

CHAPTER 4. MEASURING THE WORLD'S DIGITAL NATIVES

4.1 Introduction

Digital environments have permeated and changed the lives of young people the world over – from mobile-phone text messaging to massive multiplayer gaming and online video sharing. For more than two decades, people have discussed and debated the emergence of a distinct and recognizable global population of young people who were born into the digital age and are growing up using information and communication technologies (ICTs) in their daily lives. This population of networked youth is often referred to as *digital natives*, and has been praised, celebrated, critiqued and worried over. One groundbreaking collection of seminal ethnographic studies, for instance, has outlined “how digital media are changing the way young people learn, play, socialize, and participate in civic life”. In a summary of their five-year research programme, they argue that: “Most youth use online networks to extend the friendships that they navigate.... The majority of youth use new media to ‘hang out’” (Ito et al., 2008).

Both national and international policy-makers are also paying increasing attention to digital natives, not only because of the possibilities that ICTs open up for young people all around the world, but also on account of the role that young people play in shaping and driving the information society (Box 4.1).

In order to truly understand the impact of digital technologies on young people – and ultimately the social, cultural and policy-making implications of this phenomenon – it is critical to avoid confining consideration to *how* digital media

are changing young people or *what* young people are doing with the myriad of technologies in differing contexts; it is at least as important to ask *where* it holds true that “most” youth are online.

So far, no one has yet quantified digital natives, in particular in the developing world. This has left some key questions unanswered: Just how big is this population of digital natives? How are they distributed geographically and in terms of levels of economic development? What does this tell us about youth, networks, education, policies and other, broader issues?

This chapter offers a first attempt to measure the world's digital native population, on the basis of ITU data and United Nations demographic statistics. It presents a model for calculating the number of digital natives in each country. This in turn makes it possible to calculate the size of the digital native population by country, by region and by income level. The chapter also endeavours to relate the presence of digital natives to education and literacy levels, and ultimately to policy-making.

According to the model, in 2012 there were around 363 million digital natives out of a world population of around 7 billion – or 5.2 per cent. Defining “youth” as young people aged 15 to 24, this means that 30 per cent of the world's youth have been active online for at least five years. While it follows that fewer than a third of the world's young people today are digital natives, this group nonetheless plays an important role: first, because where the online population is concerned, youth are clearly overrepresented, and second,

Box 4.1: Youth and ICT: the BYND 2015 Global Youth Summit

Young people are increasingly earning recognition from governments and the international community as powerful agents of change whose inclusion in politics is vital to improving democratic processes. Recent social movements like the Arab Spring, Spain's 15-M, Mexico's YoSoy132 movement and student protests in countries around the world from Chile to the United Kingdom reaffirm the need to address this generation's call.¹

Technology – and specifically ICT – has played a central role in young people's rise to prominence on a global scale. It has helped them to mobilize behind a common cause and to collaborate, and it has given them a voice where before they had none. ICT has brought them together in response to social concerns. It has connected them across huge geopolitical barriers.

For young people, access to information means better access to the capital, markets and training they need in order to pursue a career or studies; increased participation in political processes; and recognition of young people as responsible citizens in today's society. Youth entrepreneurship – which is facilitated by access to technology, the Internet and information – is fast being positioned as a solution for youth employment.

Young people are rising to the challenge by pioneering the use of ICT and by driving trends in what is a major and dynamic growth industry. Reasons for their great ability to adapt to and use ICTs include their capacity to learn to use ICTs quickly, their natural enthusiasm for new technology (which offers a wide variety of solutions for playing, communicating and socializing), their generally higher literacy rates and the extra spare time they tend to have compared to older people (ITU, 2008).

Recognizing not only the potential impact of ICTs on young people but also the effect that young people have in terms of driving the information society, ITU organized the first global summit on ICTs and youth, from 9 to 11 September 2013, in Costa Rica: **BYND 2015 Global Youth Summit**. The event brought together young people from all corners of the globe with the aim of highlighting their priorities and capturing their combined voice in crucial national and international policy- and decision-making processes. The outcomes of the summit included a crowdsourced, multimedia statement to be presented to Heads of State at the United Nations General Assembly in September 2013.

For more information, see:

<http://www.itu.int/en/bynd2015/Pages/default.aspx>.

because digital natives are key drivers when it comes to ICT uptake, use and impact.

In the world as a whole, most young people are not digital natives. The degree to which young people are networked varies considerably across the globe, and digital nativism is not uniform, but differs according to location and circumstances. For instance, the model indicates that throughout Europe no fewer than 79 per cent of youth are digital natives, whereas in Africa the figure drops to 9.2 per cent. Having said that, although in the Africa region only one in ten young people may be digital natives, this chapter also shows that those young people are often their nation's drivers in terms of getting online, thereby trailblazing a new digital future for their country.

The chapter begins with a review of the literature around the digital native concept, including an overview of the debate scholars are having on the topic, and the pros and cons. It then offers an operational definition of the digital native,

and a computational model based on that definition. The next section applies the model to available data, resulting in a country-by-country estimate of the number of digital natives in 2012. These results are then analysed by region,² development level and income grouping,³ and through the lens of educational enrolment levels. The chapter also highlights the need for further research into the way digital natives think, work, communicate and do things, putting more emphasis on research in and about the developing world. It concludes with some final thoughts and recommendations for policy-makers.

The literature review below describes different ways of defining the digital native, along with ways in which these networked youth may (or may not) be fundamentally different from their non-networked peers. These debates notwithstanding, what the ethnographic collection cited above (Ito et al., 2008) makes plain is that the young people who are meaningfully connected to digital media do indeed experience new ways to “hang out”, “mess around” and “geek

out”; and, moreover, that these differences can be important, positive and purposeful. However, what this chapter adds to the discussion – among other things – is that, globally speaking, the digital natives are still the *minority* – albeit an important one – of today’s youth, but will soon become the majority.

For policy-makers, these results lead to several conclusions:

- Where young people are already mostly online, this reality needs to be taken into account in terms of how we approach their learning, playing and civic engagement.
- Where young people are only starting to come online, their digital future needs to be planned for.
- And, in any event, young people are the tip of the digital spear across much of the globe, so we must be ready to listen, learn and grow with them.

4.2 Review of the literature

The concept of digital native

A robust model to quantify digital natives has to be founded upon, and situated within, the existing corpus of literature on the subject. It is therefore important, before defining the model and presenting results, to review the relevant literature.

While the literature diverges in many of its viewpoints, it is, regrettably, more homogeneous in its geographic focus. Nearly all of the studies available are specifically from North America, or otherwise more generally from high-income countries. As this chapter will show, the reality of digital nativeness varies considerably between high- and low-income contexts, and so the tendency for the literature to “ignore” the developing world means it is systematically blind to a measurably different scenario. It is indeed hoped that the *global* quantitative model in this chapter may help respond to the literature’s narrowness of scope.

Digital native, net generation or millennials

There are more than a few names in circulation that try to capture the broad concept of youth and digital networking

technologies. Three of the most common terms in use are “net generation”, “digital natives” and “millennials”.

When Donald Tapscott (1998) wrote about the concept in the late 1990s, *net generation* was perhaps the first neologism used to identify young digital users. Strictly confining this population to precise generational dates, net generation includes only those people born between January 1977 and December 1997 (Tapscott, 1998). Coinciding with “the digital revolution,” the net generation is characterized as being “at the heart of the new digital media culture,” “exceptionally curious, self-reliant, contrarian, smart, focused, able to adapt, high in self-esteem, and has a global orientation” (Tapscott, 1998). Oblinger and Oblinger (2005) add that people in the net generation were born around the time the PC was introduced. These authors also posited that the net generation “is able to intuitively use a variety of IT devices and navigate the internet”, but that “their understanding of the technology or source quality may be shallow” (Oblinger and Oblinger, 2005: 25).

Digital native, the term chosen for this report, is perhaps the most widely used phrase in circulation. Marc Prensky coined digital native in 2001, and later elaborated on the concept in 2009 and elsewhere (Prensky, 2001a, 2001b, 2004, 2009, 2011). Digital natives, according to Prensky, are the generation of young people who are all “native speakers” of the digital language of computers, video games and the Internet (Prensky, 2001a: 1). In other words, they are the first generation to have grown up with new technology, having lived their entire lives surrounded by and using tools and toys of the digital age. E-mail, cellphones and instant messages are not only *a part* of their lives but are *integral parts* of their lives (Prensky, 2001a). According to Prensky, who focuses mostly on youth in the United States, unlike older generations young people are now constantly surrounded by and immersed in, and permanently plugged into, portable personal devices such as mobile telephones, MP3 players and handheld games consoles (Prensky, 2001a; see also Selwyn, 2009).

Prensky argues that the emergence and rapid dissemination of digital technology to the point where it is essential to a young person’s existence signifies a radical break or discontinuity in the last decades of the 20th century, which he calls a singularity (Prensky, 2001a). While suggesting a radical break with previous generations, Prensky did not

define digital natives in terms of specific dates of birth, as Tapscott did with net generation.

Prensky clearly distinguishes his digital native generation from its predecessors by referring to the latter as “digital immigrants”. Digital immigrants are “those who may have acquired some form of digital literacy”, (Robinson, 2008: 1) but nonetheless keep “their foot in the past” (Prensky 2001a: 2). Roughly speaking, according to Prensky, in the case of the United States, all people born before 1980 are digital immigrants. They do not turn to the Internet first for information, prefer to read manuals (rather than assume that a program teaches itself), print out e-mails and documents ready-for-edit, physically show (rather than e-mail) a link, and even speak in an outdated language (Prensky 2001a: 2).

In 2000, Howe and Strauss published *Millennials Rising: The Next Great Generation*, from which the term *millennials* took hold. The first cohorts of millennials in the United States graduated from high school in 2000, and Howe and Strauss (2000) describe them as upbeat and engaged youth whom adults hold to high standards. Jones et al. (2010)

also characterized millennials as heavy technology users, noting that a 2007 survey of US-based college students born between 1983 and 1992 found that 97 per cent of the students owned a cellphone and 56 per cent owned an MP3 player.

A 2013 private-sector survey of over 12 000 young Internet users showed that these millennials shared a number of common characteristics, in particular the belief that ICTs were important for participating in politics and society (Box 4.2).

There are a myriad of other terms associated with digital natives: *generation next*, *Google generation* (Helsper and Eynon, 2010: 2), *born digital* (Palfrey and Gasser, 2008), *generation Y* (Perillo, 2007), *generation C* (Duncan-Howell and Lee, 2007), *homo-zappiens* (Veen and Vrakking, 2006), *technological generation* (Monereo, 2004) and *net savvy youth* (Levin and Arafeh, 2002). Others have written about young people who are *new millennium learners* (Pedró, 2007) and are described as living *digital childhoods* (Vandewater et al., 2007) within *media families* (Rideout and Hammel, 2006).

Box 4.2: Survey depicts optimistic millennial generation that believes in the potential of ICTs

A 2013 online survey by Telefónica and the Financial Times of more than 12 000 Internet users between the ages of 18 and 30 in 27 countries shows that the large majority of what the survey calls “millennials” believe that technology has made an important and positive difference in their lives and that it is important for personal success.

The Telefónica Global Millennial Survey, which was carried out in 27 countries across six regions,⁴ also revealed that the young online generation tends to be optimistic about its future and believes that it can make a difference. Millennials say that technology has helped them participate in the political process, and that they are engaged and concerned about societal issues. According to them, the most important ways to make a difference in the world are by providing “more access to education and improving the quality of education (42 per cent), protecting the environment (41 per cent) and eliminating poverty (39 per cent)”. The majority also believe that climate change is “a very pressing issue”.

The survey revealed a shared belief in the potential of technology, but also highlighted a number of regional differences, as well

as a gender gap. While Asian and Latin American millennials were the most optimistic about the economy and their region's future, most Europeans and North Americans were much more pessimistic.

A comparison of women's and men's perception of ICT skills and the importance of technology showed that more men than women believed themselves to be on the cutting-edge of technology. Also, fewer women than men believed that technology had influenced their view on life and that technology was the most important area of study.

The survey recognizes the need to understand the millennial generation, and Telefónica will be using the results to better understand its young customers' concerns and needs, and to identify solutions that make a difference. According to Neelie Kroes, Vice-President of the European Commission: “These young men and women are the future. If you want to succeed you need to know what they care about – such as reducing the gender gap, improving the quality of education and increasing access to technology – and work with them to make concrete positive changes.” (Telefónica press release of 4 June 2013).⁵

While Prensky, Tapscott and these many other writers do not often state it explicitly, their concepts emerge from and are premised upon high ICT-uptake contexts, and in particular the high-income communities of the United States. A thorough overview of the literature clearly reveals this leaning towards the United States, Western Europe and other high-income countries, with very little work on this topic examining, or emanating from, the developing world.

This chapter will employ the term *digital native* to describe young technology users. But the question of just what this term encompasses – i.e. the precise definition of digital native – has many answers in the existing literature.

Age range or generation?

There has been some debate as to whether digital natives are best characterized in terms of a fixed *age range* or a *generation*. Defining digital natives in terms of an age range does not result in a fixed set of individuals, but rather captures a snapshot of people in general at a certain period of their lives. For example, “teenager” is defined in terms of an age range, and includes everyone from 13 to 19; thus, the composition of the teenager set constantly changes as new members enter when they turn 13 and current members leave when they turn 20.

By contrast, a generation refers to a fixed set of people for their entire lifetimes, regardless of what age its members reach. The name of the generation is in reference to the historical context in which the people were born. Edmunds and Turner define a generation as “an age cohort that comes to have social significance by virtue of constituting itself as a cultural identity” (2002: 7). Pierre Bourdieu (1993) argues that generations are socially and culturally defined and produced, each with its own tastes, orientations, beliefs and dispositions (or “habitus”) that emerge as a result of historical and economic circumstances, as well as generational struggles over cultural and economic resources (Buckingham, 2006). Put simply, a generation may be understood as a cohort of people born within a specific time-frame and who may be defined by beliefs or dispositions that are shaped by a historical event or a cultural identity. For example, the “baby boomers” are the generation of people who were born in the United States soon after World War II. Their baby boomer label has stayed with them

through childhood, teenage years and middle-age, and will continue to identify them through old age.

In 1993, Mackenzie Wark argued that: “Generations are not defined by war or depression any more. They are defined by media culture” (Wark, 1993). More than a decade later, David Buckingham (2006) explores the idea that media is a signifier of generational affiliation. After a critical discussion, Buckingham concludes that, in fact, there may be a digital generation of young people who share a cultural identity expressed in their beliefs and dispositions, and in terms of how and for what they use digital technology and media.

The debate as to whether the set of digital natives is defined by an age range or a generation extends to specifying exact birth dates for its members. As discussed above, Prensky did not set exact dates to define digital natives. However, other authors have suggested specific birth dates that characterize the generation. Some authors believe digital natives appear after 1980 (Palfrey and Gasser, 2008), while others are more precise, dating millennials as people born “in or after 1982” (Oblinger, 2003: 38) and before 1991 (Oblinger and Oblinger, 2005: 2.9).

One generation or many?

Some writers have taken the generational concept of digital native a step further, defining multiple generations within a typology of digital natives. When the notion was first introduced in the late 1990s and early 2000s, it was conceived as just one generation, namely the young people at that time. As the concept has persisted into the 2010s, it has been suggested that a second generation of digital natives has now emerged. Some argue that, although this second generation shares the digital native characteristics of an upbringing surrounded by and using technology as tools and toys, it also displays new features. Oblinger and Oblinger (2005), for instance, believe that the second generation is characterized by the “omnipresence and interactivity of the internet, the availability of a range of portable communications devices, and the virtually immediate speed of communications”. Helsper and Eynon (2010) identify the rise of Web 2.0 as marking a shift in digital natives, separating those born after 1990 from the young adults born between 1983 and 1990, and label the former as second-generation digital natives.

Jones et al. (2010) also define the concept as being much more complex than a single generation. One of their findings, from a study of first-year students who were all born after 1983 but are younger than 25, was that those who used new technology often did so in ways that did not entirely fit the expectations of the net generation or digital native theses.

One thing is clear, though: given that the digital age has arrived at different times in different countries, such specific birth dates cannot be applied universally across countries, and are only meaningful in the context of the countries studied by the authors cited above.

A population based on access and learning, or breadth and depth of use?

An alternative notion is that digital natives are a *population* defined by their shared accumulation of experience, skills or expertise, rather than a specific age group or generation. A population is a subset of people who share characteristics, such as all people who have access to Internet at home or who are digitally literate (Palfrey and Gasser, 2008: 14). Members of this population can either come from any age range or generation (e.g. any home Internet user), or be further delimited by age range or generation (e.g. home Internet users between the ages of 15 and 24).

