Coding bootcamps:
A STRATEGY FOR
YOUTH EMPLOYMENT

Report

75 million youth unemployed worldwide

Less than 25% of Women work in the IT industry

2+ million jobs in the world require programming skills

Coding Bootcamps
Intensive 3-6 months in person classes for people with no prior experience to learn programming skills and work as junior developers

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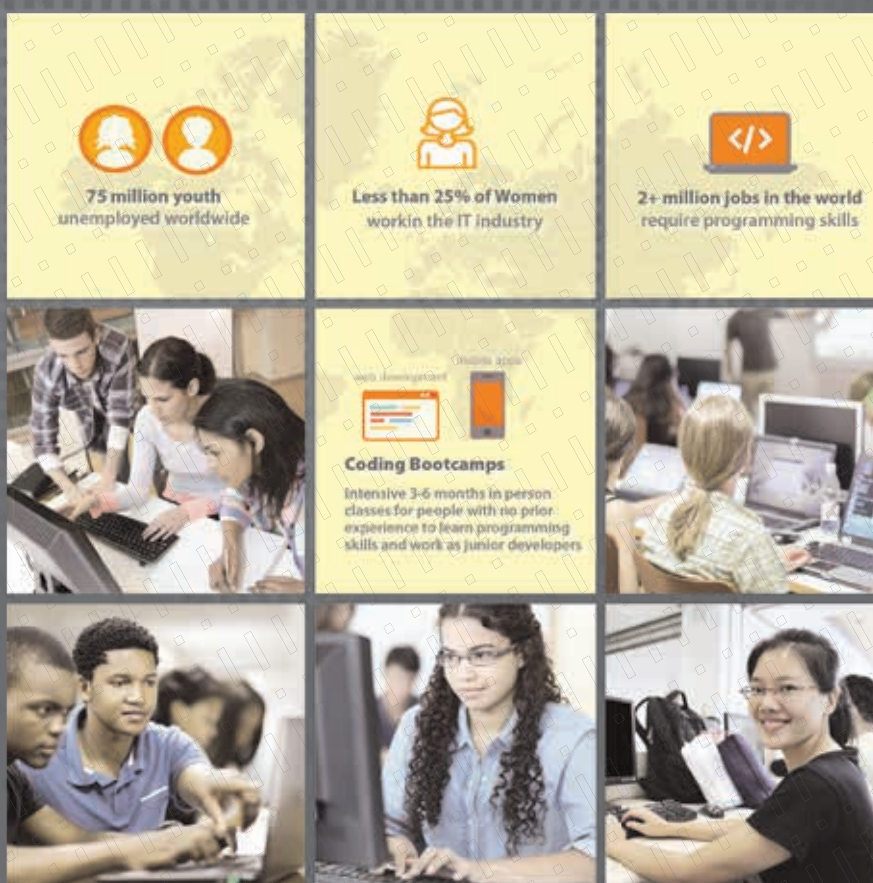
Coding bootcamps: A strategy for youth employment

Acknowledgements

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Foreword

Youth unemployment around the world continues, virtually unabated, leaving today's young people facing enormous challenges finding a decent job and earning an income. And while the technology industry continues to grow at an accelerated pace, companies across a range of sectors are facing a shortage of professionals with the requisite coding skills to fill their workforce needs. The good news is that the increasing demand for workers who can write code is opening up opportunities for young people to pursue careers as junior developers both in the booming technology industry and in other sectors of the economy. An example of this is the coding bootcamp — a new type of job training programme that has burst onto the global scene.

Coding bootcamps are three-to-six month intensive in-person training courses, where students learn programming foundations and then practise what they have learned in project-based exercises that aim to simulate the every-day work environment. Rather than targeting existing ICT professionals, coding bootcamps are aimed at people with little or no previous experience in coding. Coding bootcamps tackle the apparent gaps in formal education systems by providing an accelerated path for motivated people to develop the coding skills that are in high demand today.

This report aims to put the spotlight on the coding bootcamp phenomenon as a trend that simultaneously offers promising solutions for the global technology talent shortage and as a strategy that could reduce youth unemployment. The report discusses the short history of the bootcamp phenomenon, identifies the primary models in operation, reviews how they contribute to the employment path, and considers their potential to improve employment opportunities for youth (young men and women alike). In addition to their potential for generating jobs, coding bootcamps may also address the lack of women working in tech and ICT careers. Some coding bootcamps are succeeding in increasing the number of women graduates at much higher levels than traditional university computer science programmes.

The International Telecommunication Union (ITU) is pleased to contribute this research to the Global Initiative on Decent Jobs for Youth, a new United Nations system-wide, multistakeholder initiative to address youth unemployment around the world. ITU is leading the thematic areas of digital skills and tech hubs.

Addressing high unemployment, especially among youth and women, is a priority in many nations of the world. Policy-makers and other stakeholders should continue to explore every avenue — including bootcamp models — to improve the earning prospects of youth worldwide. It is my hope that this report inspires action.

Brahima Sanou

Director, ITU Telecommunication Development Bureau

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1   Introduction

One evening after work, Savannah W. joined an open house at Galvanize School in Denver to learn more about their coding bootcamps- intensive coding training courses that prepare people with little or no prior experience in software development to work as junior developers. At 22 years old, and recently graduated with a degree in English, her job prospects seemed limited to writing marketing materials or blog posts for websites; not exactly the professional pathway she had envisioned for herself. Savannah signed up for a 24-week web programming class with Galvanize, and after successfully completing the programme, was hired by IBM as a software developer in San Francisco, earning a six-figure salary.

As a recent New York Times article highlights Savannah's story, similar success stories are cropping up almost daily in the mainstream media, particularly in the United States and Europe: young men and women from a variety of professional backgrounds complete coding bootcamps and land high-paying jobs. Meanwhile, the technology industry continues to grow at an accelerated speed, and companies in different sectors of the global economy are faced with a shortage of professionals with the requisite coding skills to fill their workforce needs. The increasing demand for workers who can write code, *the language of the digital world*, is opening up job opportunities for people "across a spectrum of jobs – poker players, bookkeepers, baristas" to pursue higher-paying careers as junior developers in the booming technology industry.[1]

1.1   Coding bootcamps: An option for skills training

As the demand for technology talent continues to grow and businesses in many countries struggle to find qualified workers with programming skills, young people with non-technical backgrounds often have to look beyond the walls of a traditional classroom and a four-year degree to gain these skills at a faster pace. This has become easier to do as a variety of alternative learning spaces and opportunities are emerging to meet that need. From online interactive platforms like Codecademy and Massive Open Online Courses (MOOCs), to interacting with other people interested in learning programming through meet-ups and hackathons, a plethora of options now exist for a wide range of learning styles; each with different learning and employment outcomes. Coding bootcamps are the newest addition to this marketplace of spaces for learning how to code.

