some extent determined by their access to preschools with varying quality. The outcomes at age 10 and age 18 are affected by the same factors. We assume that the "hard-wired" effects of biological embedding have diminished, although for some outcomes the process of biological embedding continues through to adolescence.

Figure 5.A1.1 ▪ **Four ways in which success accumulates**

Biological embedding (dark blue arrows), Foundations for Success (light blue arrows), cumulative effects (grey arrows), and institutional selection effects (white arrows)
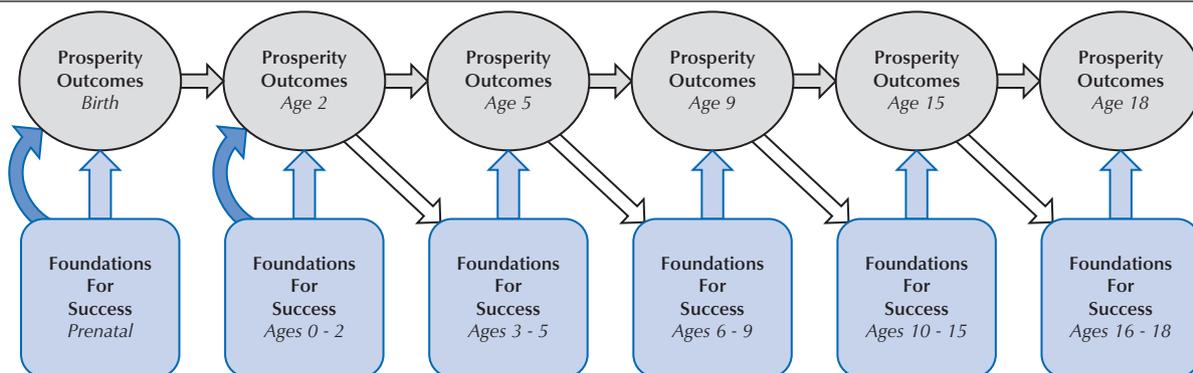
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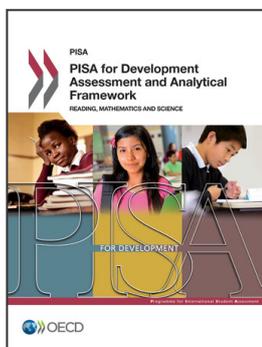
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