Helsper and Eynon (2010) express this sentiment, theorizing that a digital native is determined not only by age (or generation), but also by experience and breadth of use. In one of the few cases coming out of Africa, Thinyane, on the basis of a study of first-year university students in South Africa, argues that “rather than calling Digital Natives a generation – an overstatement, especially in light of the fact that only 1 billion of the 6 billion people in the world even have access to digital technologies – we prefer to think of them as a population” (Thinyane, 2010: 412). Even Prensky has begun to distance himself from the notion of the digital native as a generation (2009). A study conducted in the United Kingdom found “no evidence of the much hyped generational divide” needed to define a generational digital native (Jones, 2002: 11). It argues that digital natives are better understood as a diverse group – young and old – who share technological experience, skills or expertise.

Palfrey and Gasser (2008) identify the digital native according to access to technology “because access is differentiated between states and regions and between social classes within individual states”. For them, access to technology seems to include electricity and broadband, as well as education systems that teach literacy (including digital literacy) and emphasize critical thinking. Subsequently, they clarify that this population is further limited insofar as access to new technology alone is not sufficient: digital natives must have access *and* have a “learned digital literacy” (Palfrey and Gasser, 2008). For example, someone with Internet access at home and digital literacy honed through formal or informal learning would be considered a digital native, whereas someone with no access to the Internet, or with access to the Internet but no formal or informal training, would not. Similarly, a 10-year old or a 75-year old who have cultivated considerable, comparable expertise and skills in technologies could both be classified as digital natives, regardless of their generational differences. Thus, according to this understanding of digital native, a subset (but not all members) of the net generation are digital natives; and, conversely, members of other generations (i.e. not youths) can be digital natives.

It has also been argued that the defining features of digital natives go beyond age, dates of birth, access or level of expertise, and entail consideration of just *what* they use the technologies for, and *how*. Focusing on a number of digital activities that indicate digital nativeness, Helsper and Eynon (2010) find that breadth of use, experience, gender and education are just as important as, or even more important than, age in defining the digital native. They believe that digital nativism is a combination of factors: age (the youngest generation which has grown up with technology), experience (those who have been using or submerged in the Internet the longest) and breadth and depth of use (those for whom the Internet is integrated into daily life) (Helsper and Eynon, 2010: 6).

Some scholars argue that digital natives are drawn to the omnipresence and interactivity of the Internet in places like the United States, as well as the availability of a range of portable communication devices, and the virtually immediate speed of communications (Oblinger and Oblinger, 2005; Robinson 2008: 1). In addition, digital natives in developed nations purportedly exercise what Hargittai

and Hannant describe as “autonomy of use,” namely the freedom to use the technology when and where one wants, without constraint from others such as queues of library patrons or employer supervision (Hargittai and Hinnant, 2008: 607).

According to these scholars, young people in high-income communities use digital technology and the Internet on their mobile phones, tablets and computers to engage with friends on social media platforms, chat or instant messaging, to download and listen to music, to play games with friends or strangers around the world, to browse websites for fun, and to blog (and “micro-blog”). For these authors, the ubiquity of the technologies and the style of work and play that these communities use them to engage in circumscribe part of the definition of the digital native. Some indeed posit that the distinguishing feature of digital natives is the sophisticated way that they absorb the technologies into their daily lives (NetDay, 2004; Robinson, 2008: 68).

Although the temptation is to focus on sophistication and ubiquity of use, there is growing evidence that many young people’s actual usage of digital technologies remains rather more limited in scope than the digital native rhetoric would suggest (Selwyn, 2009). For example, surveys of adolescents show a predominance of game playing, text messaging and retrieval of online content (Crook and Harrison, 2008; Luckin et al., 2009; Lenhart et al., 2008), whereas younger children’s use is more rudimentary, centred on writing, image creation and basic gaming (Selwyn, 2009).

Others suggest that young people’s Internet use is not as sophisticated as it seems. For instance, Selwyn (2009) believes that the most accurate description of young people’s use of the Internet is passive consumption of knowledge rather than active creation of content, or in Crook and Harrison’s (2008) words, a “low bandwidth exchange” of information and knowledge. Although young people might consider themselves more skilled at using the Internet than their parents (Livingstone and Bovill, 2001), a study comparing the information-seeking abilities of teens and adults in the United States and Australia found that teens are likely to have less patience and poorer research skills (Nielsen, 2005). Moreover, it has been argued that children between the ages of nine and nineteen lack skills in evaluating material they find (Hargittai and Hinnant, 2008: 605). Kennedy et al.

(2008) also remind us that core technology-based skills do not necessarily translate into sophisticated skills with other technologies or general information literacy.

Length of use and submerged exposure

Departing from a focus on the type, breadth or sophistication of use, Prensky’s seminal article seems to suggest that mere *exposure* leads to the necessary accumulation of experience, expertise or skills to enter the digital native community. He describes young people in the United States from kindergarten to college as having “spent their entire lives surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all other toys and tools of the digital age” (Prensky, 2001a). His article seems to imply that young people’s being submerged in technology and the Internet translates to some degree of experience or expertise, which calls for new teaching techniques tailored to their evolved way of learning.

The notion of being submerged surfaces again in Helsper and Eynon’s (2010) definition of digital native as a combination of three factors: age, experience and breadth. Experience, as they define it, includes people “who have been on internet the longest, while they might not have grown up with the internet when young, they have been ‘submerged’ in it for the longest period of time”⁶.

On the basis of this simple notion of exposure, it has been suggested that the experience required to be a digital native can be measured simply in terms of the number of years a person has been online or the amount of time a person spends online (Hargittai, 2010: 5). For instance, veterans are defined as people who have been online for at least three years, whereas newcomers are those who started using the Internet in the past year (Hargittai and Hinnant, 2008: 609). A more specific type of veteran is the “netizen”, who, in addition to being online for three years, goes online, from home, every day (Howard et al., 2001). According to this study, netizens, in comparison with less avid users, engage in more capital-enhancing activities online than do “utilitarians”, “experimenters” or “newcomers” (Hargittai and Hinnant, 2008: 609).

Some authors have combined the generation or age range with the number of years of exposure in order to define the digital native. Prensky (2001a, 2001b), for instance, specified

that digital natives were a generation of students who were younger than 22 years old in 2007 (i.e. born after 1985), had more than ten years' experience using a computer, indicated they had learned to use a computer by teaching themselves or through family and friends, and reported being able to solve ICT problems by themselves or by drawing on supportive social networks.

Brown and Czerniewicz conducted a study based on a definition of those who have "grown up digital" as people who had used a computer at least since they were 12 years old and had more than ten years' experience (2010: 4). Linking their data to Prensky's more stringent criteria, among other findings, they showed that only a small percentage of students – not a whole generation – actually met the criteria Prensky proposed.

Socio-economic, gender and geographic definitions

In contrast to a focus on age or depth or length of use as the qualities best defining digital nativeness, some authors argue that other factors, such as socio-economic position, gender, class, language and geography are better defining qualities (Shah and Abraham, 2009). Studies suggest that young people's ability to access digital technologies runs strongly along lines of socio-economic status and social class, as well as gender, geography and the many other prominent, entrenched "social fault lines" (Golding, 2000).

Some social groups of young people appear to be just as digitally excluded as older generations, although in subtle ways. For instance, studies across Europe and North America show that levels of computer and Internet use are lower among rural youth, female youth and youth from families with low levels of parental education (Vandewater et al., 2007; Selwyn, 2009). Another study shows that girls use the Internet in a greater variety of ways than boys at a younger age (9-15 years), but that boys make broader use of the Internet at an older age (16-19 years) (Livingstone and Helsper, 2007: 13).

General academic literature on Internet use echoes these studies, suggesting that even once people cross the initial connectivity divide, numerous differences affect how they incorporate the Internet into their lives, including level of

education of the user and the user's parents, gender and ethnicity (Hargittai, 2010).

Cognitive and learning differences

Another way to approach the digital native concept is through how digital natives think and learn differently from other people. Howe and Strauss (2000) and Prensky (2001a, 2001b) offer complex visions of the digital native as young people (or students) who think and process information in fundamentally different ways from their predecessors. Prensky (2001b) argues for a digital native version of neuroplasticity, the phenomenon whereby stimulation of the brain causes it to change structure and thus affects the way people think. He submits that children raised with a computer think differently because of their "hypertext minds". "They leap around. It is as though their cognitive structures were parallel, not sequential" (Prensky, 2001b: 10). He asserts that "today's students think and process information fundamentally differently from their predecessors" and that their "brains have changed" (Prensky, 2001a: 4).

According to Prensky, digital natives have been conditioned by their technological environment to expect immediate responses. They prefer random non-linear access to information (i.e. hyperlinks), and have a preference for images over text-based content. Described as multitaskers, they are comfortable being engaged in several tasks simultaneously. They are characterized as being impatient with slower, systematic means of acquiring information and knowledge, and expect instant response and gratification or reward from the technologies they use. Additionally, according to these theories, they are highly adaptive, function best when networked, and use a range of technologies to network with their peers (Prensky, 2001a; Robinson, 2008: 1; Helsper and Eynon, 2010: 2).

Citing neurobiology, social psychology and studies done on children using games for learning, Prensky (2001b) also suggests that digital natives learn differently: "linear thought processes that dominate educational systems now can actually retard learning for brains developed through game and Web-surfing processes on the computer" (Prensky, 2001b: 10). Their approach to learning, he posits, is more collaborative, oriented to problem-solving and task-based (Prensky, 2001a).

However, other scholars and research studies disagree with, or are skeptical about, the notion that digital natives process information differently.⁷ A study by Margaryan et al. (2011) in Australia did not find evidence to support claims that students' patterns of learning and technology use are shifting or that young people adopt radically different learning styles. Rather, they conclude that students seem to conform to traditional pedagogies, albeit with minor uses of digital technology tools for content delivery (Margaryan, Littlejohn and Vojt, 2011).

Bullen and Morgan's (2011) study conducted in six different countries at a range of different institutions showed that learners have differing views about the integration of social and academic uses of technology, and are not generally challenging the dominant academic paradigm. They conclude that, to date, there is no convincing evidence to support claims that digital natives learn differently and that the "implications for education are far from clear" (2011: 60, 62-23).

A 2013 study carried out among first-year undergraduate students at the University of Hong Kong (HKU), China, showed that "first-year undergraduate students at HKU are indeed digital natives, using a wide range of technologies for personal empowerment and entertainment, but not always digitally literate in using technology to support their learning" (Kennedy and Fox, 2013). The study, which aimed at expanding knowledge on digital natives to the "Asian learner and their use of technology", also tried to understand the potential impact that digital nativism had on the design of learning environments in higher education. It found that there were new opportunities to "create blended learning environments" (2013: 76), including opportunities to motivate and assess students that take advantage of different learning technologies, but that face-to-face relationships remained important.

Much of the literature emphasizes ways in which technology may be incorporated as an educational tool to enhance digital natives' learning, and countless journals, articles and blogs join the conversation about how best to incorporate technology in the classroom.

In sum, the debate as to whether digital natives think, learn or work differently and, if so, how, is not yet settled, and

more research in this area seems necessary. Nonetheless, it appears clear that many education systems are integrating technology in institutional design and curricula for students at all levels (pre-primary through higher education), with mixed results, both enhancing and hindering students' ability to learn.

The literature described above demonstrates that there is an array of definitions for the digital native, from a generation, to an age range, to including aspects of expertise, learning, depth or breadth of use, or years of exposure. In addition, some argue that the set of digital natives is defined not just by who they are or what they do, but also by how their brain works and how they learn and think.

The following section will show that the literature not only varies on just how to define digital native, but also differs in terms of its enthusiasm for the concept itself. While some writers have argued that digital nativism is the biggest change to hit the world's youth, others suggest it is more of the same and part of an ever-evolving media landscape.

Criticisms of the digital native concept

As the concept of the digital native has attracted increasing attention within the academic and popular media, a significant body of critical literature has challenged many points. Looking at these critical responses helps to reveal ways in which a quantitative model of the kind presented in this chapter is inherently limited, as well as areas where the work can respond to specific critiques and challenges.

Moral panic and historical amnesia

One criticism levelled at Prensky's work in particular is that it inspires an academic *moral panic*, being put forward with "tones of euphoria and paranoia" (Shah and Abraham, 2009: 12). This school of thought argues that digital native proponents have developed an argument in "dramatic language, proclaim a profound change in the world, and pronounce stark generational differences" (Bennett et al., 2008; Bennett and Maton, 2010). Critiques quote Prensky's dramatic tone ("really big discontinuity... a 'singularity' – an event which changes things so fundamentally that there is absolutely no going back" (2001a: 1)) and binary language (new generation vs. all previous; technical natives vs. immigrant accents; learners vs. teachers, etc.).

Digital nativism also falls prey to something Bennett and Maton (2010) call *historical amnesia*. Historical amnesia, they say, is when declarations of fundamental change obscure, if not explicitly deny, past precedents for contemporary change (Bennett and Maton, 2010: 16). The digital native, when described as a radical break, lessens the incentives to recognize preceding social or cultural changes. Bennett and Maton also suggest that the digital native theory may mistake new expressions of well-known interests and behaviours for totally new phenomena.

Homogeneity in the presence of diversity

One of the most prevalent criticisms focuses on the diversity of young users of technology (and those who do not use it at all), and the tendency to conflate digital natives into a homogeneous whole.

The critics of treating digital natives as a generation point out that the generation in question is quite diverse in terms of its access to and use of technology. Many authors have argued that there is a digital divide in technology access and use, as evidenced by significant differences in how and why young people use the new technologies and the Internet, as well as how effectively they use them.⁸ A number of writers have highlighted the complexity and diversity of the use of new technologies by young people, which tend to be ignored or minimized in arguments that support the digital native concept (Helsper and Eynon, 2010). Studies highlight systematic variation among young adults' online behaviour (Hargittai, 2010) and the way in which the digital native theory "over-states the rift between generations in terms of their level of immersion in technology" (Bayne and Ross, 2007: 1).

This is especially the case in developing countries, where the use of, and even basic access to, ICTs is much more limited than in high-income countries. Brown and Czerniewicz (2010) note that in South Africa the term digital native describes only a small and elite group of students. They also identified another group of students who were broadly inexperienced with computer-based technologies; they go on to call this group "digital strangers" (Brown and Czerniewicz, 2010). Li and Ranieri (2010) surveyed ninth-grade students in China, here too finding a broad range of digital competencies. Similarly, a qualitative study of digital natives in Chile did not find common technical traits or

special abilities among students interviewed (Sánchez et al., 2011).

Moreover, the issue of ICT disparity *between* developing and developed countries has been raised numerous times in the literature as a constraint on the global applicability of the existing concepts of digital nativeness (Brown and Czerniewicz, 2010; Palfrey and Gasser, 2008; Palfrey, Gasser, Maclay and Beger, 2011; Smith, 2009; Thinyane, 2010; Tustin et al., 2012; Williams, 2011).

Palfrey and Gasser contrast the "high levels of broadband access, high rates of literacy, and educational systems that (often) emphasize critical thinking" in wealthy countries with the situation in the developing world where "technology is less prevalent, electricity often scarce, and literacy rates low, and the number of teachers who know how to instruct kids in the use of technologies in short supply" (Palfrey and Gasser, 2008: 14). Furthermore, the growing disparity in technology access and use also exists within rich countries, such as among rural or low-income communities (Palfrey and Gasser, 2008). The Berkman Center for Internet and Society at Harvard University and UNICEF underline this concern by identifying three divides that must be bridged: basic access to technologies and related infrastructure (e.g. electricity); skills to use the technologies; and limited understanding of how young people navigate the online world (Palfrey et al., 2011). According to them, the effects of these divides are felt most acutely in the developing world.

Other authors have emphasized the fact that there are significant differences in how and why young people use new technologies, as well as how effectively they use them (e.g. DiMaggio and Hargittai, 2001; Facer and Furlong 2001; Hargittai and Hinnant, 2008; Livingstone and Helsper, 2007). According to Helsper and Eynon (2010), this complexity and diversity of use of new technologies by young people is a topic often ignored or minimized in many arguments in support of the digital native concept.

"Othering" and creating binary opposites

A further criticism levelled against digital native is that it is an "othering" concept. It sets up a binary opposition between those who are natives and those who are not – the so-called digital immigrants (Brown and Czerniewicz, 2010). Just as Prensky describes the new generation in contrast

to predecessors, the technical natives as opposed to the immigrants with unshakeable accents (2001a), Tapscott's (1998) account also is based on binary oppositions between technologies (the television versus the Internet) and generations (the baby boomers versus the net generation) (Buckingham, 2006).