The concept of bootcamp training is not completely unfamiliar to the technology industry. For many years, IT professionals have turned to bootcamp-style training to learn different coding programs, obtain certifications, or specialize in a particular programme. The coding bootcamps now gaining international attention are different. Their target audience is not IT professionals but people who have little or no previous experience in coding. This new breed of aspiring software developers join intensive three-to-six month training programmes where they learn the foundations of programming, immersing themselves in a learning environment that combines elements of in-person training with interactive and project-based exercises that represent real workplace environments, situations, and problems. During this training, students learn not only how to code in a specific programming language, but perhaps more importantly, how products are developed in the real world – from problem identification to crafting and sharing ideas, troubleshooting, and collaborating throughout the product cycle.[2]

Bootcamp training programmes come in various shapes and sizes, but they are usually full-time or part-time, three to six month, intensive, hands-on, and in-person training programmes that teach participants how to code in various programming languages. The growing popularity of coding bootcamps and the high levels of positive employment outcomes reported from the training they provide have generated a lot of interest in their potential for decreasing youth unemployment globally, but especially in developing countries. Coding bootcamps tackle the apparent gaps in formal education

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1   Lohr, S. New York Times. (28 July, 2015) As Tech Booms, Workers turn to Coding for Career Change. www.nytimes.com/2015/07/29/technology/code-academy-as-career-game-changer.html?_r=3

2   Duffner, R. The Rise of the Coding Bootcamp. *WIRED Magazine*. www.wired.com/insights/2014/08/rise-coding-boot-camp/

systems by providing an accelerated path for people to develop the coding skills that are currently in high demand.

The coding bootcamp phenomenon began in the United States in 2011 in response to two trends: an increase in demand for software developers in *all economic sectors*, and the somewhat inadequate evolution of computer science curriculum in formal education institutions to produce developers with the work-ready skills desired by the increasingly software-driven global economy (see chapter 2 for a detailed discussion). From only a handful of providers in 2011, the industry has grown exponentially in the past four years. Today, over 67 coding bootcamp providers operate in the United States and Canada alone, graduating over 16 000 students, seventy-five per cent of which found a full-time job and gained an average 44 per cent increase in salary (according to Course Report, an organization that monitors the bootcamp industry).[3] And with women making up nearly 40 per cent of the student body population, the bootcamp training model could contribute not only to narrowing the skill gap but also the pressing gender gap in the technology industry.[4] Although the vast majority of bootcamp providers operate mainly in developed countries, this form of rapid skills training is beginning to emerge in other regions of the world (Figure 1), with some interesting adaptations to suit specific socio-economic conditions.

Figure 1: Coding bootcamps in different regions of the world

Source: Bootcamp.me (https://fvcproductions.com/portfolio/bootcamp-me/)

1.2   Employment outcomes of coding bootcamp training

Although training options such as online tutorials and MOOCs may be the least time-consuming and most affordable training option, coding bootcamps have certain advantages over these options. For example, self-taught methods impart technical skills only, whereas coding bootcamps typically also prepare students with interpersonal skills needed for effective teamwork and experience working on a product from start to finish.

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[3]   Course Report. Alumni Outcomes & Demographics Study. 2015
    https://www.coursereport.com/2015-coding-bootcamp-job-placement-demographics-report
[4]   Lin, G. As Coding Bootcamps grow the skills gap could shrink. *LinkedIN Blog*. 17 September, 2015.
    http://blog.linkedin.com/2015/09/17/as-coding-bootcamps-grow-the-skills-gap-could-shrink/

Coding bootcamp graduates also appear to have a stronger path to employment.[5] Employer perceptions of MOOCs and lack of 'official' credentials[6] are barriers to employment for graduates of online platforms such as Codecademy and Treehouse. As Figures 2 and 3 demonstrate[7], the basic computer science and coding training that these platforms provide is unlikely to land people a job: coding bootcamps are associated with the goal of getting a job, while the other forms of training are associated with the more limited goal of gaining some skills. However, if young people are interested in learning to code, self-taught methods are productive ways to assess whether or not to make the investment of time and other resources in a coding bootcamp.

Figure 2: Expected outcomes per form of coding training

We analyzed 12 popular programs for learning how to code. Each group of programs focuses on a different outcome. Finding a program that fits your goals is the first step to figuring out what type of program you should choose.

Land a job as a junior developer

Developer

Junior Dev

Hack together my own ideas

Hobbyist

Hacker

Learn the basics of web development

Tinkerer

Beginner

Hours of practice

GOAL: LEARN THE BASICS

code Codecademy   ◈ Code School

🌲 Treehouse   ∞ Coursera

GOAL: HACK TOGETHER IDEAS

U Udacity   Tealeaf Academy

T Thinkful   B Bloc's Rails Course

GOAL: GET A JOB

◎ Hack Reactor   GA General Assembly

Dev Bootcamp   B Bloc's Full Stack Track

Source: Bloc.io

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5   Information on the employment outcomes of both MOOCs and self-taught methods is mostly anecdotal, found in blogposts written by people who taught themselves to code and landed a full-time, high-paying job in organizations like Google and Facebook. But it is unclear whether these anecdotes represent the majority of people who teach themselves to code.

6   Weber, L. (17 November, 2015). Online Skills Are Hot, But Will They Land You a Job? Wall Street Journal. www.wsj.com/articles/online-skills-are-hot-but-will-they-land-you-a-job-1447806460

7   Navigating the Coding Bootcamp Ecosystem. Bloc. https://www.bloc.io/coding-bootcamp-comparison

Figure 3: Time involved in developing coding skills based on students goal

The best part about learning to code? There are a ton of options to fit your life. Time and intensity play a factor. Choose a program length and level that matches your goals and fits your lifestyle. Some programs require you to attend in person, while others allow you to learn remotely on your own schedule.

GOAL CATEGORIES
- Learn the basics
- Hack together ideas
- Get a job

Provider	Time
Codecademy	No time frame
Code School	No time frame
Treehouse	No time frame
Coursera	5 weeks average
Udacity	32 weeks average
Tealeaf Academy	16 weeks average
Thinkful	24 weeks average
Bloc's Rails Course	12 weeks total (36 weeks part-time)
Hack Reactor	20 weeks total (8 weeks of prework)
General Assembly	14 weeks total
Dev Bootcamp	19 weeks total (9 weeks of prework)
Bloc's Full Stack Track	24 weeks total (72 weeks part-time)

Source: Bloc.io

Industry monitor, Course Report (Alumni Outcomes & Demographics Study), surveyed over 600 graduates from 44 coding bootcamp providers and found that 66 per cent are employed in a full-time job that requires the skills they learned in bootcamp. Graduates reported an average salary of USD 46 638 before bootcamp and an average salary of USD 64 255 after bootcamp (an average salary increase of 38 per cent or USD 18 000).