According to these critiques, binary opposites create an "other" by alienating one of the binary pair (e.g. the noticeable immigrants and the outdated television). Livingstone and Helsper (2007) concluded that a binary divide between haves and have-nots, or users and non-users, no longer applies to young people. For example, a study of pre-service teachers at the University of British Columbia in Canada found no statistically significant difference in ICT scores between digital natives and digital immigrants; they suggest that "the notion of a digital divide is misleading and deceptive, distracting researchers from studying the diversity of ICT users and the nuances of their ICT competencies" (Guo, Dobson and Petrina, 2008: 235, 252). A recent study by Romero, et al. (2012) also suggests that a binary divide between generations is a fiction. In their study of one thousand or so online learners from Canadian and European universities, they found that older learners (people born before 1982) felt equally as confident with using ICT as the younger learners (people born between 1982 and 1991) and were able to carry out different activities simultaneously.

Western bias

An additional significant criticism levelled against the digital native concept is that it is reminiscent of morally questionable chapters in history related to "migration, integration, and racial and cultural differences in Western society" (Bayne and Ross, 2007). Bayne and Ross (2007) submit that the *native* evokes a controlling force in the future while the *immigrant* is portrayed as old and obsolete.

This Western bias underlines, for some authors, the high-income country partiality of many digital native proponents. For instance, defining natives and immigrants by generation reflects a privileged position of living in the United States, according to Thomas (2011), who argues that Prensky's description of a digital native describes a generation gap which may have occurred in the United States, but that

the same definition applied to other parts of the world would not hold true. Other scholars note the apparent predominance of research from developed countries (Palfrey et al., 2011) and in particular the United States (Thinyane, 2010). Indeed, in one review of the global reach of the term, respondents from Africa, Latin America and Asia routinely expressed unfamiliarity with the digital native concept (Shah and Abraham, 2009).

Summary of the literature review

The literature discussed above reveals the contours of the digital native academic discourse and the extensive research that has been carried out on the digital native concept, albeit mostly in the United States and Western Europe. First conceived of as a generation corresponding roughly with Generation Y (people born between 1980 and 1995), it has been posited that a second generation was born with the Web 2.0 wave. Other scholars depart from the idea of characterizing digital natives by age range (for example, young people under 25) or generation, arguing instead that other features such as breadth of use, skills, experience or expertise are more pertinent. Proponents of this approach suggest that digital natives can be recognized by their use of technology, whether it is used as a *toy* for socializing and entertainment or as a *tool* for information and career advancement. Notably, taking into consideration the use of technology, and in particular skilled or honed expertise, broadens the scope for some authors to include people from older generations who have as much experience with technology as young people born and raised with the technology (if not more). In these cases, digital natives are best considered a population – neither a complete generation, nor confined to a particular generation.

Another prominent approach to digital natives focuses on how they think, describing them as non-linear, collaborative multitaskers who expect immediate responses, are highly networked, and prefer images and multimedia over text. While some believe that digital natives think fundamentally differently from previous generations, others express doubt that digital natives learn and process information differently.

Not surprisingly, the digital native concept has been subject to a range of criticisms. Some claim that much of the literature adopts an alarmist attitude that exaggerates the

role of technology, overly singing its praises or dwelling on its pitfalls. Another critique focuses on the homogeneous nature of some descriptions of digital nativism, pointing out that not all young people have access to or use technology in the same way, and that those who use technology are not necessarily young or skilled.

The literature review clearly demonstrates how little research has been done so far on digital natives and networked youth in the developing countries. While this can be explained by a number of factors, including the fact that the information society, and especially Internet use, has emerged much later in those countries compared with the United States and Western Europe, there is an urgent need for further research on how ICTs are used by, and impact on, young people in the developing world. There is plenty of evidence that points to the eagerness of young people across the world to jump on the information society bandwagon once the technologies become available and affordable. Indeed, ITU statistics show that Internet usage among young people (15-24 years old) is higher than the corresponding figure for the total population, especially in countries with low Internet usage overall. In many developing countries, Internet access at home is limited. Other places, such as schools and Internet cafes, not only become important locations for Internet access but are also more targeted towards, or frequented by, the younger members of the population. Coupled with the relatively higher proportion of youth in the populations of developing countries, an important group of digital natives could emerge in those countries within the next decade.

4.3 Quantifying digital natives

While the literature on digital natives is rich and significant, to date there has been no attempt to develop a quantitative model and count the digital native population worldwide. Through the creation of such a model, and the resulting analysis, the concept can be circumscribed and tested for its value and validity. This process will serve both to provide evidence to support (or refute) the value of the concept, and to highlight possible responses and policy issues specific to the digital native community. This chapter thus complements and augments the existing literature by providing a global perspective and offering testable results and measurements.

Having said that, quantifying and counting digital natives cannot respond to the full range of criticisms levelled against the concept. For example, the proposed process of counting digital natives does not allow for nuancing, but rather entails a binary decision: either someone is or is not a digital native.

Nevertheless, adding a global quantitative model and analysis of the digital native to the available literature should provide greater insights into the practical uses of the concept – and in addition provide a testable platform that can further illuminate its strengths and weaknesses.

Irrespective of the conceptual debates, the world's population of digitally networked youth is real and, hence, measurable. By creating a globally testable measure of digital nativism, as this report does for the first time, some of the points of debate outlined above can be reasoned through and, perhaps, put aside.

The digital native model

This section puts forward a definition of the digital native that is operational within the confines of the existing data. It then develops a computational model that maps existing data onto the definition. Put simply, a digital native is defined here as the population of networked youth – aged 15-24 years – with five or more years of online experience. The number of digital natives in 2012 is computed country by country using the model, either on the basis of existing country estimates of the number of young people online in 2007 (five years before 2012), or by employing a statistical function to work out an estimate. The resulting estimate, along with overall country population data, creates a worldwide measure of digital natives in 2012.

The literature review above makes clear that many parameters have been used to define a digital native: age range, date of birth, level of exposure to the Internet and related technologies, depth and range of use of these technologies, and more. Any analytical model will want to include the most salient parameters, but has to balance this against the need for a realistically quantifiable model that relies on available global datasets.

With these two requirements in mind, this chapter puts forward the following definition:

Definition: A digital native is defined as a youth, aged 15-24 inclusive, with five years or more experience using the Internet.

This definition encompasses the most salient elements often cited in the literature, while excluding those dimensions that are prohibitively hard to operationalize and measure (e.g. depth of use) and/or most controversial (e.g. cognitive differences defining the population). Nor does the definition prescribe what the Internet is used for.

Specifics of the model

Consider the year 2012. According to the definition above, in 2012 a digital native would be someone with five or more years of experience using the Internet who is 15 to 24 years of age. Under this model, a simplifying assumption is made that once someone in their youth starts to use the Internet they continue to use it year after year. For example, if a young

person was using the Internet in 2007, the model assumes that they are still using it in 2012. Similarly, if they were using the Internet before 2007, they continued to use it in 2007. This is called the *monotonicity assumption*.

Monotonicity assumption: Once a young person starts to use the Internet, they continue to use it year after year, presuming no deaths or drop-outs among young Internet users.

Given the above definition and assumption, the number of digital natives in a country in 2012 is equal to the number of Internet users aged 10-19 in the year 2007. Such people will have at least five years of Internet experience by 2012. Therefore, in order to calculate the total number of digital natives in a country in 2012, it is necessary to take the Internet penetration (users per 100 people) for youth aged 10-19 in 2007 in that country and multiply it by the total number of youth aged 10-19 in 2007 in that same country.

Box 4.3: Digital native model

Digital native penetration (%) in year t = Internet users (%) aged 10-19 in year $t - 5$

Digital native absolute numbers in year t =

$$\text{Internet users (\%)} \text{ aged } 10-19 \text{ in year } t - 5 * \text{population aged } 10-19 \text{ in year } t - 5 / 100$$

Youth Internet use functions:

Internet users (%) aged 10-19 = survey data, where available, otherwise:

$$y = -0.014x^2 + 2.358x + 0.337; \quad 0 < x \leq 85 \quad (1)$$

$$y = 100; \quad x > 85 \quad (2)$$

where x is the total Internet user penetration (%) and y is the youth Internet user penetration (%) in a given year.

Country example: Costa Rica

The youth Internet user penetration was not available for Costa Rica in 2007; therefore, the model has to be applied.

Since total Internet user penetration in Costa Rica in 2007 was estimated at 28.4, function (1) is applied:

$$y = -0.014 * 28.4^2 + 2.358 * 28.4 + 0.337 = 56.01$$

This means that the estimated youth Internet user penetration (%) for Costa Rica in 2007 was 56.01, which, according to the digital native model, is equal to the digital native penetration (%) in year 2012.

Digital native absolute number in year 2012 = Internet users (%) aged 10-19 in year 2007 * population aged 10-19 in year 2007 / 100
= 56.01 * 855 218 / 100 = **479 028**

In order to determine the percentage of youth who used the Internet in 2007, national household survey data collected by ITU were used, where available, with any missing values being estimated. To estimate the missing values for the proportion of youth Internet users, a function was developed, based on available data from household surveys, which relates the Internet penetration of the overall population (x) to the Internet penetration specific to youth (y)⁹ (see Box 4.3).

Since more survey data are available for the age group 15-24 than for the age group 10-19, data for the first age group were used in the function.¹⁰ Hence, for the purpose of this analysis, it is assumed that Internet user penetration for the age group 10-19 is similar to that for the age group 15-24. Available data show that in most cases the penetration for the 10-14 age group is indeed the same or very similar to that for the age group 15-24.¹¹ In summary, this Youth Internet Use Function takes the available youth-disaggregated Internet penetration data and estimates youth Internet penetration for all countries where this information is not available from household surveys for a given year, in this case for 2007. The model was applied to a total of 180 countries.¹² Box 4.3 presents the model specifics and a country example.

4.4 Analysis of the results

The previous section defined the digital native and operationalized the definition with a formal model and existing data from surveys. This section will apply the results for an analysis of digital natives across the world (180 countries).

According to the above digital native model, in 2012 there were 363 million digital natives out of a world population of around 7 billion. Thus, across the globe, some 5.2 per cent of the world's total population qualified as digital natives. At the same time, this accounts for 30 per cent of the global youth population aged 15-24. If all digital natives came together to make up their own country, it would be slightly bigger than the United States, the world's third most populous nation. The sum of all digital natives also represents more than the entire population of Brazil and Mexico combined.

Figure 4.1 illustrates the distribution of digital natives by country across the globe, with countries listed in alphabetical order. A bigger box means more digital natives within that country. Not surprisingly, countries with very large populations, such as Brazil, China and India, are prominent in the figure, but highly networked countries with relatively smaller populations, including Canada, the Netherlands and the Republic of Korea, also stand out.

When viewed in terms of their absolute numbers, digital natives in the largest countries (e.g. China and India) predominate. However, when they are studied in terms of penetration per 100 people, i.e. as a percentage of the overall population, other patterns are revealed. The estimated proportion of a total population that are digital natives varies between countries, from a low of 0.13 per cent (Timor-Leste) to a high of 14 per cent (Iceland). The countries at the median are Belarus and Syria, with 5.5 and 5.4 per cent digital natives, respectively. Interestingly, China is very close to the median, with digital natives representing 5.6 per cent of its population.

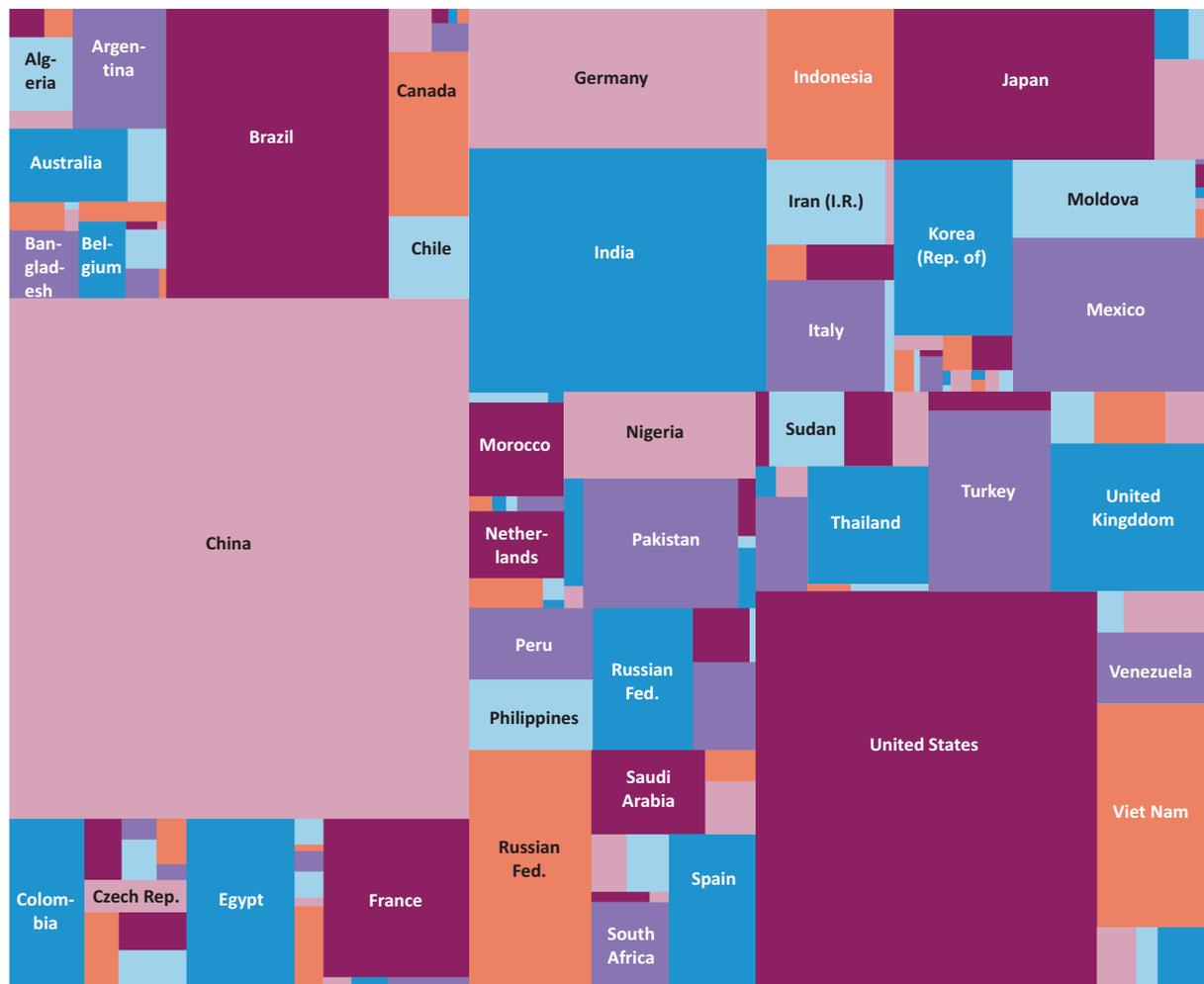
These percentages are portrayed on the map in Figure 4.2, where darker shading represents a higher proportion of digital natives. Table 4.1 shows the values for all countries included in the model.

Not surprisingly, the results show that high-population countries have high absolute numbers of digital natives, and that high-income countries (which usually display high overall levels of Internet use) tend to have relatively high percentages of their population categorized as digital natives. Iceland, New Zealand, the Republic of Korea and the United States, for example, are all countries with relatively high levels of ICT use that also have a high proportion of digital natives.

The countries with the highest proportion of digital natives are all high-income or upper-middle-income countries, and include countries with very high levels of overall Internet penetration, countries at the top of the ICT Development Index (IDI) and countries with relatively larger shares of youth population.