While exact numbers are hard to come by (apart from those provided by Course Report), indications are that the number of coding bootcamps and their graduates have grown exponentially in the last few years:

> "In 2011, fewer than one hundred LinkedIn members indicated they had graduated from bootcamp programmes. In 2014, more than 8 000 members completed coding bootcamps and added them to their profiles, reflecting a rise in acceptance of the bootcamp model. The number of bootcamp graduates in the first six months of 2015 has nearly surpassed all of 2014. At this rate, we can expect to see more than 16 000 graduates by the end of 2015 — more than double the total number of 2014 graduates."[8]

Evolution is also evident in the types of skills training provided. Early bootcamps focused on development for web and mobile applications; newer bootcamp programmes have expanded to teach other digital skills like data science, UX/UI design, and product management, and as the type of skills taught have expanded, so has the number of graduates and the revenue generated.[9]

Costs vary, but most bootcamps have tuition rates around USD 10 000 in the United States. Some bootcamps in the United States are also working with universities to become accredited, which can also allow for the tuition to be covered with financial aid and grants.

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8   Gan, L. (17 September 2015). As Coding Bootcamps Grow the Skills Gap Could Shrink. *LinkedIn Blog*. http://blog.linkedin.com/2015/09/17/as-coding-bootcamps-grow-the-skills-gap-could-shrink/
9   Eggleston, L. (15 November, 2015). 2015 Rise of the Bootcamp Model. *Course Report Blog*. https://www.coursereport.com/resources/report-2015-rise-of-ux-ui-data-science-bootcamps

Against this backdrop of global youth unemployment, growing importance of the technology sector, a coding skills shortage in both technology and non- technology industries, and anecdotes of a fast track to employment for coding bootcamp graduates in the United States and Europe, this report explores the emergence of coding bootcamps in developing countries. Based on reviews of the websites of 40 bootcamp providers in Africa, Asia, Latin America, the United States, and Europe; interviews with 22 of these providers; and media coverage of the bootcamp phenomenon, the report discusses the history of the bootcamp phenomenon, identifies the primary models in operation, reviews how they contribute to the employment path, and considers their potential to improve employment opportunities for women and youth in some developing countries.

Four broad models are found to characterize the coding bootcamp landscape. They are briefly outlined below (see chapter 4 for more detailed descriptions):

1   Ready-to-Work model: This is the traditional approach to coding bootcamps - intensive 12 to 24 weeks full or part-time rapid skills training programmes that prepare people to qualify for employment shortly after the training ends.

2   Bootcamp+ model: This is an extended training approach - longer training programmes (1 to 2 years) that equip students with a broader range of sustainable income-generation skills in addition to coding competencies. Found mainly in Africa, they tend to focus on adding entrepreneurship training.

3   Mini Bootcamp model: These are very short-term training programmes ranging in length from two days to one month. They are typically designed to spark interest in learning the basics of programming, to recruit or identify talent, for professionals to update their skills, and for outreach and community building.

4   Early Education model: These are efforts to trigger interest in programming at an early age. This model includes workshops, hackathons, and online platforms as well as more encompassing efforts such as schools integrating coding skills into their curriculum. Although not focused on employability in the short term, the early education model is an important trend to monitor.

Organization of the report

Chapter 2 elaborates on the state of coding skills shortages in the technology industry and other employment sectors in developed countries as well as globally. Chapter 3 describes the expansion of the coding bootcamp phenomenon from the United States and Europe into emerging economies in other parts of the world, and the various forms it has taken in these locations. The final chapter offers some conclusions and recommendations on the potential of coding bootcamp training to alleviate youth unemployment in developing countries.

2   Employment and the coding skills shortage

The International Labour Organization (ILO) estimates that in 2014, 37 per cent (about 75 million) of all unemployed people around the world were young people.[10] In general, unemployment levels have been blamed on reasons such as a shortage of jobs or migration of companies in search of cheap labour. However, in recent years, commentaries about employment have shifted, citing an abundance of open positions and the lack of (mostly technology-related) skills as a major reason these jobs are going unfilled. Headlines such as, "Lack of coding skills may lead to skills shortage",[11]

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[10]   Mourshed, M., Farrell, D., & Barton, D. (2015, p.11). *Education to Employment: Designing a System that Works*. http://mckinseyonsociety.com/downloads/reports/Education/Education-to-Employment_FINAL.pdf

[11]   Venkatraman, A. (2014). Lack of coding skills may lead to skills shortage in Europe. *Computer Weekly*. www.computerweekly.com/news/2240225794/Lack-of-coding-skills-may-lead-to-severe-shortage-of-ICT-pros-in-Europe-by-2020-warns-EC

in Europe; "Employers see skills shortage in Java, .Net, PHP"[12] in Silicon Valley, United States; and "Microsoft warns of 'acute' skills shortage," in the United Kingdom, have become fairly common in the mainstream media. In addition, the McKinsey Center for Government 2015 report, *Education to Employment: Designing a System that Works*, posits that formal education systems are not adequately preparing today's youth with the training and skills required for the job market.[13] Given this scenario, what types of training and employment strategies would help resolve the gap between people looking for work and employers looking for workers? Addressing the youth unemployment crisis is not just about creating jobs; the solution also needs to address the skills demanded in today's workforce.

In order to assess the prevalence of skill shortages in any sector of the job market, one needs an accurate measure of the number of jobs and opportunities for employment in that sector. Are the headlines about coding skills shortages representative of what is happening around the world? If so, what type of coding skills are lacking? Is it a global shortage or a trend found mainly in advanced economies?

This chapter addresses these questions at a high level, providing a foundation for discussing ongoing and potential interventions later in the report. It reviews available literature and attempts to ascertain the extent of the technology skills shortage, if any, especially as it relates to coding.[14]

2.1   Background: ICTs and employment

ICT jobs are growing: It is widely recognized that the information and communication technology (ICT) sector as a whole is growing exponentially as society becomes increasingly digital and interconnected. A variety of sources (as cited throughout this chapter) point to the demonstrated employment-generating capacity of the ICT sector in general.[15] A 2013 World Bank policy note, *Connecting to Work*, also makes a distinction between ICT jobs and ICT-enabled work.[16] Borrowing from the Organisation for Economic Co-operation and Development (OECD) classification, the report defines *ICT jobs* as those "which are directly created through the production of ICT and through the intensive use of ICT". They include:

1.   ICT specialists: Those who develop and put in place the ICT tools for others, whose main output of the job is ICT (coders, software developers and engineers, programmers fall into this category).

2.   Advanced users: Competent users of advanced, often sector-specific, software tools, whose main job is not ICT but ICTs are tools (graphic designers, statisticians, data scientists are some examples of this type of user).

3.   Basic users: Competent users of generic tools, where ICTs are a tool but not the main job.

The report explains that while all three categories of workers and jobs can be found in every economy, "there is a lack of data about the number of ICT jobs, especially in the developing world." Even so, it cites several examples of the growth of ICT jobs in many regions around the world, from Europe (growing about 3 per cent per year) and the United States (where the mobile application industry is

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12   Willmot, D. (2014). Silicon Valley Sees Skills Shortages in Java, .NET, PHP: http://insights.dice.com/2014/04/16/silicon-valley-sees-skills-shortages-java-net-php-linux/

13   Mourshed, M., Farrell, D., & Barton, D. (2015, p.12). Education to Employment: Designing a System that Works. http://mckinseyonsociety.com/downloads/reports/Education/Education-to-Employment_FINAL.pdf

14   This report uses the term "coding", which includes programming, software development and engineering, web development, application development, Internet of things development, and so on.