Iceland, the country with the highest proportion (14 per cent) of digital natives among its population, boasts the

Figure 4.1: Distribution of digital natives across countries (absolute numbers), 2012



Note: Absolute number of digital natives in each country (listed alphabetically, top to bottom and left to right) indicated by relative size of box.
Source: ITU

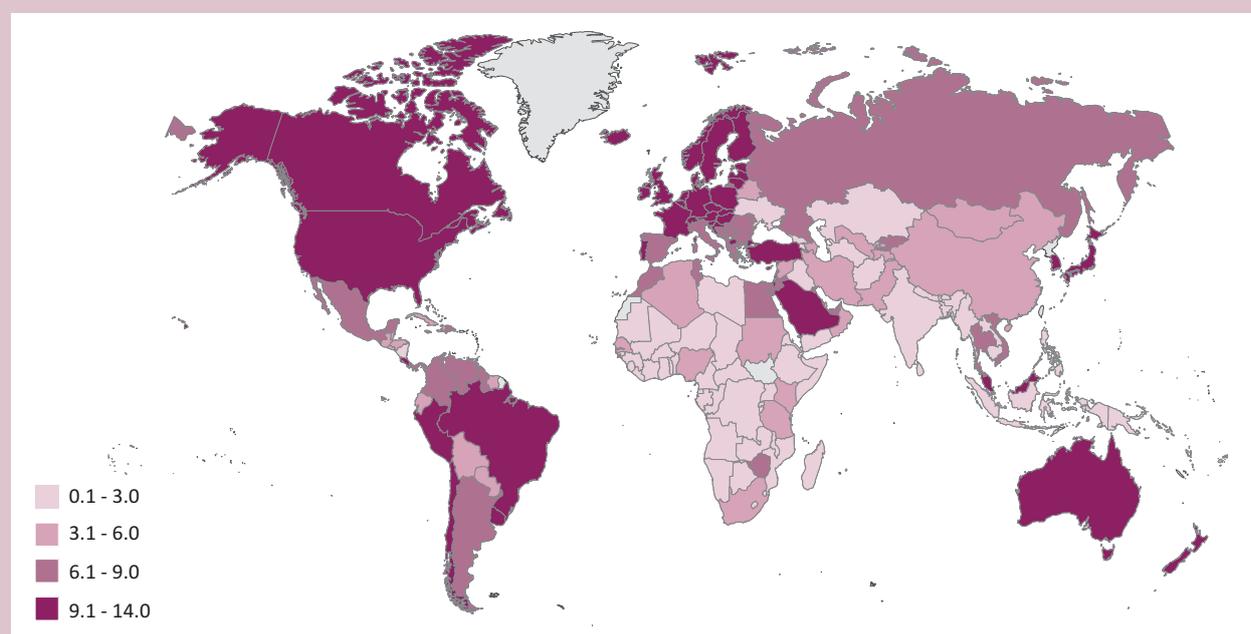
highest Internet user penetration rates worldwide, at 96 per cent in 2012, and almost all households in the country have Internet at home. Iceland's youth population accounts for more than 14 per cent of the total population of the country – one of the highest ratios among the European countries. In 2012, no fewer than 96 per cent of Iceland's young people were digital natives.

New Zealand stands out among the high-income countries, in second position with 13.6 per cent of its population qualifying as digital natives. Ranked 16th in the IDI, New Zealand has a household Internet access penetration of

87.4 per cent and an Internet usage penetration of 89.5 per cent. While this is somewhat below other top IDI performers, New Zealand's youth population is proportionately larger than that of other top IDI countries, at 14.3 per cent of the total population. In 2012, almost 95 per cent of the youth population were digital natives.

The **Republic of Korea** lies in third place, 13.5 per cent of its population being digital natives, just below the figure for New Zealand. ICT uptake in the country is exceptionally high, and the Republic of Korea has topped the IDI for the past three years. Although its youth population is also

Figure 4.2: Digital natives as a percentage of total population, 2012



Source: ITU.

relatively large, at 13.5 per cent of the total population, the main reason for the Republic of Korea's high position is high Internet usage among young people: by 2012, almost 100 per cent of the country's youth population qualified as digital natives. The government has made extensive efforts to adapt its education system to the needs of digital natives and to take advantage of ICTs to transform the way students learn. Its SMART Education project stands for Self-directed, Motivated, Adaptive, Resource-enriched and Technology-embedded learning. By 2015, all students will be able to access cloud-based educational services via wireless Internet in school, and utilize the learning materials whenever and wherever they want. There will be an unlimited amount of educational material, in all possible formats, including videos and games. The Government of the Republic of Korea also provides opportunities for teachers to further develop their ICT-in-education skills.¹³

Malaysia, in particular, stands out as a developing country with one of the highest proportions of digital natives. With 13.4 per cent of digital natives in 2012, the country ranks fourth globally, as compared with its much lower rank (59th) on the IDI. This is a country with a relatively high overall Internet penetration across all age groups in 2012 (66 per

cent) that was also fairly high in 2007 (42 per cent). With 18 per cent of the population falling into the youth age range, however, Malaysia does not have a particularly large youth "bulge" (more will be said about this phenomenon below). Instead, the main explanation for Malaysia's position near the top of the list is the high estimated proportion of young people who have at least five years of experience in using the Internet, at 74.7% in 2012. While home Internet access was not particularly high (15 per cent) in 2007, young people may access the Internet in other locations, such as schools. Malaysia has a history of investing not only in education, but also in ICTs in education. A 2002 ITU study on the Internet in Malaysia highlighted the country's advances in bringing schools online, and back in 2000 as many as 31 per cent of primary and 54 per cent of secondary schools already had PC facilities, while 10 per cent of primary and 34 per cent of secondary schools had Internet access (ITU, 2002).

Among the Latin American countries, Brazil, Chile, Costa Rica and Uruguay each have 10 per cent or more digital natives, more than in a number of high-income developed countries. In Morocco, Peru and Turkey, some 9 per cent of the population are digital natives, more than in Spain, Greece or Italy. In Italy, in particular, the percentage of digital

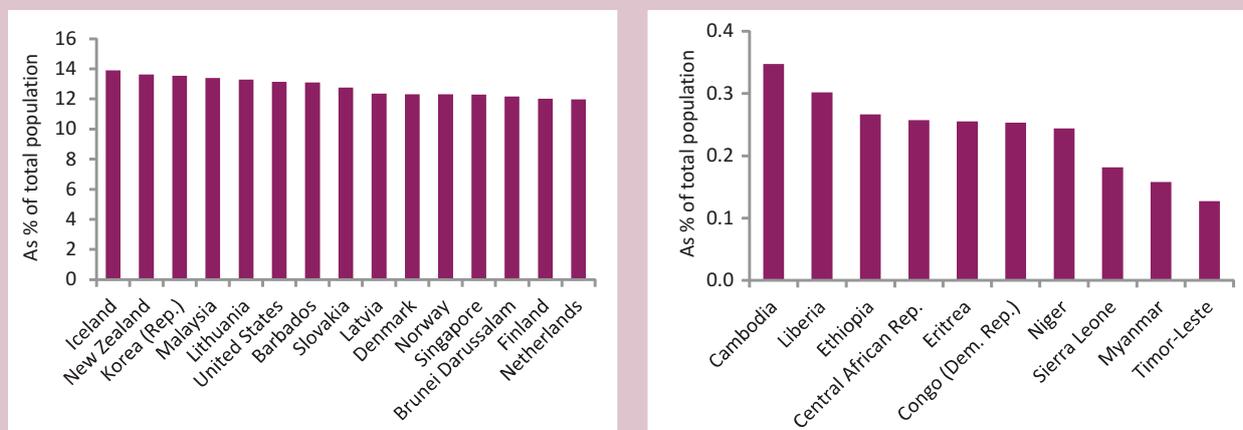
Table 4.1: Digital natives, 2012

Rank	Economy	DN (total)	DN as a % of total population	DN as a % of total youth*	Share of youth population**
1	Iceland	45'495	13.9	95.9	14.4
2	New Zealand	606'040	13.6	94.8	14.3
3	Korea (Rep.)	6'552'589	13.5	99.6	13.5
4	Malaysia	3'914'573	13.4	74.7	17.9
5	Lithuania	436'045	13.2	92.7	14.3
6	United States	41'322'288	13.1	95.6	13.7
7	Barbados	35'830	13.1	90.5	14.4
8	Slovakia	696'917	12.7	92.9	13.7
9	Latvia	275'036	12.3	97.0	12.7
10	Denmark	685'624	12.3	96.9	12.6
11	Norway	607'837	12.3	93.3	13.1
12	Singapore	643'589	12.2	88.4	13.8
13	Brunei Darussalam	50'049	12.1	73.7	16.5
14	Finland	645'961	12.0	98.3	12.2
15	Netherlands	1'993'587	11.9	98.4	12.1
16	Israel	915'636	11.9	80.0	14.9
17	Canada	4'124'622	11.9	90.1	13.2
18	Poland	4'538'102	11.8	89.4	13.3
19	Estonia	158'260	11.8	96.0	12.3
20	Sweden	1'110'582	11.7	89.4	13.1
21	Hong Kong, China	833'148	11.6	90.5	12.8
22	Australia	2'621'640	11.4	83.1	13.8
23	Chile	1'961'464	11.3	67.0	16.8
24	Switzerland	862'768	11.2	94.0	11.9
25	United Kingdom	6'992'034	11.1	85.9	13.0
26	France	6'982'540	11.0	90.7	12.1
27	Malta	45'548	10.9	79.8	13.6
28	Luxembourg	56'414	10.8	88.5	12.2
29	Saint Lucia	18'921	10.6	56.0	19.0
30	Macao, China	60'149	10.6	73.7	14.4
31	Belgium	1'139'462	10.6	91.3	11.6
32	Austria	886'475	10.5	87.7	12.0
33	Saudi Arabia	2'988'281	10.4	59.0	17.7
34	Hungary	1'018'863	10.2	84.9	12.1
35	Trinidad & Tobago	137'561	10.2	63.4	16.1
36	Grenada	10'702	10.2	48.4	21.0
37	Brazil	20'081'178	10.1	60.2	16.8
38	Germany	8'287'453	10.1	94.2	10.7
39	Uruguay	340'181	10.0	65.4	15.3
40	Costa Rica	479'028	10.0	54.7	18.3
41	Slovenia	202'731	9.9	92.3	10.8
42	TFYR Macedonia	205'166	9.9	67.5	14.7
43	Czech Republic	1'044'895	9.9	82.1	12.1
44	Peru	2'922'648	9.8	52.1	18.9
45	Cyprus	110'504	9.8	62.7	15.6
46	Ireland	447'888	9.8	78.4	12.5
47	Japan	12'200'091	9.6	99.5	9.7
48	Croatia	420'144	9.6	80.7	11.9
49	Turkey	6'933'267	9.3	53.7	17.3
50	Bahamas	32'393	9.2	53.3	17.3
51	Portugal	980'279	9.2	86.7	10.6
52	Morocco	2'829'799	8.7	45.8	19.0
53	Argentina	3'555'551	8.6	52.5	16.5
54	Jamaica	238'553	8.6	46.7	18.5
55	Jordan	542'817	8.4	40.4	20.8
56	Viet Nam	7'527'242	8.4	43.6	19.2
57	Montenegro	52'658	8.3	60.1	13.8
58	Serbia	819'138	8.3	62.8	13.2
59	Spain	3'887'992	8.3	84.6	9.8
60	Colombia	3'904'502	8.2	45.6	18.0
61	Maldives	26'444	8.2	35.4	23.0
62	Kuwait	234'242	8.1	55.8	14.5
63	Venezuela	2'366'932	7.9	43.5	18.2
64	Panama	285'298	7.9	46.0	17.1
65	United Arab Emirates	635'781	7.8	56.6	13.8
66	Mexico	9'086'114	7.8	43.3	18.1
67	Bulgaria	560'896	7.6	68.3	11.1
68	Greece	861'104	7.5	74.6	10.1
69	Moldova	263'203	7.5	45.6	16.4
70	Romania	1'584'515	7.4	60.1	12.3
71	Bosnia and Herzegovina	270'180	7.2	55.7	13.0
72	Dominican Rep.	733'019	7.2	38.8	18.5
73	Lebanon	306'940	7.2	40.1	17.8
74	Micronesia	8'013	7.1	32.2	22.2
75	Mauritius	92'113	7.0	42.3	16.6
76	S. Tomé & Príncipe	11'849	6.9	32.8	21.0
77	St. Vincent and the Gr.	7'335	6.7	36.5	18.4
78	Italy	4'065'346	6.7	67.8	9.8
79	Egypt	5'532'746	6.6	34.9	18.9
80	Kyrgyzstan	357'450	6.6	30.5	21.5
81	Tunisia	700'044	6.5	36.7	17.8
82	Bahrain	87'967	6.5	50.8	12.7
83	Guyana	48'049	6.3	32.4	19.6
84	Russian Federation	8'974'678	6.3	49.6	12.7
85	Thailand	4'387'062	6.3	42.3	14.8
86	Albania	198'333	6.1	34.1	18.0
87	Zimbabwe	796'166	6.1	25.1	24.4
88	Azerbaijan	551'410	5.9	30.9	19.0
89	China	75'210'372	5.6	34.7	16.0
90	Belarus	527'032	5.5	41.8	13.2
91	Syria	1'141'451	5.4	26.1	20.7
92	Suriname	28'450	5.3	31.6	16.8
93	Belize	16'847	5.2	24.4	21.3
94	Bolivia	500'185	4.9	24.2	20.1
95	Qatar	93'271	4.8	38.6	12.5
96	Honduras	362'189	4.6	21.6	21.2
97	Ecuador	671'850	4.5	24.6	18.4
98	Cape Verde	22'316	4.4	19.7	22.5
99	Fiji	38'639	4.4	24.7	17.9
100	Oman	126'663	4.4	26.0	16.7
101	Iran (I.R.)	3'188'749	4.2	21.6	19.5
102	Algeria	1'512'106	4.1	21.6	19.2
103	Mongolia	117'484	4.1	20.7	19.9
104	Tajikistan	280'152	4.0	17.2	23.0
105	Sudan	1'789'721	3.9	19.9	19.7
106	Paraguay	259'834	3.9	19.5	19.9
107	Uzbekistan	1'072'320	3.8	17.5	21.8
108	Kenya	1'596'013	3.7	18.5	20.2
109	Senegal	485'465	3.7	18.0	20.5
110	Cuba	414'580	3.7	26.7	13.8
111	South Africa	1'848'847	3.6	18.6	19.6
112	Haiti	369'222	3.6	17.3	20.8
113	Guatemala	528'839	3.5	17.2	20.4
114	Tonga	3'655	3.5	18.5	18.8
115	Pakistan	6'143'363	3.4	16.0	21.3
116	Tanzania	1'571'929	3.3	16.9	19.5
117	El Salvador	197'758	3.2	14.4	21.9
118	Vanuatu	7'909	3.1	15.8	19.9
119	Nigeria	5'154'598	3.1	16.0	19.3
120	Georgia	128'126	3.0	19.7	15.1
121	Gambia	53'912	3.0	14.4	20.5
122	Gabon	44'935	2.9	13.6	21.1
123	Bhutan	21'253	2.8	13.7	20.7
124	Philippines	2'699'063	2.8	14.1	19.8
125	Ukraine	1'231'068	2.7	21.4	12.8
126	Botswana	54'891	2.7	12.4	21.5
127	Yemen	665'487	2.6	12.0	21.8
128	Samoa	4'583	2.5	12.6	19.7
129	Namibia	57'556	2.4	11.5	21.2
130	Swaziland	29'692	2.4	9.9	24.5
131	Armenia	75'543	2.4	14.4	16.9
132	Indonesia	5'841'176	2.4	13.7	17.5
133	Zambia	324'758	2.3	11.8	19.8
134	Nicaragua	123'340	2.1	9.8	21.2
135	Lesotho	43'477	2.0	8.5	23.1
136	Libya	122'917	1.9	11.4	16.7
137	Ghana	468'171	1.8	9.3	19.7
138	Uganda	644'338	1.8	9.0	20.1
139	India	22'660'059	1.8	9.5	18.9
140	Kazakhstan	269'422	1.6	9.6	17.1
141	Angola	317'113	1.6	7.9	20.0
142	Cameroon	302'917	1.5	7.3	20.4
143	Sri Lanka	301'853	1.4	9.5	15.0
144	Congo	55'530	1.3	6.8	19.2
145	Togo	72'077	1.1	5.5	20.7
146	Comoros	8'701	1.1	6.3	17.9
147	Guinea-Bissau	17'710	1.1	5.6	19.9
148	Rwanda	118'691	1.1	5.4	19.6
149	Afghanistan	335'958	1.0	4.9	20.6
150	Solomon Islands	5'549	1.0	5.0	19.5
151	Lao P.D.R.	62'152	1.0	4.2	23.0
152	Côte d'Ivoire	195'380	0.9	4.7	20.4
153	Bangladesh	1'423'409	0.9	4.7	20.1
154	Benin	84'682	0.9	4.6	19.7
155	Djibouti	8'169	0.9	4.2	21.2
156	Papua New Guinea	62'852	0.9	4.6	19.3
157	Turkmenistan	39'693	0.8	3.7	21.0
158	Nepal	238'079	0.8	3.7	20.9
159	Equatorial Guinea	5'653	0.8	3.9	19.4
160	Mauritania	26'877	0.7	3.7	19.8
161	Somalia	56'955	0.6	3.1	18.7
162	Malawi	85'334	0.5	2.6	20.4
163	Mozambique	122'269	0.5	2.5	19.8
164	Iraq	166'937	0.5	2.5	19.6
165	Chad	55'872	0.5	2.4	19.8
166	Mali	73'385	0.4	2.3	19.6
167	Guinea	46'734	0.4	2.2	19.8
168	Burundi	38'081	0.4	2.0	21.9
169	Burkina Faso	74'860	0.4	2.1	20.0
170	Madagascar	83'190	0.4	1.9	20.2
171	Cambodia	50'145	0.3	1.6	21.8
172	Liberia	12'759	0.3	1.6	19.2
173	Ethiopia	229'727	0.3	1.2	21.6
174	Central African Rep.	11'713	0.3	1.2	20.6
175	Eritrea	14'180	0.3	1.3	19.5
176	Congo (Dem. Rep.)	175'259	0.3	1.2	20.4
177	Niger	40'436	0.2	1.3	18.5
178	Sierra Leone	11'034	0.2	0.9	19.5
179	Myanmar	76'302	0.2	0.9	18.2
180	Timor-Leste	1'495	0.1	0.6	21.2

Note: DN: Digital natives. * Refers to population aged 15 to 24. ** Share of youth population (15-24) among the total population.

Source: ITU.

Chart 4.1: Digital natives as a percentage of total population, top countries (left) and bottom countries (right), 2012



Source: ITU.

natives (6.7 per cent) is relatively low, compared with other European countries and developed countries elsewhere. This can be explained by the relatively low youth population ratio in Italy and its lower Internet user penetration relative to other countries from the European Union in 2007.

In Africa, Mauritius, which ranks first in the regional IDI, also has the highest percentage (7 per cent) of digital natives. Second is Zimbabwe, where 6.1 per cent of the population are digital natives in 2012. The country has the world's second highest share of young people aged 15-24, at 24.5 per cent.

Chart 4.1 shows the 15 countries with the largest estimated proportion of digital natives among their population, as well as the ten countries with the smallest percentage of digital natives. The ten countries with the lowest proportion of digital natives – all well below one in 100 people – are mostly nations suffering from conflict, with very low Internet penetration overall and which also feature low on the IDI. Five of them – Central African Republic, Democratic Republic of the Congo, Eritrea, Ethiopia and Niger are among the ten countries with the lowest IDI 2012 values, and Liberia ranks 146th out of 157 on the IDI.¹⁴ Cambodia, on the other hand, ranks 120th on the IDI, and has one of the largest shares of young people (aged 15-24) in the world. This suggests that, with the right policies aimed at increasing Internet access outside

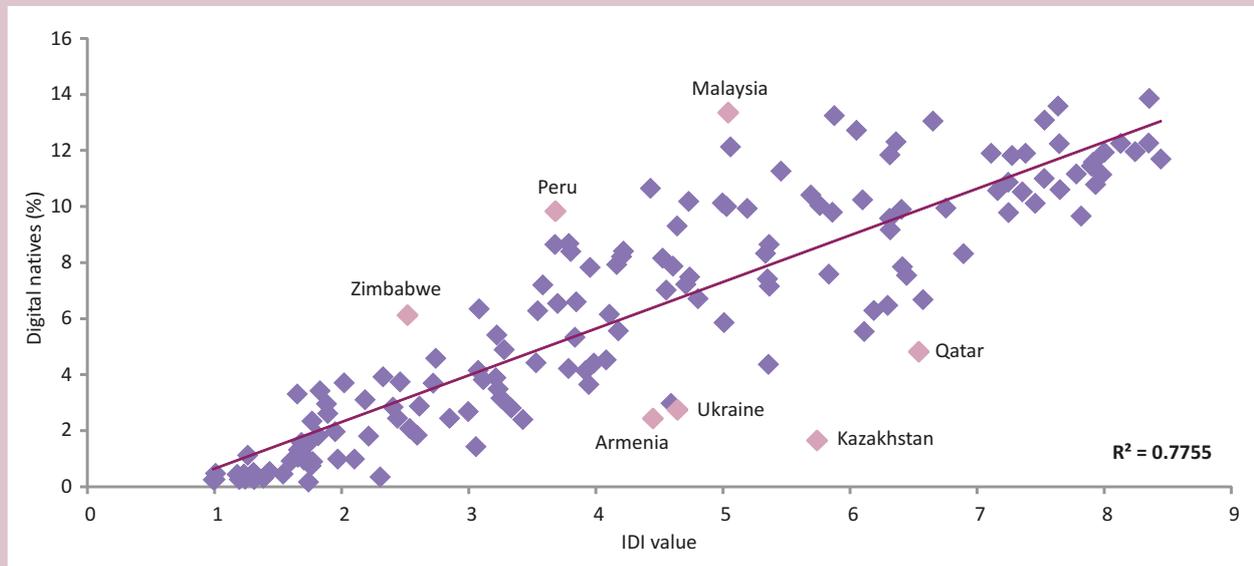
major urban areas, Cambodia could rapidly increase its number and proportion of digital natives. Important steps are already under way in this regard: in 2013, the country finalized its National Broadband Policy, which aims at expanding broadband Internet access nationwide.¹⁵

Digital natives and the ICT Development Index (IDI)

A comparison between countries' ICT infrastructure and uptake – as measured by the IDI – and their proportion of digital natives shows a strong correlation (Chart 4.2). This suggests that enhancing ICT access and use should support a growing level of digital nativism.

Nevertheless, the correlation is not as strong as between the IDI and per capita gross national income (GNI p.c.), and the results also reveal somewhat different patterns compared with the IDI results (see Chapter 2). While a number of the top IDI performers (such as the Nordic countries, but also the Republic of Korea and Hong Kong, China) also have high percentages of digital natives, other countries with relatively larger youth populations display higher proportions of digital natives in relation to some top IDI performers.

Countries well above the trendline, including Malaysia, Peru and Zimbabwe, have a relatively large number of

Chart 4.2: Relationship between digital natives as a percentage of total population and the IDI value

Source: ITU.

digital natives compared to their IDI levels. Countries below the trendline, including Armenia, Kazakhstan and Qatar, have a relatively low number of digital natives compared to their IDI levels. While in the case of Qatar this may be explained by the low proportion of youth in the population (15-24 years olds made up only 12.5 per cent of the total 2012 population), the proportions of youth in Armenia and Kazakhstan are about the same as the world average (around 17 per cent), suggesting that more efforts could be undertaken to connect the younger generation there.

Digital natives across income and geographic categories

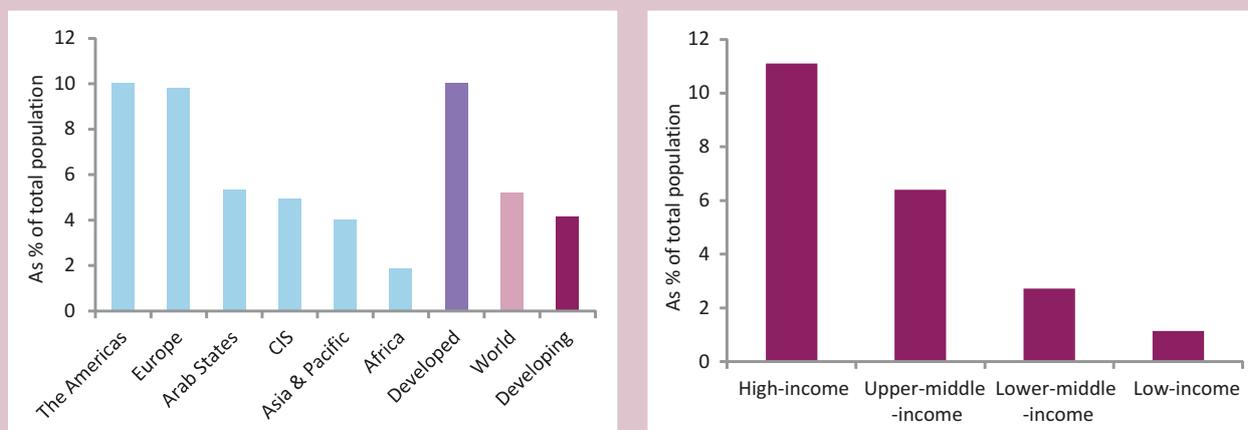
Studying the countries with very high and very low percentages of digital natives among their population reveals some geographic and income patterns. High-income countries that have high ICT levels (and rank high on the IDI), notably many European countries, seem to have high percentages of digital natives, while low-income countries, notably African countries, dominate the list with low levels. Indeed, upon closer analysis, the proportion of digital natives in a country varies according to economic level and geographic region. The proportion

of digital natives in each region varies from a high 10 per cent in the Americas to 1.9 per cent in Africa. Africa and Asia and the Pacific have relatively low levels of digital natives per capita compared with, for instance, Europe. (Chart 4.3, left).

There is, however, significant variation among countries within the regions, in particular within the Asia and Pacific region (where the proportion of digital natives ranges from 0.13 per cent in Timor-Leste to 13.6 per cent in New Zealand). The least variation among countries is found in Europe.

A country's population of digital natives also resonates with its level of (economic) development. Some 4.2 per cent of the people residing in developing countries are digital natives, while in the developed countries digital natives account for 10 per cent of the population (Chart 4.3, left). Looking at income groupings, there is a consistent increase in the percentage of digital natives when moving from low- to high-income countries (Chart 4.3, right). The significantly lower proportion of digital natives in low-income countries than in high-income countries is primarily due to their relatively lower levels of ICT – and in particular Internet – uptake.

Chart 4.3: Digital natives as a percentage of total population, by region and level of development (left) and by income (right), 2012



Source: ITU.

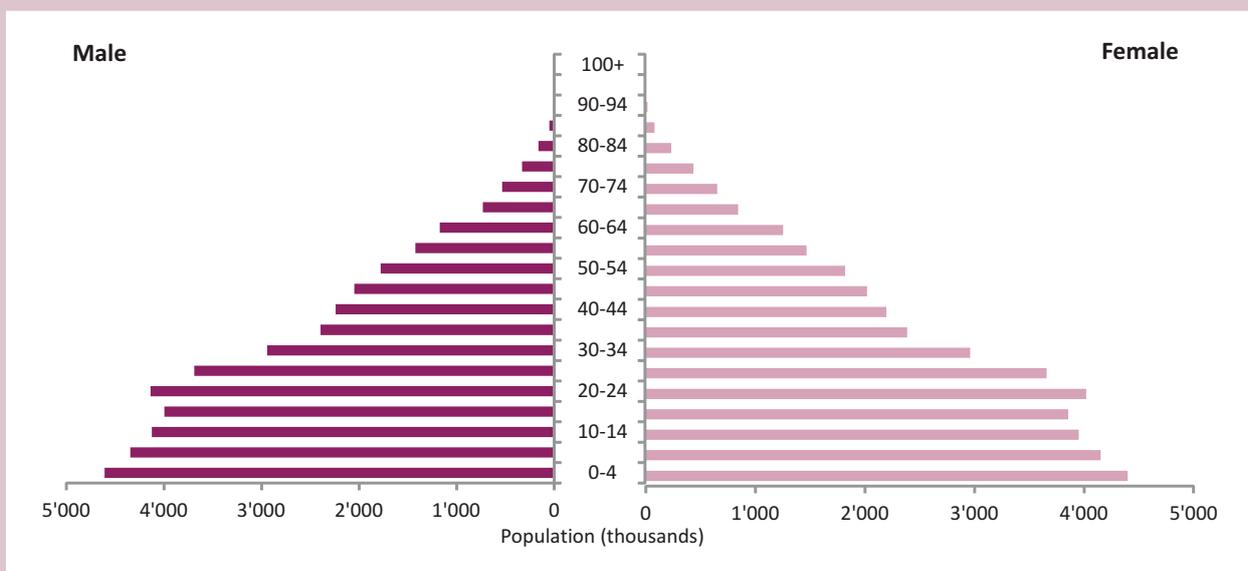
Youth bulge

For the purposes of this chapter, digital natives are defined as youth with at least five years of experience in using the Internet. Therefore, high proportions of digital natives in 2012 for a given country may be attributable to: (i) relatively high number of young people aged 10-19 in 2007, resulting in a high number of young people aged 15-24 in 2012,

combined with medium or relatively high levels of overall Internet use in 2007; or (ii) high levels of Internet use in 2007, resulting in high levels of five-year youth Internet use in 2012; or (iii) some combination of the two.

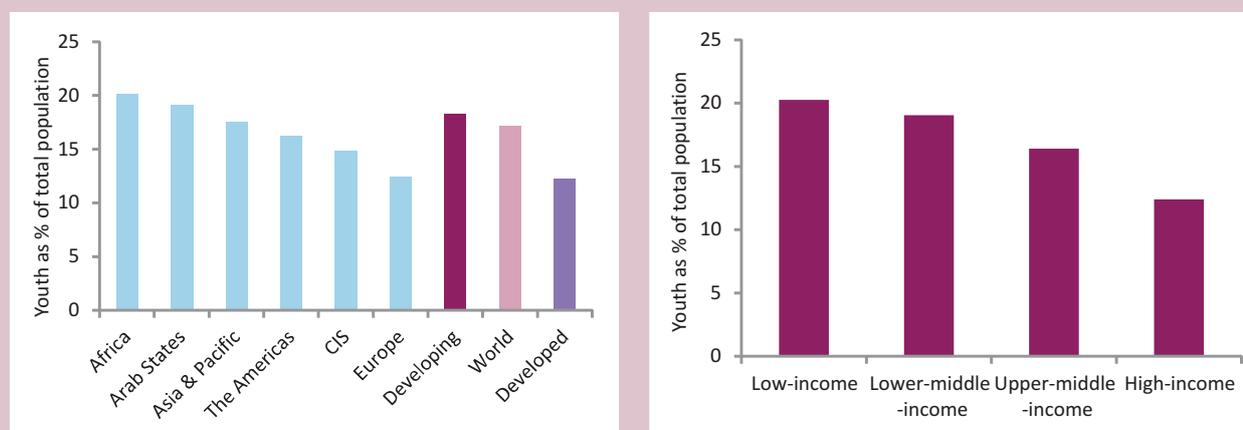
Many countries are known to have a “youth bulge” or, in other words, a large proportion of young people relative to their population as a whole. Studies on this phenomenon

Chart 4.4: Population distribution by age group and gender, Egypt, 2010



Source: United Nations Population Division (UNPD).

Chart 4.5: Percentage of population in the age group 15-24, by region and level of development (left), and income group (right), 2012



Source: ITU.

have focused in particular on the developing world, where a combination of high fertility rates and declining infant mortality has resulted in a large proportion of the population comprising children and young adults. The population pyramid depicted in Chart 4.4 shows a “classic” youth bulge based on 2010 population data from Egypt. A majority of Egyptians are aged 25 or younger.

Indeed, the percentage of a country’s population that falls within the digital native age range of 15-24 in 2012 varies significantly across the world, from a low of 9.7 per cent in Japan to a high (youth bulge) of 24.5 per cent in Swaziland. The global figure is 17 per cent.

Differences between the proportions of youth within the age range 15-24 are significant between developed and developing countries: 12.3 per cent in the former compared with 18.2 per cent in the latter. Regionally, the percentage of the population in the 15-24 age range varies from 20.1 per cent in Africa to 12.4 per cent in Europe (Chart 4.5, left). In the Europe region, Germany, Greece, Italy, Portugal, Slovenia and Spain have a relatively small proportion of 15-24 year olds, below 11 per cent. In Cape Verde, Lao PDR, Lesotho, Maldives, Micronesia, Swaziland, Tajikistan and Zimbabwe, the percentage is at least twice as high. Africa, in particular, but also developing countries in Asia and the Pacific, Latin America and the Caribbean, and the Arab States, have more of a youth bulge than Europe, which is

not unexpected given that, as mentioned, youth bulges are particularly prevalent in developing nations. The percentage of population in the 15-24 age range in 2012 is depicted on the map in Figure 4.3.