15   However, hard numbers about the volume of both general and more specialized (e.g. coding, programming, and software development) ICT jobs are scarce, for both developed and developing countries. Furthermore, while estimates are frequently reported, particularly for the United States and Western Europe, concrete data on the *actual* number of jobs available and the *actual* number of jobs going unfilled due to skill shortages, are not freely available in the public sphere.

16   Raja, S., Imaizumi S., Kelly, T., Narimatsu, J., & Paradi-Guilford, C. (2013). *Connecting to Work: How information and communication technologies could help expand employment opportunities*. World Bank ICT Sector Unit www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/09/09/000456286_20130909094536/Rendered/PDF/809770WP0Conne00Box379814B00PUBLIC0.pdf

seeing 45 per cent growth) to India (where IT services provide over 2 million people with jobs) and Kenya (where one mobile application company, M-PESA, employs 23 000 people).

On the other hand, the *Connecting to Work* report defines *ICT-enabled work* as work that is made possible because of the existence of ICT tools, which have enabled people to connect to jobs irrespective of their location, in addition to creating new forms of work, such as microwork. Given the highly interconnected world, geography is becoming relatively unimportant when working with ICTs.

While some specialized development jobs are largely prevalent in places like Silicon Valley in the United States or the Republic of Korea, many other ICT-enabled jobs are available across a number of regions and countries. Many jobs enabled by the ICT sector are created in emerging economies in the Asia-Pacific region and Americas region, particularly when it comes to small and medium sized enterprises (SMEs). There is also an opportunity for people outside of the main technology hotspots, such as Silicon Valley and the Republic of Korea, to compete in the ICT economy through outsourcing and even immigration to these economies, as skills shortages persist. The World Bank notes that "outsourcing directly employs over 3.4 million people across Egypt, India, and the Philippines." It goes on to state that:

> "ICTs allow workers to be located anywhere, at least theoretically. While this allows firms to access a global talent pool, it also means that the increase in the number of firms or in economic activity in one location does not translate to the increase in employment in that location. For example, the growth of the IT industry in the U.S. might not anymore lead to an increase in labour demanded within the U.S., but to a growing demand for programmers who could work remotely from other countries."

There is therefore the potential for jobseekers in regions such as Africa, Asia-Pacific, and the Americas to develop these highly sought-after skills and take advantage of the jobs available either locally or globally.

ICT jobs are not limited to the ICT industry: In the increasingly digitized knowledge society, it is not just technology firms that are looking to employ coders. The Economist notes that:

> "In a broad spread of industries, from car making to aerospace to domestic appliances, products have ever more lines of code embedded in them. These firms, too, are struggling to hire enough developers. Ford advertises as many jobs in software as many a midsized technology firm. As they seek to serve their customers via smartphone apps, all sorts of service businesses, from banking to retailing, need more people with software skills."[17]

Furthermore, ICT jobs generate employment opportunities in other sectors. The statistics on ICT jobs often do not take into account the jobs created indirectly from ICT jobs.[18] For example, the *Connecting to Work* report states that "in India, one job in the ICT industry created up to four indirect jobs… in the Philippines, one new job in IT creates two to three new jobs in other sectors… in Latin America, 2.4 new jobs in other sectors of the economy for every job in the ICT sector."

2.2   ICT skills shortages

Given that the demand for software developers spans most, if not all, employment sectors, it is relevant to take a look at employers in general when assessing the ICT skills shortage. Much of the existing data comes from industry research about the skills that employers desire from job applicants and employees.

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[17]   Schumpeter. *How to bag a geek*. www.economist.com/news/business/21644150-battle-software-talent-other-industries-can-learn-silicon-valley-how-bag

[18]   Such indirect jobs can take a variety of forms. For example, they can include jobs in the public sector funded by the taxes paid by ICT workers, jobs created in the service sector given that ICT workers use their wages in restaurants, shops or buying services or even new jobs required to support certain ICT services. An example of this includes agents that provide cash in/cash out facilities to support a mobile money operation.

Workforce skills are not keeping up with growth in the ICT sector: The general picture indicates that many companies are concerned about the state of training and knowledge among job applicants and staff in the ICT sector. The *Strategy for the Global Initiative on Decent Jobs for Youth*[19] launched by a coalition of 19 United Nation agencies on 1 February, 2016, notes that:

> "Technology, innovation, and other factors have led to rapidly changing labour market opportunities, conditions and skill requirements for young women and men. In some technology sectors, there is even a skills shortfall, leading to unfilled job vacancies and the need for new skills training."[20]

A recent Manpower Group report, *2015 Talent Shortage Survey*, surveyed 41 700 hiring managers in 42 countries to identify if and where talent shortages exist[21]. While not specific to ICTs or coding, the results offer insight into where shortages exist, from the perspective of the managers surveyed. The top ten hardest jobs to fill includes three that are related to ICT, IT or coding: engineers are the third hardest to fill, technicians come in fourth, and the ninth hardest jobs to fill are IT staff (especially developers and programmers, database administrators, and IT leaders and managers). The report also found that the top two reasons hiring managers are having difficulty filling jobs are lack of available applicants/no applicants (35 per cent) and lack of technical competencies (hard skills – 34 per cent). Similarly research by McKinsey & Company suggests that positions are going unfilled due to lack of applicants' skills: "Almost 40% of employers say a lack of skills is the main reason for entry-level vacancies."[22]

Reporting on a survey of 3 200 Chief Information Officers (CIOs) and technology leaders from companies in 30 countries, Harvey Nash (2014), a global recruitment consultancy and IT outsourcing service provider, suggests that technology skills shortages are on the rise.[23] Sixty per cent of CIOs were concerned about this shortage in 2014, increasing from just 45 per cent in 2013, this is the highest this number has been since 2008 before the recession. Twenty-five per cent of CIOs state they are experiencing a coding skills shortage. At the same time, 42 per cent of CIOs plan to increase IT headcount in the next year, as IT budgets grow more than they have since 2006 (44 per cent of CIOs anticipate IT budget growth in the future). It is therefore possible that these shortages will only increase if there will be more jobs available without a corresponding increase in amount of talent.

2.2.1   Coding skills shortages: Global trends

Software developers are expected to be in high demand over the next four years: The United States Bureau of Labor Statistics projects that employment in computer-specific occupations will increase by 22 per cent by 2020, with the demand being highest for software developers (between 28 per cent and 32 per cent, depending on the type of development).[24] In a study to identify the most in-demand jobs in 24 countries,[25] Michael Page (a recruitment and employment agency) concludes that the top two most in-demand professions (across all regions except Africa) are software engineers and developers.[26]

However, according to a recent survey of IT professionals conducted by TechTarget and Harvey Nash, development and associated talent remains in short supply, with the shortage increasing from 22 per

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[19]   United Nations Chief Executive Board for Coordination Report of 30th Session (Annex IV: The Global Initiative on Decent Jobs for Youth) https://www.unsceb.org/content/report-30th-session-october-2015-new-york.

[20]   Pa ILO, chair of the Task Team composed of: FAO, ITC, ITU,UNCTAD, UNDESA, UNDP, UNEP, UNESCO, UNFPA, UN-Habitat, UNICEF, UNIDO, UNRWA, UN-WOMEN, UNWTO, WIPO, the World Bank Group, and (ex officio) the Office of the Secretary-General's Envoy on Youth. (2015). *The Global Initiative on Decent Jobs for Youth.*

[21]   ManpowerGroup. *Talent Shortage Survey 2015*. www.manpowergroup.com/wps/wcm/connect/db23c560-08b6-485f-9bf6-f5f38a43c76a/2015_Talent_Shortage_Survey_US-lo_res.pdf?MOD=AJPERES

[22]   Mourshed, M., Farrell, D., & Barton, D. (2015, p.16). *Education to Employment: Designing a System that Works.* http://mckinseyonsociety.com/downloads/reports/Education/Education-to-Employment_FINAL.pdf

[23]   Harvey Nash. *CIO Survey 2014*: www.harveynash.com/group/mediacentre/2014%20CIO_survey.pdf

[24]   Thibodeau, P. (29 March, 2012). IT jobs will grow 22 per cent through 2020, says U.S. *Computer World*. www.computerworld.com/article/2502348/it-management/it-jobs-will-grow-22--through-2020--says-u-s-.html

[25]   Based on official occupation shortage lists published in the OECD Better Life Index.

[26]   Walters, N. (8 October, 2015). The most in-demand jobs around the world. *Business Insider*. www.businessinsider.com/most-in-demand-jobs-around-the-world-2015-10

cent in 2013 to 26 per cent in 2014.[27] Skills most in demand include big data and analytics, change management, and development.

High demand for developers is a result of the rise of the software-driven enterprise: The emergence of coding as a highly valued skill is redefining business strategies and labour demands. Discussing the complicated issue of skills shortages, an OECD report explains:

> "Some structural changes, such as the adoption of new technologies, may increase the demand for certain skills that are not immediately available in the labour market, creating skills shortages even when unemployment is high. In fact, having a large pool of unemployed people provides no guarantee that employers can find appropriately skilled individuals to fill their vacancies."[28]

According to a CA Technologies-commissioned report by Oxford Economics:

> "A new kind of company, the software-driven enterprise, is redefining business strategy and performance. Across industries and around the world, these companies are leaders in the accelerating application economy, where code is king and competitive differentiation depends on customer-pleasing apps and advanced development methods."[29]

This new organizational form, "the software-driven enterprise," could be the locus of the most severe coding-specific skill shortages. However, it is important to bear in mind that as noted above with the three categories of ICT workers, these skills are used in most, if not all, occupations and sectors.

Business leaders in technology and non- technology industries believe the biggest barrier to entering the application economy is lack of knowledge and skills. The aforementioned Oxford Economics report presents survey results from 200 business leaders in the Americas, Europe, and Asia Pacific regions across a wide variety of sectors, from manufacturing and business services to retail and healthcare. Almost half of respondents (43 per cent) agree or strongly agree that shifting to a software-driven economy will be critical to their success both now and in the next three years.

The report further states that these shifts to software-driven operations and products require acquiring new talent with different, emerging skills, which "companies are finding very difficult to find, with 42 per cent of survey respondents naming "lack of knowledge and skills" as the largest barrier to entering the application economy. These different skills include both programming and applying programming to data science, collaboration, APIs, and IT security — "the top skills needed for success in the application economy". Some of the "highly important" skills needed for the application economy include: data science (22 per cent), DevOps (20 per cent), API development and usage (19 per cent), programming and development (18 per cent), and job-specific software (15 per cent), all of which require some level of coding ability.

Ubiquity of smartphones could exacerbate the shortage: As smartphones become more and more ubiquitous, it can be inferred that the demand for mobile applications will grow, further increasing the demand for programmers. Figure 4 below provides some of the staggering numbers on the global application economy and employment. [30]

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[27] Silverthorne, V. (2015, November 6). Taking strides in the software developer shortage. *TechTarget*. http://searchsoftwarequality.techtarget.com/news/4500256938/Taking-strides-in-the-software-developer-shortage
[28] OECD. (2015). *Skills Shortages*. http://skills.oecd.org/hotissues/skillsshortages.html
[29] Oxford Economics. (2015). *The battle for competitive advantage in the app economy*. http://rewrite.ca.com/content/dam/rewrite/files/White-Papers/CA%20-%20The%20Battle%20for%20Competitive%20Advantage%20in%20the%20App%20Economy%20-%20final%20June%205%202015.pdf
[30] Upadhyaya, P. (30 July, 2015). By the Numbers: Sizing Up the App Economy in 2015. *CA Technologies ReWrite*. http://rewrite.ca.com/us/articles/application-economy/by-the-numbers-sizing-up-the-app-economy-in-2015.html

Figure 4: By the numbers: Sizing up the app economy in 2015

The global app economy:
- 2 billion: number of smartphone users around the world in 2015
- 180 billion: number of global application downloads expected in 2015
- USD 10 billion: 2014 iOS application revenue generated in 2014
- USD 77 billion: Annual worldwide application revenue projected by 2017
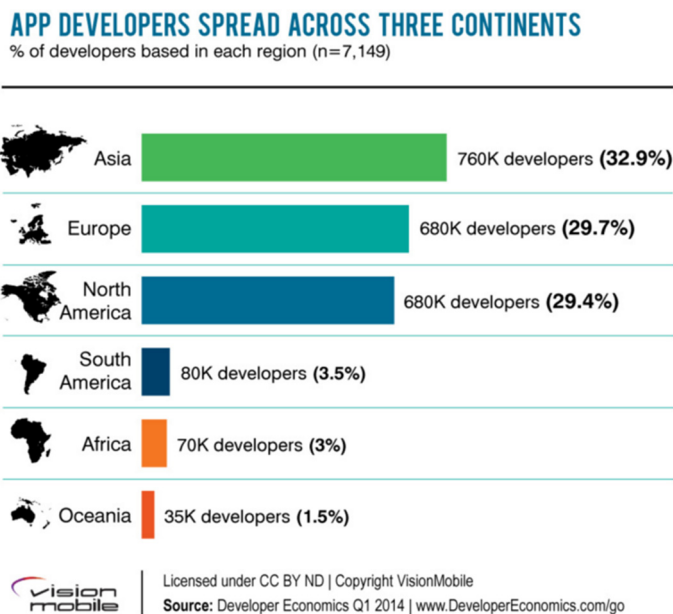- USD 143 billion: Estimated mobile app total market size by 2016

Job creation in the United States app economy:
- 627 000: Number of U.S. jobs created by the iOS App Store to date
- 110: Percentage job growth for Android developers between 2012 and 2014
- 54: Percentage job growth for iOS developers between 2012 and 2014
- 43: Percentage of enterprise app developers who currently earn at least USD 120 000 per year
- 19: Percentage of consumer app developers who earn the same

Source: CA Technologies

Figures 5 and 6 below present a picture of global trends within the mobile application economy. Perhaps unsurprisingly, Latin America, and the Arab and Africa regions, have the smallest number of developers; however as discussed in section 2.2.2, even in these regions, there are indications of the existence of local shortages in skilled technology talent.