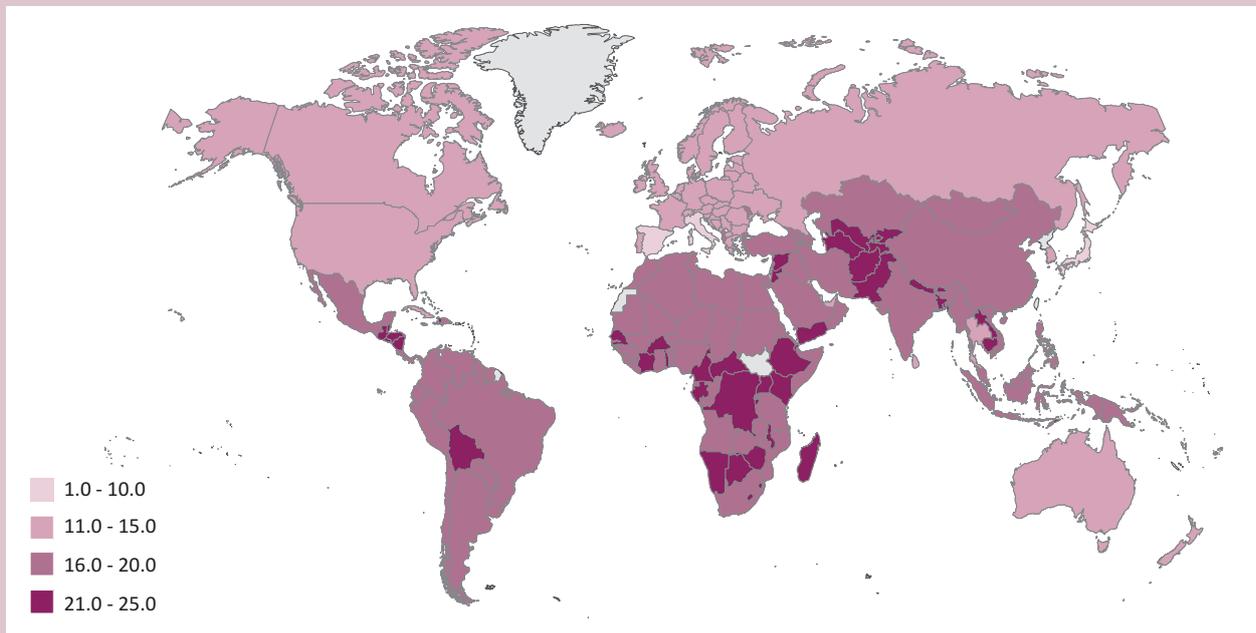
Looking at income categories, it is apparent that the youth bulge is most significant among the low-income and lower-middle-income countries (Chart 4.5, right). This also explains why some low-income economies, such as Kyrgyzstan and Zimbabwe, where 15-24 year olds represent 21.5 and 24.4 per cent of the population, respectively, have relatively high percentages of digital natives. Similarly, lower-middle-income economies Morocco, Egypt and Syria have relatively high proportions of digital natives, owing in part to a large young population group.

Digital natives compared with overall youth population

Another way of looking at digital natives is by analysing their penetration as a percentage of the total youth population in a country.

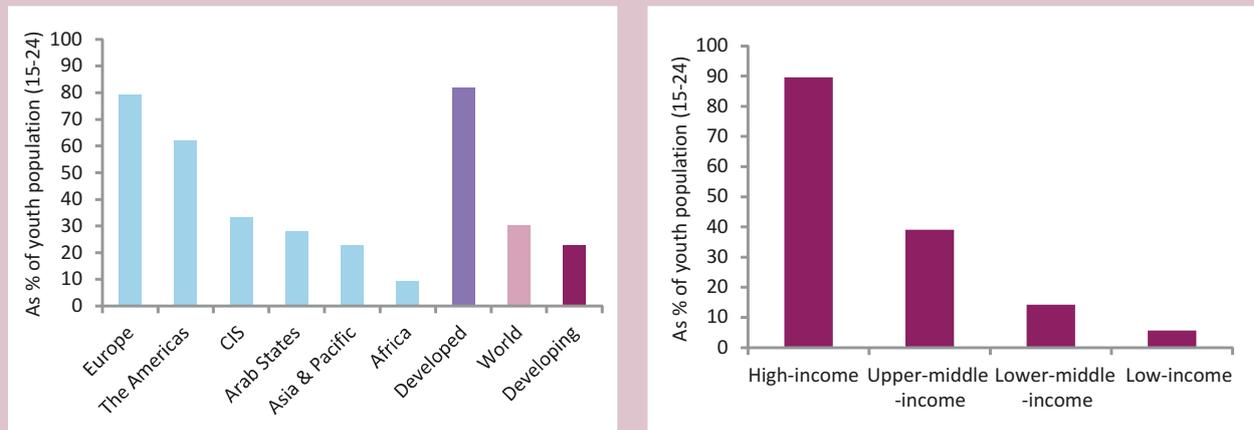
The variation in the proportion of a nation’s youth population that are estimated as having been Internet users for five years or more (i.e. are digital natives) in 2012 ranges from a high 99.6 per cent in the Republic of Korea to a low 0.6 per cent in Timor-Leste. In 21 countries (mainly high-income and developed), more than 90 per cent of 15-24 year olds have

Figure 4.3: Percentage of population in the age group 15-24, 2012



Source: UNPD.

Chart 4.6: Digital natives as a percentage of youth (15-24), by region and level of development (left), and by income group (right), 2012



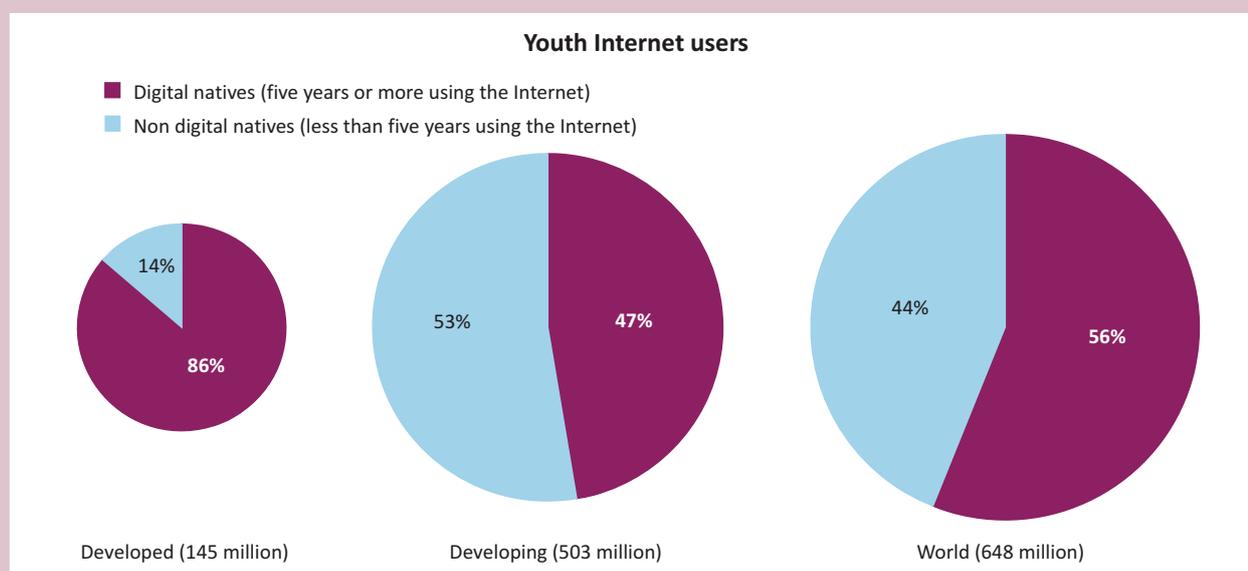
Source: ITU.

been online for at least five years. The figure varies significantly according to region and economic level, between 9.2 per cent in the Africa region and 79.1 per cent in Europe (Chart 4.6 left).

The percentage of Internet users aged 15-24 with five or more years of experience ranges from 22.8 per cent in the developing world to 81.9 per cent in the developed world (Chart 4.6, left).

Further disaggregation by the four income categories shows a range from 5.7 per cent in low-income countries to 89.6 per cent in high-income countries (Chart 4.6, right).

While many low-income countries have a youth bulge, they also have relatively low numbers of young people who have been using the Internet for at least five years compared with

Chart 4.7: Percentage of digital natives among youth Internet users, 2012

Source: ITU.

higher-income countries. In high-income countries, most young people (89.6 per cent) fall into this category (and are thus digital natives); whereas in low-income countries, only about one in 20 young people qualify as digital natives. Similarly, 8 out of 10 young people in Europe have five or more years of experience on the Internet, while only about one in 10 young people in Africa have had similar network experience.

Comparing absolute figures for digital natives with the total numbers of youth Internet users in 2012, important differences can be observed across regions. Chart 4.7 presents digital natives as a proportion of total connected youth in 2012, for developed and developing regions, and for the world as a whole. It shows that there are a large number of young people who started using the Internet only more recently (i.e. less than five years ago). Out of a total of 145 million young Internet users in the developed countries, 86.3 per cent are estimated to be digital natives, compared with less than half of the 503 million young Internet users in the developing world. Looking at the world figure, slightly more than half (56 per cent) of young Internet users are considered digital natives. This means that there are around 285 million (44 per cent) of “newcomers” (young people with less than five years of experience in using the Internet) in the world in 2012.

Age gaps: Internet use among youth compared with Internet use among the overall population

As mentioned before, a country will have a large proportion of digital natives if it has a youth bulge and at least medium levels of Internet user penetration; or if it has high and sustained Internet user penetration within its population as a whole. Nonetheless, there are also significant differences among countries when it comes to the percentage of youth who are Internet users in relation to the percentage of the overall population using the Internet. While some countries have fairly uniform levels of Internet penetration across all age groups, in others, according to available data and estimates, young people are much more networked than the population as a whole.

The previous section analysed the percentage of youth with sustained Internet experience, comparing the figures around the globe. More online youth will naturally lead to more digital natives. This section compares the relative intensity of youth Internet use with a country's overall Internet penetration. While the percentage of a country's youth Internet use (for at least five years) is what drives its proportion of digital natives, any difference (or

gap) between the levels of Internet use among young people, on the one hand, and the overall population, on the other, will help explain to what degree these digital natives are the early adopters, leading the way in a nation's path towards becoming an information society. The extent to which digital natives drive a nation's ICT uptake is important for understanding, learning from and responding to the needs of these network-enabled youth. It is also important since it helps understand the potential that these networked youth represent in terms of driving the information society, stimulating innovation and harnessing the benefits of ICTs.

The Internet user *age gap* can be calculated as the ratio of Internet user penetration in the 15-24 age range to overall Internet user penetration. For the purpose of this section, 2012 Internet user figures are compared. A ratio of one would mean that Internet penetration among youth is exactly the same as for the population as a whole (no age gap); a ratio of 2 would mean that youth are twice as networked as the overall population; and so forth.

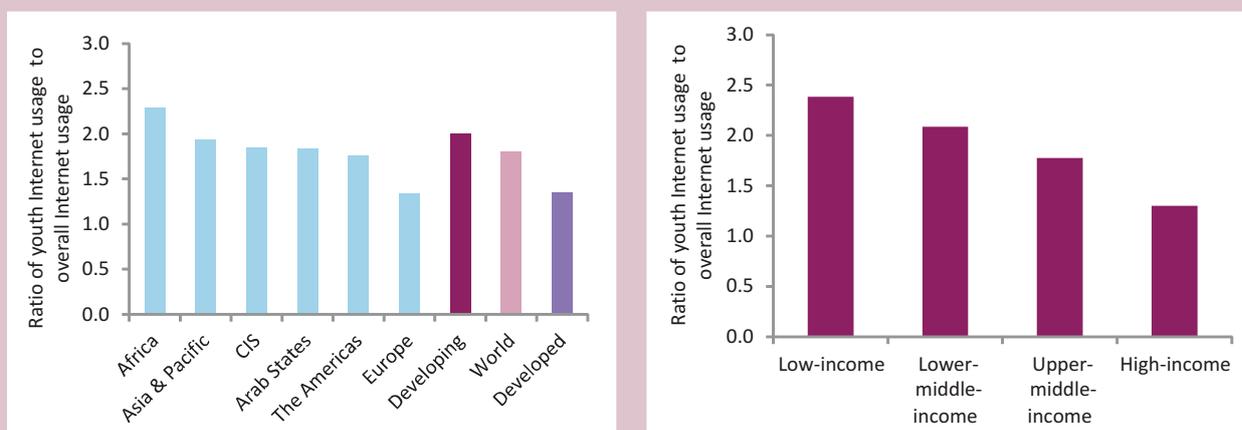
Table 4.2 shows Internet user penetration for youth and for the total population, as well as the calculated ratio between these two penetration rates (the age gap), for each country. The ratios range from a high of 2.8 in Eritrea (nearly three times as much Internet use among young people as compared with the population as a whole) to a

low of 1.0 in Iceland (where nearly everyone, from all age groups, is an Internet user, with only a tiny increase among young people). The global average is 1.8, demonstrating that, worldwide, youth are, on balance, nearly two times more networked than the global population as a whole.

This ratio reveals a significant higher degree of Internet use among young people than in the population as a whole in most countries, but with variations between regions and according to economic level. Looking at the six regions, the ratio ranges from 2.3 in Africa to 1.3 in Europe (Chart 4.8, left). The average ratio for developing countries is 2 (i.e. twice as many young people are online than members of the population as a whole), while the average ratio for developed countries is 1.3. Looking at variations across the four income categories, the ratio decreases significantly as we move from low-income to high-income countries, as depicted in Chart 4.8, right.

In every country of the world, the 15-24 year olds are more likely to be Internet users, suggesting that the young are drivers of the information society. In most of the world's least developed countries, young people are nearly three times more likely than the general population to be using the Internet. This is the case, for example, in Timor-Leste, Myanmar, Burundi, Sierra Leone and Somalia, even if Internet penetration in these countries remains very low. In highly populated countries such as Bangladesh, Pakistan and India,

Chart 4.8: Ratio of youth (15-24) Internet usage to overall Internet usage, by region and level of development (left), and by income group (right), 2012



Source: ITU.

Table 4.2: Internet user penetration, youth and total population, 2012

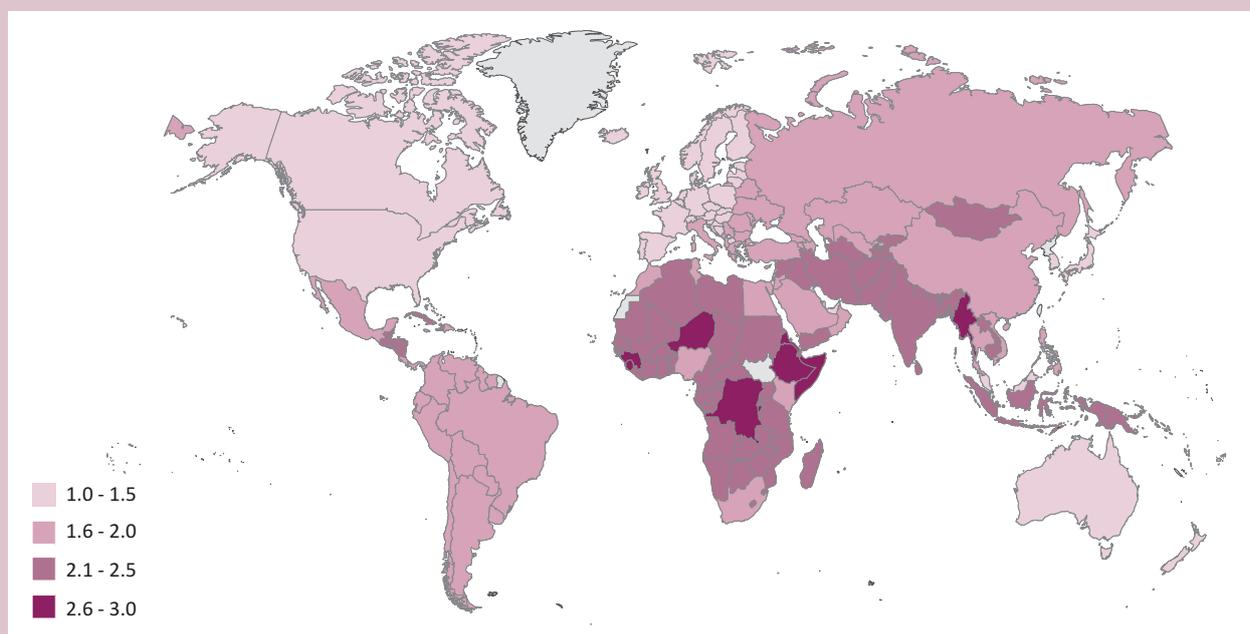
Economy	Youth Internet user penetration*	Total Internet user penetration	Age gap**
Korea (Rep.)	99.6	84.1	1.2
Germany	99.6	84.0	1.2
United Arab Emirates	99.6	85.0	1.2
Switzerland	99.6	85.2	1.2
France	99.6	83.0	1.2
Australia	99.6	82.3	1.2
Belgium	99.6	82.0	1.2
Canada	99.5	86.8	1.1
United Kingdom	99.5	87.0	1.1
United States	99.5	81.0	1.2
Austria	99.5	81.0	1.2
Bahrain	99.4	88.0	1.1
Qatar	99.4	88.1	1.1
Slovakia	99.4	80.0	1.2
Kuwait	99.3	79.2	1.3
Japan	99.3	79.1	1.3
Estonia	99.2	79.0	1.3
Ireland	99.2	79.0	1.3
New Zealand	99.2	89.5	1.1
Finland	99.0	91.0	1.1
Luxembourg	98.8	92.0	1.1
Denmark	98.5	93.0	1.1
Netherlands	98.5	93.0	1.1
Czech Republic	98.4	75.0	1.3
Sweden	98.3	94.0	1.0
Singapore	98.2	74.2	1.3
Latvia	98.2	74.0	1.3
Norway	98.0	95.0	1.0
Israel	98.0	73.4	1.3
Barbados	98.0	73.3	1.3
Hong Kong, China	97.8	72.8	1.3
Iceland	97.7	96.0	1.0
Hungary	97.5	72.0	1.4
Spain	97.5	72.0	1.4
Bahamas	97.4	71.7	1.4
Malta	96.8	70.0	1.4
Slovenia	96.8	70.0	1.4
Lithuania	95.9	68.0	1.4
Malaysia	94.9	65.8	1.4
Bosnia and Herzegovina	94.6	65.4	1.4
Poland	94.5	65.0	1.5
Macao, China	94.1	64.3	1.5
Portugal	93.9	64.0	1.5
TFYR Macedonia	93.4	63.1	1.5
Croatia	93.3	63.0	1.5
Chile	92.4	61.4	1.5
Lebanon	92.2	61.2	1.5
Cyprus	92.1	61.0	1.5
Brunei Darussalam	91.6	60.3	1.5
Oman	91.4	60.0	1.5
Trinidad & Tobago	91.1	59.5	1.5
Italy	90.0	58.0	1.6
Montenegro	89.1	56.8	1.6
Greece	88.5	56.0	1.6
Argentina	88.3	55.8	1.6
Bulgaria	87.8	55.1	1.6
Uruguay	87.8	55.1	1.6
Morocco	87.7	55.0	1.6
Albania	87.4	54.7	1.6
Azerbaijan	87.0	54.2	1.6
Saudi Arabia	86.8	54.0	1.6
Kazakhstan	86.3	53.3	1.6
Russian Federation	86.2	53.3	1.6
Romania	83.2	50.0	1.7
Brazil	83.1	49.8	1.7
Colombia	82.2	49.0	1.7
Saint Lucia	81.9	48.6	1.7
Serbia	81.4	48.1	1.7
St. Vincent and the Grenadines	80.8	47.5	1.7
Costa Rica	80.8	47.5	1.7
Belarus	80.1	46.9	1.7
Jamaica	79.7	46.5	1.7
Georgia	78.6	45.5	1.7
Panama	78.3	45.2	1.7
Turkey	78.2	45.1	1.7
Dominican Rep.	78.1	45.0	1.7
Egypt	77.1	44.1	1.7
Venezuela	77.0	44.0	1.7
Moldova	76.3	43.4	1.8
China	75.0	42.3	1.8
Grenada	74.8	42.1	1.8
Tunisia	74.0	41.4	1.8
Mauritius	74.0	41.4	1.8
Jordan	73.5	41.0	1.8
South Africa	73.5	41.0	1.8
Viet Nam	71.6	39.5	1.8
Armenia	71.2	39.2	1.8
Maldives	70.9	38.9	1.8
Mexico	70.3	38.4	1.8
Peru	70.0	38.2	1.8