Figure 5: Number of application developers by region 2014

APP DEVELOPERS SPREAD ACROSS THREE CONTINENTS
% of developers based in each region (n=7,149)

Asia — 760K developers (32.9%)
Europe — 680K developers (29.7%)
North America — 680K developers (29.4%)
South America — 80K developers (3.5%)
Africa — 70K developers (3%)
Oceania — 35K developers (1.5%)

Licensed under CC BY ND | Copyright VisionMobile
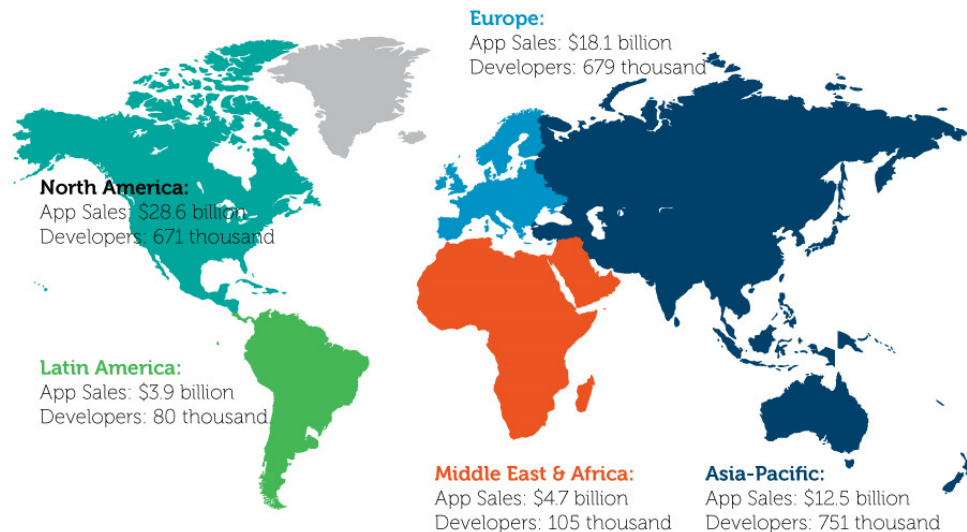Source: Developer Economics Q1 2014 | www.DeveloperEconomics.com/go

Source: Developer Economics[31]

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[31] Asteriadis, N. A $68 billion app economy. *Developer Economics*. www.developereconomics.com/report/q1-2014-68-billion-app-economy/

Figure 6: The global app economy (2013)

THE APP ECONOMY IS GLOBAL
...but North America accounted for 42% of total app sales in 2013

Europe:
App Sales: $18.1 billion
Developers: 679 thousand

North America:
App Sales: $28.6 billion
Developers: 671 thousand

Latin America:
App Sales: $3.9 billion
Developers: 80 thousand

Middle East & Africa:
App Sales: $4.7 billion
Developers: 105 thousand

Asia-Pacific:
App Sales: $12.5 billion
Developers: 751 thousand

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Source: Business and Productivity Apps | www.visionmobile.com/AppMarket

Source: VisionMobile[32]

2.2.2   Coding skills shortages: Regional trends

The Economist describes the technology talent shortage as a global one, where both technology and non-technology companies alike are struggling to hire and retain software developers with the right skills:

> "Although the competition for talent is particularly stiff in Silicon Valley, the phenomenon is a global one. In India, e-commerce giants such as Flipkart and Snapdeal are scrapping for software engineers to help them compete with Amazon there. One of China's largest Internet firms, Baidu, is sponsoring matchmaking events for workers because surveys have shown that married employees are less likely to hop to a rival."[33]

While the bulk of data and research available comes from the United States and Europe, as described above, an overview of the limited data on other regions is presented below.

2.2.2.1 Asia Pacific

The Harvey Nash *CIO Survey 2014* shows that CIOs in the Asia-Pacific (APAC) region are 16 per cent more likely than the global average (60 per cent) to believe they will be negatively impacted by the skills shortage. Seventy-six per cent of CIOs in China and Hong Kong, China also believe they will be affected by the skills shortage there. About half (49 per cent) in the APAC region plan to increase their

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32   Vision Mobile. Business and Productivity Apps. www.visionmobile.com/product/business-productivity-apps/
33   Schumpeter. How to bag a geek. *The Economist*. www.economist.com/news/business/21644150-battle-software-talent-other-industries-can-learn-silicon-valley-how-bag

IT headcount in the next year as do 42 per cent in China, and Hong Kong, China. In Viet Nam, 84 per cent of CIOs believe skills shortages will have an impact and 61 per cent plan to increase IT headcounts.

The Manpower Group report (*Talent Shortage Survey 2015)* states that talent shortages are on the rise globally, with the shortages being most problematic in Japan, Peru, and Hong Kong, China, the top three including two Asia economies. Employers in India, New Zealand, and Singapore are also more likely than the global average to report talent shortages.

Another study, commissioned by Cisco Systems and reported in the *IEEE Job Site*, states that there will be "a skills gap of over 400 000 networking professionals across the Asia Pacific region by 2016."[34] Countries mentioned in the study include Australia, India, Indonesia, Malaysia, Philippines, Republic of Korea, Thailand, and Viet Nam. The study also found that "29% of companies interviewed indicate difficulty in finding qualified candidates."[35]

2.2.2.2 Latin America

Findings from the Manpower Group survey suggest that five of the top ten countries having trouble filling jobs due to talent shortages are in Latin America: Peru with 67 per cent of employers reporting having difficulty filling jobs, Argentina (63 per cent), Brazil (63 per cent), Panama (58 per cent), and Colombia (57 per cent).[36] Mexico is close behind at 54 per cent.