Economy	Youth Internet user penetration*	Total Internet user penetration	Age gap**
Uzbekistan	67.8	36.5	1.9
Philippines	67.4	36.2	1.9
Ecuador	65.9	35.1	1.9
Tonga	65.5	34.9	1.9
Cape Verde	65.4	34.7	1.9
Suriname	65.3	34.7	1.9
Guyana	64.8	34.3	1.9
Bolivia	64.6	34.2	1.9
Fiji	64.0	33.7	1.9
Ukraine	63.9	33.7	1.9
Nigeria	62.7	32.9	1.9
Kenya	61.6	32.1	1.9
Paraguay	53.9	27.1	2.0
Thailand	53.0	26.5	2.0
Iran (I.R.)	52.2	26.0	2.0
Micronesia	52.1	26.0	2.0
Cuba	51.6	25.6	2.0
El Salvador	51.4	25.5	2.0
Bhutan	51.3	25.4	2.0
Belize	50.5	25.0	2.0
Syria	49.4	24.3	2.0
Kyrgyzstan	45.0	21.7	2.1
S. Tomé & Príncipe	44.7	21.6	2.1
Sudan	43.7	21.0	2.1
Swaziland	43.3	20.8	2.1
Libya	41.7	19.9	2.1
Senegal	40.5	19.2	2.1
Sri Lanka	38.8	18.3	2.1
Honduras	38.5	18.1	2.1
Yemen	37.2	17.4	2.1
Ghana	36.6	17.1	2.1
Zimbabwe	36.5	17.1	2.1
Angola	36.3	16.9	2.1
Mongolia	35.2	16.4	2.1
Guatemala	34.5	16.0	2.2
Indonesia	33.3	15.4	2.2
Algeria	33.0	15.2	2.2
Uganda	32.0	14.7	2.2
Tajikistan	31.6	14.5	2.2
Equatorial Guinea	30.5	13.9	2.2
Nicaragua	29.6	13.5	2.2
Zambia	29.6	13.5	2.2
Tanzania	28.8	13.1	2.2
Namibia	28.5	12.9	2.2
Samoa	28.5	12.9	2.2
India	27.8	12.6	2.2
Gambia	27.5	12.4	2.2
Botswana	25.6	11.5	2.2
Nepal	24.9	11.1	2.2
Haiti	24.3	10.9	2.2
Lao P.D.R.	24.1	10.7	2.2
Vanuatu	23.8	10.6	2.2
Pakistan	22.4	10.0	2.3
Gabon	19.6	8.6	2.3
Djibouti	18.9	8.3	2.3
Rwanda	18.4	8.0	2.3
Turkmenistan	16.6	7.2	2.3
Iraq	16.4	7.1	2.3
Solomon Islands	16.2	7.0	2.3
Bangladesh	14.6	6.3	2.3
Congo	14.2	6.1	2.3
Comoros	13.9	6.0	2.3
Cameroon	13.3	5.7	2.3
Afghanistan	12.8	5.5	2.3
Mauritania	12.6	5.4	2.3
Cambodia	11.6	4.9	2.4
Mozambique	11.4	4.8	2.4
Lesotho	10.9	4.6	2.4
Malawi	10.3	4.4	2.4
Togo	9.5	4.0	2.4
Benin	9.1	3.8	2.4
Liberia	9.1	3.8	2.4
Burkina Faso	8.9	3.7	2.4
Central African Rep.	7.3	3.0	2.4
Guinea-Bissau	7.0	2.9	2.4
Côte d'Ivoire	5.9	2.4	2.5
Papua New Guinea	5.7	2.3	2.5
Mali	5.4	2.2	2.5
Chad	5.2	2.1	2.5
Madagascar	5.1	2.1	2.5
Congo (Dem. Rep.)	4.3	1.7	2.5
Guinea	3.8	1.5	2.6
Ethiopia	3.8	1.5	2.6
Niger	3.6	1.4	2.6
Somalia	3.6	1.4	2.6
Sierra Leone	3.4	1.3	2.6
Burundi	3.2	1.2	2.6
Myanmar	2.8	1.1	2.7
Timor-Leste	2.5	0.9	2.7
Eritrea	2.2	0.8	2.8

Note: * Refers to population aged 15 to 24. ** Ratio of youth (15-24) Internet users to overall Internet users.

Source: ITU.

Figure 4.4: Ratio of youth (15-24) Internet users to overall Internet users, 2012



Source: ITU and UNPD.

the ratio is also high, between 2.2. and 2.3. The map of the ratio is shown in Figure 4.4

Clearly, youth in low-income and lower-middle-income countries as well as in many African and Southern Asian countries are the relatively most networked – they are the early adopters leading their countries in Internet use. This factor, along with the additional youth bulge described above, points to the significance, not just in number, but in importance, of digital natives especially in low-income and lower-middle-income countries and countries of Africa and Southern Asia. If youth are leading digital adoption within a country, then they are likely to:

- have an online life experience with which the rest of the country's population will not be so familiar;
- have higher levels of expertise and digital literacy compared with the population as a whole;
- have potentially adopted a more networked mindset (as described in some of the literature above) than the wider population.

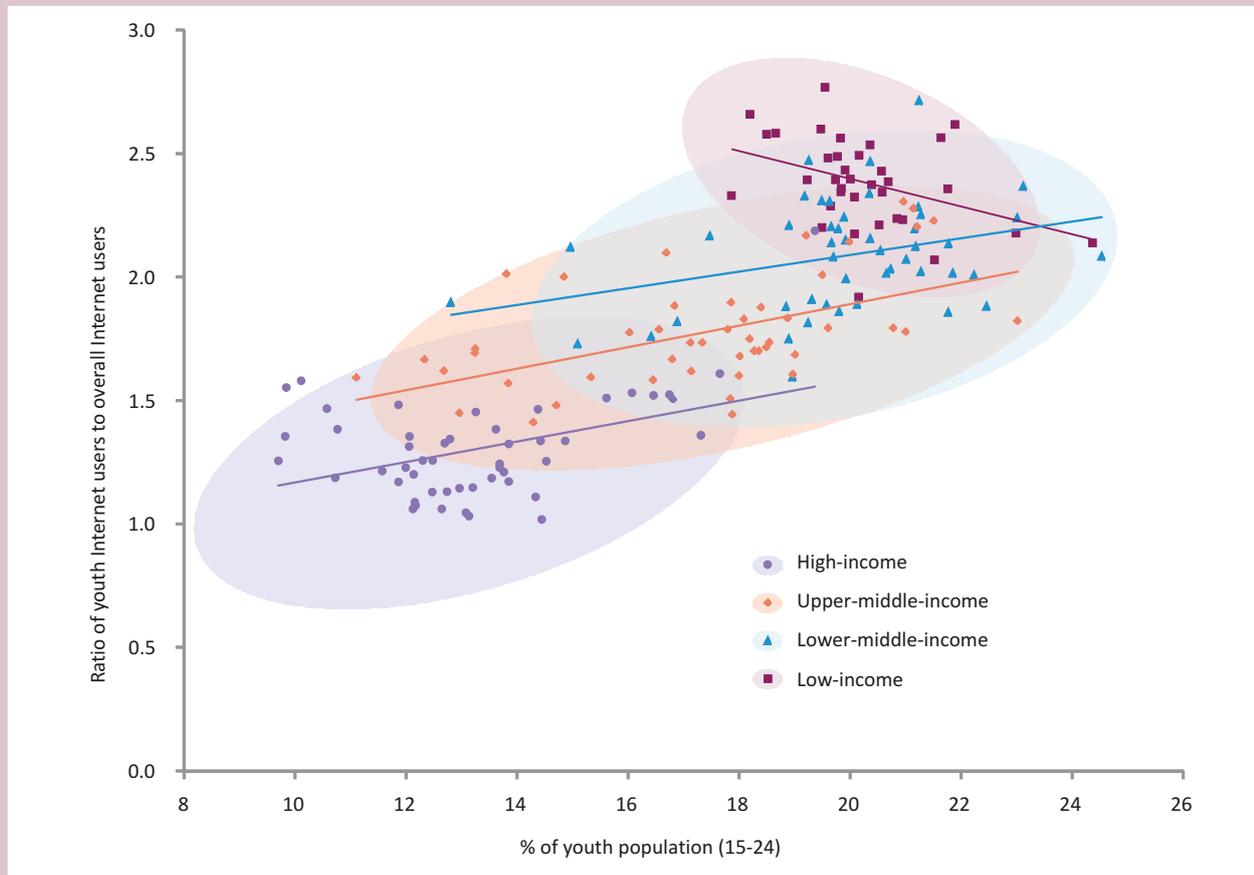
Indeed, it is a reasonable conjecture that, as the age gap increases, so too do the most dramatic properties ascribed to digital natives by some proponents – namely, that they think differently and are a breed apart.

What this finding points to is that it is the countries with the biggest age gaps (which are primarily in the developing world) that are liable to be those most impacted by their digital natives. Paradoxically, while most of the literature on digital natives focuses on high-income countries, the most important location for the application of this concept is likely to be the developing world. These findings also highlight the need for further research to analyse how digital natives think, work and do things differently, and whether this should have an impact on the way digital natives are taught or employed.

Age gap and youth bulge

Finally, some countries have *both* a youth bulge and a relatively more networked youth. In fact, a country's youth bulge and the *age gap* are strongly correlated (the correlation coefficient between the two indicators is 0.78). Relatively small youth bulges and low age gap ratios (meaning that young people

Chart 4.9: Relationship between the ratio of youth (15-24) Internet users to overall Internet users (y-axis) and percentage of total population aged 15-24 (x-axis), by income group, 2012



Note: Linear fit. Shaded regions depict 95 per cent confidence levels of fit.
Source: ITU and UNPD.

are not particularly more networked) occur in high-income countries, while the reverse is true for low-income countries.

Chart 4.9 portrays the relationship between a country's youth bulge and the age gap, with countries grouped according to the four income levels. The bottom three lines represent countries in the high-income, upper-middle-income and lower-middle-income groups. What is clear is that, for each of these groups, the lower the income levels the higher the relative degree of Internet use among youth. Furthermore, the greater the youth bulge for these income groups, the more networked the youth are relative to the country as a whole.

Finally, the graph shows that the youth in low-income countries (the top line) are indeed the most relatively networked in comparison with the countries in the other

income groupings. For these countries, young people truly are driving Internet use. However, and interestingly, as the youth bulge increases in low-income countries, the ratio of youth Internet users to the users in the general population actually declines, in contrast to what occurs in the other three economic groups, which show the opposite trend. This might be the case in low-income countries because the youth bulge in those settings occurs particularly in their most under-resourced (e.g. rural) areas, i.e. in the contexts and communities least able to gain Internet access. If this is true, it implies that those particular settings are characterized at the same time by a higher percentage of youth and a lower level of overall Internet use (including among young people) in comparison with the country's more developed areas. Verifying this hypothesis will require further research, as it carries important policy implications.

Digital natives and educational factors

The above analysis makes clear that the world is filled (unevenly) with digital natives and that in low-income countries in particular young people are the most networked and are driving Internet penetration. Encouraging and nurturing these digital natives is important everywhere, but especially so in the developing world, where they are the early Internet adopters.

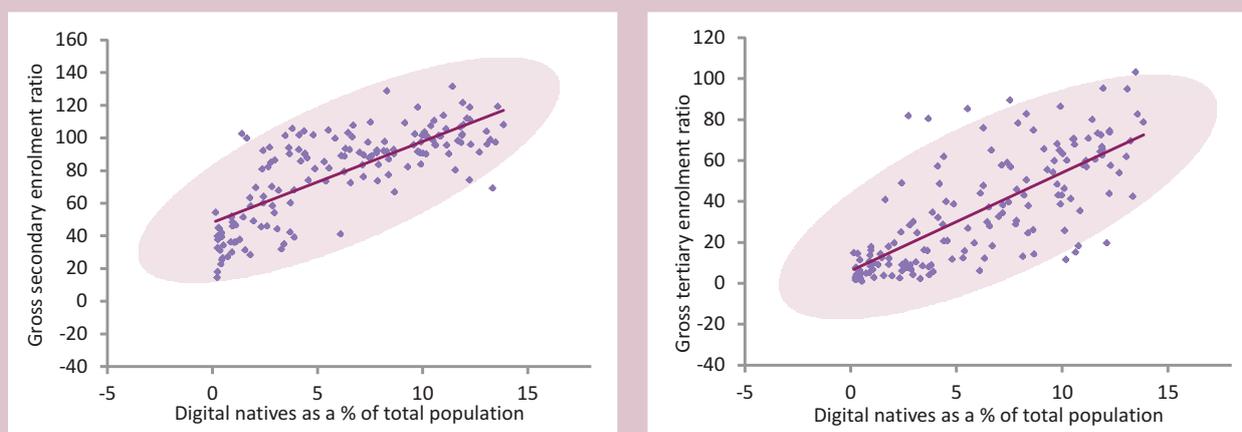
There are many ways in which a country might nurture and expand its population of digital natives. One perhaps obvious solution is simply to enhance the availability and affordability of Internet access, for instance through ensuring competition and a robust ICT marketplace. Indeed, a nation's proportion of digital natives correlates strongly with all of the major ICT indicators¹⁶ (e.g. mobile-phone subscriptions, Internet usage, household access to a computer and to Internet). As shown above, there is a strong relationship between a nation's ICT infrastructure and uptake (as measured by the IDI) and the percentage of its population that are digital natives.

In addition to ICTs, *education*, which is also taken into account in the IDI calculation (see Chapter 2), is another important correlate to digital nativism. An analysis of the major educational indicators, using the most recent available data, and their relationship to a nation's share

of digital natives brings out a number of interesting linkages. Chart 4.10 shows the relationship between school enrolment at the secondary and tertiary levels¹⁷ and a country's proportion of digital natives.¹⁸ The age range for digital natives, namely 15-24, places them within these stages of education. What can be seen overall is that, as secondary and tertiary school enrolment levels go up, so too does the percentage of digital natives. This suggests that secondary and tertiary education plays a positive role in enhancing levels of digital nativism, although this may also be the outcome of additional factors. For instance, all of these figures are closely related to a country's level of economic development (a factor at best exogenous to the digital native model).

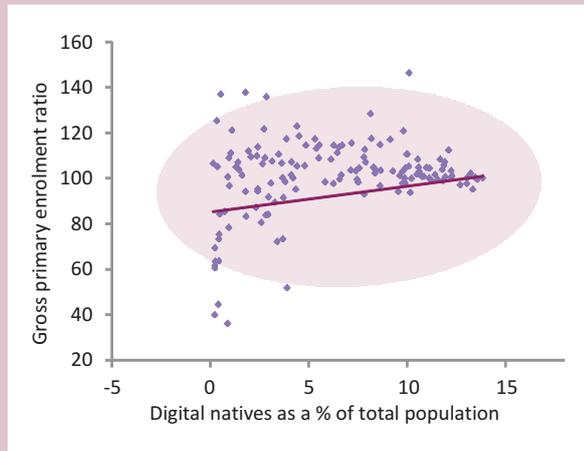
While digital natives' age range places them contemporaneously at the secondary or post-secondary education levels, arriving at these stages of schooling would have required them to pass through primary school. And, indeed, the level of primary school enrolment measured in a year in which many of these digital natives would have been of primary school age correlates with levels of digital nativism. Chart 4.11 portrays the relationship between primary school enrolment in 2002 and the percentage of the population categorized as digital natives in 2012. While the relationship is significant and positive,¹⁹ it is not at all as strong as the relationship with secondary and tertiary school enrolment (also reflecting

Chart 4.10: Relationship between digital natives as a percentage of total population and school enrolment, by education level, 2012



Note: Linear fit. Shaded regions depict 95 per cent confidence levels of fit.
Source: ITU and UNESCO Institute for Statistics (UIS).

Chart 4.11: Relationship between digital natives as a percentage of total population, 2012 and primary enrolment, 2002



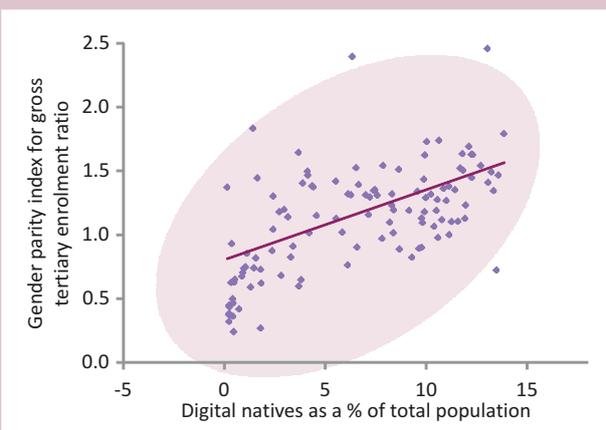
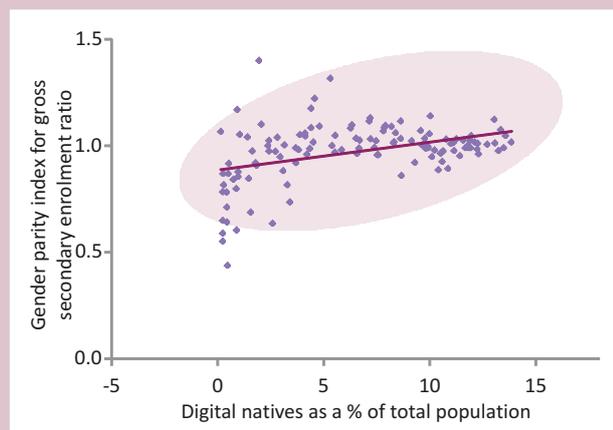
Note: Linear fit. Shaded regions depict 95 per cent confidence levels of fit.
Source: ITU and UIS.

the fact that overall primary school enrolment rates are much higher and more homogeneous across countries than enrolment rates for higher levels of education).

This suggests that, while primary school enrolment is obviously a critical pre-condition for increasing a country's proportion of youth who are digital natives, it is ultimately by enhancing the level of secondary and tertiary school enrolment that the most significant positive impact on the degree of digital nativism is likely to be achieved.

Another interesting relationship exists between a country's level of digital nativism and gender balance within school enrolment. Chart 4.12 plots the ratio of female to male enrolment in secondary and tertiary schools against the percentage of digital natives in a country. There is a statistically significant relationship between digital nativism and the ratio of females to males in secondary school and tertiary school.²⁰ While it is too early to draw firm conclusions from this particular observation, it is possible that girls are more likely to gain access to the Internet from education facilities. This would require equal access to education for both boys and girls. The analysis shows that the higher the enrolment of females in secondary and tertiary schools, the higher a country's share of digital natives. These findings will require additional research.

Chart 4.12: Relationship between digital natives as a percentage of total population and ratio of females to males in school enrolment, by education level, 2012



Note: Linear fit. Shaded regions depict 95 per cent confidence levels of fit.
Source: ITU and UIS.

4.5 Conclusions

While the concept of digital native has received considerable attention, been defined in various ways and attracted a certain amount of criticism, it seems very clear that “digital media are changing the way young people learn, play, socialize, and participate in civic life” (Ito et al., 2008). Although more research is needed in order to understand the impact that digital natives have in driving the information society, and on the way digital natives learn, work and do things, there is general agreement that young people learn and adapt to ICTs quickly. In other words, in their hands and with their minds, ICTs become a particularly powerful tool.

This chapter defines a digital native as a networked youth between the age of 15 and 24, with five or more years of experience using the Internet. It then develops a model that operationalizes this definition, and applies the model to datasets in order to quantify the world's digital natives, country by country. The chapter thus offers the first indicator, and the first quantified mapping, of the world's digital natives.

According to the model, in 2012 there were around 363 million digital natives out of a world population of nearly 7 billion. This means that 5.2 per cent of the world's population and 30 per cent of 15-24 year olds engaged in sustained activity online. **The digital natives are, globally speaking, a minority of today's youth.** This is primarily due to relatively low Internet usage rates in many developing countries with large (youth) populations; but also to the fact that ICTs are a fairly new phenomenon and that, back in 2007, by which time young people had to be online in order to be considered digital natives today (needing at least five years of experience), Internet penetration was relatively low: in 2007, only 21 per cent of the global population was online.

Over the past five years, Internet usage has increased significantly in the developing world, from 11.9 percent in 2007 to 30.7 per cent in 2012. This report has shown that 53 per cent of today's young Internet users in the developing world do not yet qualify as digital natives. **Within the next five years, therefore, the digital native population in the developing countries will more than double,** assuming no drop-outs from Internet usage among the youth population.

Digital nativism is not homogeneous across the globe, and varies by country, region and level of economic development. Indeed, **the estimated proportion of a country's total population that are digital natives varies from a low of 0.13 per cent to a high of 16 per cent, with a global value of 5.2 per cent.** Aggregating by region, the share of digital natives varies from a high of 10 per cent in the Americas to 1.9 per cent in Africa. Some 4.2 per cent of people in developing nations are digital natives, as against 10 per cent in the developed countries.

A country will have a high percentage of digital natives if it has: relatively high levels of youth and at least medium levels of Internet use; high levels of Internet use; or some combination of the two.

Many countries have a large proportion of young people relative to their population as a whole, or, in other words, a *youth bulge*. Broken down by region, the proportion of the population in the 15-24 age range varies from 20.1 per cent in Africa to 12.4 per cent in Europe. Variations are also significant across economic groups, with 18.2 per cent of the developing world in this age range as against just 12.3 per cent of the developed world. **The youth bulge in Africa and developing economies should be a core driver of the level of digital nativism in those countries.**

Furthermore, young people are more likely to be online than the general population as a whole. The proportion of the youth population who are young Internet users with five or more years of experience ranges from a high of 99.6 per cent to a low of 0.6 per cent. Aggregation by income categories shows shares ranging from 5.7 per cent in low-income countries to 89.6 per cent in high-income countries. **The high degree of sustained youth Internet use drives the level of digital nativism, in particular in Europe, North America and the developed economies in general.**

The age gap can be calculated as the ratio of a country's Internet user penetration in the 15-24 age range to its overall Internet user penetration. Values for this ratio range from a high of 2.8 to a low of 1.0, with a global average of 1.8. The average ratio for developing countries is 2 (i.e. twice as many young people are online in comparison with the population as a whole), while the average ratio for developed countries is 1.3. Therefore, **the age gap is**

most salient in the developing world, where digital natives are vigorously leading their nation's use of the Internet.

It is reasonable to conclude that, as the age gap increases, so too do the most dramatic properties ascribed to digital natives by some proponents – namely that they think differently and are a breed apart.

What this finding points to is that **the countries with the biggest Internet user age gaps (which are primarily in the developing world) are likely to be those most impacted by their digital natives.** Paradoxically, while most of the literature on digital natives focuses on high-income countries, the most important location for the application of this concept is likely to be the developing world. These findings also highlight the need for further research to analyse how digital natives think, work and do things differently, and whether this should have an impact on the way digital natives are taught or employed.

In addition, there is a strong correlation between a nation's ICT infrastructure and uptake (as measured, for example, by the IDI results) and the percentage of its population that are digital natives. Enhancing infrastructures and improving the affordability of ICT services should support a growing level

of digital nativism. Secondary school and tertiary education enrolments also correlate strongly with the percentage of digital natives within a country.

Finally, the results of this analysis yield distinct conclusions in respect of developed and developing nations. In developed economies, the majority of young people are already online, as are most of the population as a whole. As a result, digital nativism may confer less of a driving role or unique position on youth – whether in relation to their peers or to the population as a whole. By contrast, for the developing economies, the findings may offer much more food for thought. **Digital natives are driving ICT usage in many of the developing nations, insofar as young people are inimitably online relative to the population as a whole.** As the early adopters, they are already concentrating skills and experience, and encapsulate many of the most distinct traits of the digital native. Analysis from the model suggests that sustained enhancement of ICT infrastructures, together with an increase in secondary and tertiary school enrolments, especially among females, are ways to boost levels of digital nativism even further. If young people are indeed the tip of the developing world's digital spear, then this is all the more reason to focus on them, learn from them and grow with them.

Endnotes

- ¹ The 15-M Movement (*Movimiento 15-M*), which started on 15 May 2011, is part of a series of demonstrations in Spain whose origin can be traced to social networks and civilian digital platforms. The movement demands a radical change in Spanish politics, as protesters do not consider themselves to be represented by any traditional party nor favoured by the measures approved by politicians. *Yo Soy 132* is a Mexican protest movement, also closely linked to social networks, centred around the democratization of the country and its media. For more information, see http://en.wikipedia.org/wiki/2011%E2%80%93Spanish_protests and http://en.wikipedia.org/wiki/Yo_Soy_132.
- ² Region refers to the ITU/BDT regions, see <http://www.itu.int/ITU-D/ict/definitions/regions/index.html>.
- ³ References to income levels are based on the World Bank classification, see <http://data.worldbank.org/about/country-classifications/country-and-lending-groups>.
- ⁴ Telefónica, in partnership with the Financial Times, commissioned 12 171 online quantitative interviews among young people aged 18-30, across 27 countries in six regions, including North America, Latin America, Western Europe, Central and Eastern Europe, Asia and the Middle East, and Africa. The survey was carried out between 11 January and 4 February 2013, and included millennials from Argentina, Australia, Brazil, Canada, Chile, China, Colombia, Czech Republic, Egypt, France, Germany, India, Israel, Italy, Japan, Saudi Arabia, Republic of Korea, Mexico, Peru, Poland, Russian Federation, South Africa, Spain, Turkey, United Kingdom, United States and Venezuela. Country sample sizes represented in the global number were weighted by the percentage of the population in each country with access to the Internet. See more at: <http://survey.telefonica.com/survey-findings/#sthash.WAVOXBcm.dpuf>.
- ⁵ See <http://survey.telefonica.com/connected-yet-divided-telefonica-survey-of-the-millennial-generation-reveals-digital-natives-are-optimistic-about-their-individual-futures-despite-splits-across-political-economic-and-technology-ou/>.
- ⁶ However, Livingstone and Helsper's (2007) research suggests that some young people choose not to be submerged, as shown by findings that low and non-users have wholly different priorities and cannot even contemplate how the Internet could become embedded in their daily routines.
- ⁷ See, for example: Bekebrede et al. (2011); Bennett, Maton and Kervin (2008); Bullen and Morgan (2011); Guo, Dobson and Petrina (2008); Jones and Cross (2009); Kennedy et al. (2007, 2008, 2009); Pedró (2009); Reeves and Oh (2008); Selwyn (2009); Smith (2009); van den Beemt et al. (2010).
- ⁸ See, for example: Brown and Czerniewicz (2010); DiMaggio and Hargittai (2001); Facer and Furlong (2001); Hargittai and Hinnant (2008); Kennedy et al. (2008); Livingstone and Helsper (2007); Oliver and Goerke (2007); Selwyn (2009); and Thinyane (2010).
- ⁹ The function is a quadratic function based on Internet user penetration data available for the 15-24 age group for 70 countries for at least one year during the period 2009 to 2011. Internet user data collected from official sources (representative household surveys) are scarce in many developing countries (out of the 70 countries, 28 are developing), as are, *a fortiori*, data broken down by age. Therefore, data from various years had to be used. When developing the function, patterns were identified according to level of Internet usage in countries but not according to specific years, so various years could be combined. The R-squared of this quadratic function is 0.958.
- ¹⁰ ITU collects ICT use statistics by age groups using the following breakdowns: <15, 15-24, 25-74, >74.
- ¹¹ A selected number of countries collect data for the age group 10-14, and these data confirmed the assumption that Internet user penetration rates for the two age groups (10-14 and 15-24) are similar. For most of these - developed and developing - countries, Internet user penetration in both groups was almost the same (with a ratio of 1:1). However, for some developing countries, Internet user penetration in the age group 15-24 was slightly higher (with a ratio of 1.2:1). Since the penetration levels in many developing countries were still very low in 2007, the impact on the calculation of the global figures for the number of digital natives should be relatively small, although the country figure could be slightly overestimated.
- ¹² Of the 180 countries included in the analysis, 2007 survey data on youth Internet user penetration was available for 42 countries; the figures for the remaining 138 countries were estimated using the function presented in Box 4.3. Some countries were excluded because there are either no population statistics broken down by age or no overall Internet use figures available. The sum of their population represents less than 1 per cent of the world population.
- ¹³ See http://www.koreatimes.co.kr/www/news/nation/2012/05/113_111504.html.
- ¹⁴ Neither Sierra Leone nor Timor-Leste are included in the IDI 2012.
- ¹⁵ See http://www.itu.int/net/pressoffice/press_releases/2013/CM04.aspx#UcrdTfn0Geg.
- ¹⁶ Correlation coefficients between digital natives as a percentage of the total population in 2012 and the IDI 2012 indicators are as follows: 0.76 with fixed-telephone subscriptions per 100 inhabitants; 0.62 with mobile-cellular subscriptions per 100 inhabitants; 0.87 with percentage of households with a computer; 0.86 with percentage of households with Internet; 0.9 with percentage of individuals using the Internet; 0.8 with fixed (wired)-broadband subscriptions per 100 inhabitants; and 0.58 with wireless-broadband subscriptions per 100 inhabitants. For all indicators, n=154 and p values are below 0.0001.
- ¹⁷ Gross school enrolment is measured as the ratio of the number of pupils or students enrolled in a given level of education, regardless of age, and the official school-age population corresponding to the same level of education.
- ¹⁸ Correlation coefficients between digital natives as a percentage of the total population and gross enrolment ratios are: 0.76 with secondary enrollment, and 0.74 with tertiary enrolment ($r(153)=0.76, p<0.0001$) and ($r(153)=0.74, p<0.0001$ respectively).
- ¹⁹ The correlation coefficient between digital natives as a percentage of the total population and gross primary enrolment ratio is 0.27 ($r(139)=0.27, p=0.0009$).
- ²⁰ The correlation coefficients between digital natives as a percentage of the total population and the ratio of females to males in secondary and tertiary school are both significant at 0.40 ($r(122)=0.40, p<0.0001$) and ($r(113)=0.40, p<0.0001$ respectively).