The technology talent shortage in Brazil in particular has received significant media attention. An article by the Wall Street Journal describes the situation:

> "Brazil is one of the world's biggest Internet markets, ranking fifth in terms of Internet users and third for overall time spent online. It is also home to scores of companies devoted to social media, digital advertising, e-commerce and other online businesses. But the entrepreneurs behind these ventures say Brazil has a talent shortage that is inhibiting their ability to grow. In Brazil, 63 per cent of all employers had difficulty filling jobs, compared with a global average of 36 per cent, according to a 2014 survey by ManpowerGroup Inc. a human-resources firm. Technology companies in need of specialized engineering talent were among those feeling the biggest squeeze. A limited supply of top talent is a challenge for technology centers world-wide. But it is a particular problem in Brazil, which produces relatively few computer-science graduates given the size of its market."[37]

In Mexico, many businesses see opportunity for growth in the technology sector, but skilled human capital remains a challenge. An established Mexico City-based technology businessman, Ricardo Medina, sees an opportunity for Mexico to play a major role in the burgeoning Internet of Things (IoT) sector, but only once people are trained, "A great challenge we have is that not one university in Mexico is formally producing human talent prepared to work in IoT. So we're going to start a project with the Secretariat of Public Education to train 5 000 students in the development of IoT prototypes."[38]

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[34] Schneiderman, R. (August 2014). Tech Talent In Demand In The Asia-Pacific, But Shortage Of Skills Still An Issue. *IEEE Job Site*. http://careers.ieee.org/article/asiapacific_0814.php

[35] Lee, W. *The Evolution of the Networking Skills Gap in Asia Pacific.* https://www.cisco.com/web/AP/docs/cisco_ netacad_ap_idc_skills_gap.pdf

[36] Sucre, F. Where is all the Professional Talent in Latin America? *PREAL Blog*. http://prealblog.org/2014/09/09/where-is-all-the-professional-talent-in-latin-america/

[37] Chao, L. Tech-Talent Shortage Crimps Brazil. *Wall Street Journal*. www.wsj.com/articles/tech-talent-shortage-crimps-brazils-outlook-1420248531

[38] Tucker, D. Mexico's Talent Shortage is a Barrier to Internet of Things Innovation. *Nearshore Americas*: www.nearshoreamericas.com/mexico-overcome-talent-shortage-advantage-demand-internet-innovation/

2.2.2.3 Africa

Data about ICT skills in general, as well as coding skills shortages, in Africa are the hardest to come by. While there is some research about ICT opportunities for unemployed youth,[39] numbers on skills and skills shortages are currently unavailable outside of South Africa.

A list compiled in 2012 by the South African Department of Home Affairs indicates "a need for nearly 3 000 software and application programmers, nearly 3 000 project and other managers, and 1 600 information and communications technology support technicians."[40] The Manpower Group survey (*Talent Shortage Survey 2015*) found that 31 per cent of employers in South Africa are having trouble filling jobs due to talent shortages.

2.3   Summary

The available research and data clearly point to coding skills shortages in both the technology and non- technology sectors. The numbers suggest that the technology sector and technology-related jobs in all sectors are growing, while the labour supply struggles to keep up with the associated demand for programmers and developers. Given the shortcomings of computer science and coding in formal education, those that are interested in coding often have to look beyond the walls of the traditional classroom to gain skills. One avenue on offer to gain these skills is through coding bootcamps.

The next chapter presents an analysis of different coding bootcamp models identified in selected countries around the world and their contribution to addressing youth unemployment.

3   Learning to code: Adoption of the coding bootcamp model

This chapter describes four variants of the coding bootcamp concept, showcasing the evolution of this nascent training industry in low- and middle-income countries. Some of the major players in North America and Europe are also featured to represent the basic models from which other variations have emerged. The topics covered are: Coding bootcamp models in developing countries, business models, training models, employment paths, partnerships, and challenges (Table 1).

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[39]   International Youth Foundation. (2013). Analysis of ICT-enabled youth employment in Ghana, Kenya, and South Africa. www.iyfnet.org/sites/default/files/library/RockFdn_ICTYouthJobs.pdf

[40]   SA has a shortage of skilled workers in ICT. *IT News Africa*. www.itnewsafrica.com/2012/01/sa-has-a-shortage-of-skilled-workers-in-ict/

Table 1: Coding Bootcamp Features

Features	Elements
Business model	• Type of organization • Funding sources
Characteristics of the training	• Admission process • Demographics • Women's participation & strategies • Training offerings • Curriculum design and updates • Mode of delivery • Length of instruction • Certification • Cost of training • Financing aid for students
Training to employment path	• Employment services • Job placement rate • Types of jobs • Industries targeted
Partnerships	• Type of partners • Nature of partnerships
Challenges	• Providers' perception of challenges

## 3.1   Coding bootcamp models in developing countries

At a regional level, there are two trends that the coding bootcamp landscape in Africa, Asia, and Latin America have in common:

1. The rise of this industry is driven primarily by technology entrepreneurs. Many of these entrepreneurs themselves graduated from coding bootcamps in the United States and Europe and saw the potential for providing this kind of training in their country. In several instances, their strategy was to approach the bootcamps at which they received their training with a proposal to expand operations to their respective native countries. So far, however, only one has been successful in bringing the methodology and brand to their local market (Simplon in Romania) while others only succeeded in securing commitments from these bootcamps to provide mentorship to set up the programmes and for curriculum development.

2. The leaders and trainers of bootcamp organizations are all well connected to the local technology industry. This enables them to develop a network of potential employers for their students, who may either become employees of the companies or secure contracts to work as freelancers. These strong links are also critical for assessing industry demand for different programming languages, which provides guidance for curriculum development.

As noted in chapter 1 of this report, there are at least four observable models that, although not exhaustive, are representative of the range and diversity of coding bootcamps: Ready-to-Work, Bootcamp+, Mini Bootcamps, and Early Education. Nor are these models mutually exclusive since there are elements that can and do cut across models. In addition, the models describe the bootcamp programmes, not the providers; individual bootcamp providers may offer one or more of these models.

The most relevant models for immediately addressing the coding skills shortage are the Ready-to-Work and bootcamp+ models (Figure 7). The other two models are documented to portray emerging adaptations of the concept and evidence that the coding mindset is coming to be seen as a basic skill. Essentially, each model plays an important role, although at different stages in the path to employability: Ready-to-Work bootcamps (short-term); Mini Bootcamps (short-term); Bootcamp+ (medium-term); and Early Education (long-term).

Figure 7: Coding bootcamp models for short and medium term employability
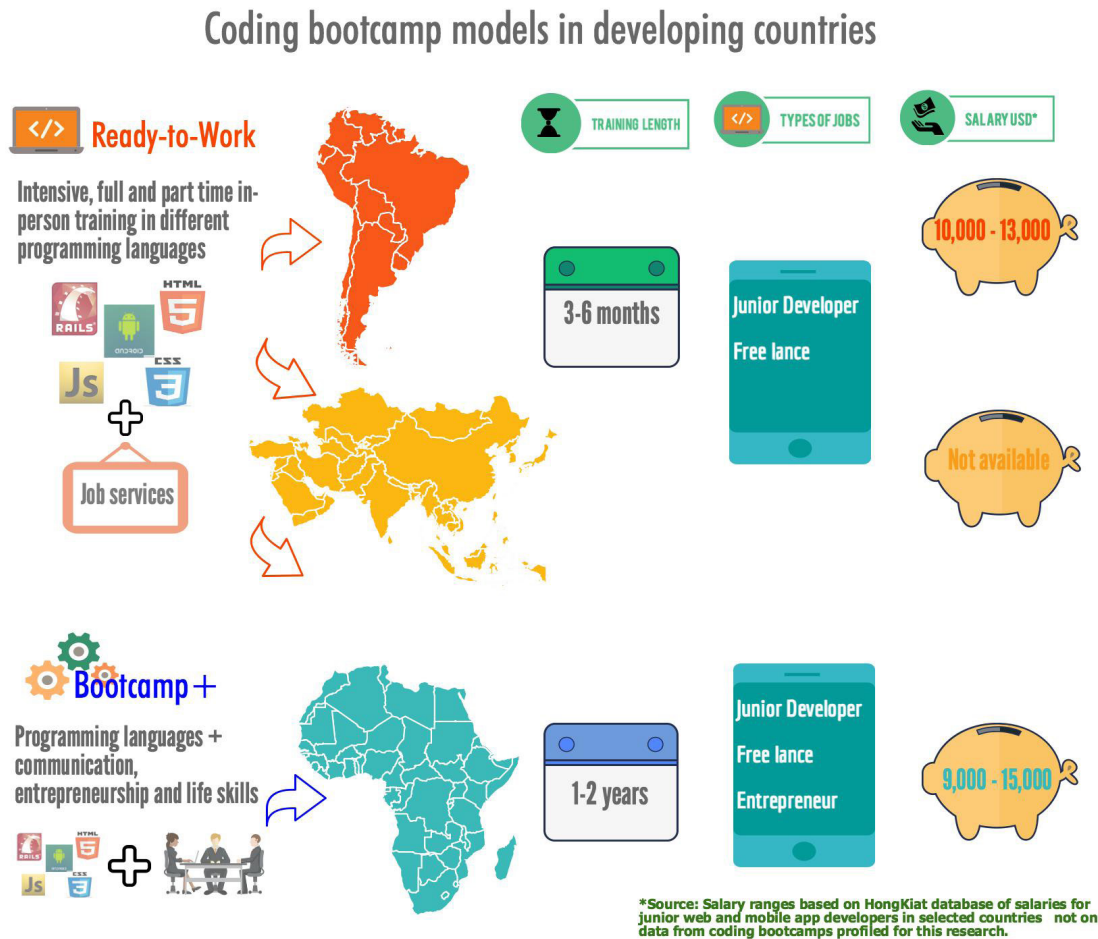
3.1.1 Ready-to-Work coding bootcamps

Programmes in this model are specifically designed to address immediate shortages of technology talent. They provide people with the full set of skills needed to qualify for a junior developer level position, either working for a company or as freelancers, and in fewer instances as interns. These types of coding bootcamps are commonly referred to as "zero to sixty" code schools, programmes that are designed to prepare someone with little or no experience in programming to take on jobs as junior developers by the end of the training.

These intense training programmes may be full or part time and last between three to five months. They are offered by both commercial and non-profit organizations including social enterprises. Given the employment-readiness focus of programmes in this model, the admission process tends to be very selective and rigid. Data on acceptance rates is scarce but may be comparable to similar coding bootcamps in the United States – around 6 per cent.

Training is often heavily oriented towards in-person class time, usually five days a week. The amount of in-class time varies depending on whether it is a full or part time programme – For full-time

programmes in-class training runs between six and ten hours a day, while the range for part-time programmes is between three and five hours. Additionally, students are required to commit to spending a certain amount of time outside class practicing the skills learned either by working on projects or exercises on online training platforms such as Codecademy. In-person classes are critical not only for developing coding skills but, perhaps just as importantly, for understanding the dynamics of teamwork, project development, client relationships, and communication skills. Without exception, programmes in this model develop and update their curriculum in-house.

The cost of training for students varies per region and programme (note that the costs below are not adjusted to purchasing price parity (PPP) in the country or region). In Africa, costs in this model range from USD 500 – USD 2 500. In Latin America, training fees range from USD 1 500– USD 3 000. For Asia, there is no data available except for General Assembly in Hong Kong, China, where the cost of the training is almost USD 10 000. Some programmes are offered for free or for a symbolic contribution. There are different options for students to finance the cost of the programme:

1. Self-financed or through credit cards or loans (although access to low-interest loans is very limited in many countries).

2. Provider makes available deferred payment options, monthly instalments, tuition deferrals until student is employed. Alternatively, once employed, a percentage of the student's monthly salary may be applied to repayment over time.

3. Training is free for students either through company sponsorship or scholarships.

Students participating in Ready-to-Work bootcamps are usually between 22-35 years in age, mostly recent college or university graduates or students working part time, and can even include small business owners.

In terms of employment services this model offers the most comprehensive set of services (from job hunting skills training to actual job placement) to support their students through the employment path. Job placement rates range from 60 per cent- 100 per cent depending on the organization.

Organizations that fit into this model include:

- **Africa**: Moringa School, eMobilis, SamaSource (Kenya); xPerience, IT Varsity (South Africa); KACE AITI (Ghana); Muzinda (Zimbabwe), iLAB Liberia (Liberia); Andela (Nigeria)

- **Asia**: Generall Assembly HK, Ace Hacker and Geek Skool (India), Ruby on the Beach (Indonesia)

- **Latin America**: Laboratoria and CodeaLab[41] (Mexico); Desafio Latam (Chile, Colombia, and Mexico); and World Tech Makers (Colombia, Brazil, y Chile)

- **Europe**: Simplon (Romania); Founders & Coders (United Kingdom); Iron Hack (Spain); and McKinsey Social Initiative (Spain)

- **United States**: Learn Tech Labs (San Francisco); Galvanize and General Assembly (Seattle)

3.1.2   Bootcamp+ coding bootcamp

The programmes in this model share some common elements with the programmes in the Ready-to-Work model and they are mostly prevalent in Africa. Like Ready-to-Work programmes, they are immersive and intensive training programmes. However, they differ in that: 1) they are more likely to be full-time rather than part-time, 2) training usually lasts much longer – between one and two years, and 3) they aim to equip students with a much broader range of skills which may include a variety of coding languages, graphic design, product management, marketing, entrepreneurship, and other general livelihoods skills. In essence, they are immersive, intensive, but *not* rapid skill development programmes and can in fact function as an alternative to college or university in some cases – for

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[41]   Codea Lab: www.codealab.mx/

example, xPerience in South Africa plans to implement a Gap Year programme in 2016 providing alternative training to recent high school graduates who can't afford other long-term tertiary education.

Admissions processes are similar to the Ready-to-Work model, although the bar for acceptance criteria may be even higher because of the scholarship-based funding structure. Akirachix, for example, has an admission process that includes a home visit to verify that the applicant comes from a low-income background; MEST applicants are required to have three to five years entrepreneurial or corporate work experience; and WeThinkCode_ applicants go through a four-week bootcamp before finalists are selected for the two-year programme.

The majority of such programmes are scholarship-based and, thus, fully free for students. However, at least one (CodeX) lists a fee of ZAR 25 000 (approximately, USD 1 700) per term for a three-term programme (CodeX also appears to secure corporate sponsorships for students). In addition to the scholarship, some programmes in this model also offer a stipend for living expenses, and in others, students can generate additional income by selling the products they develop during the training. The general trend is that students commit to working for one of the company sponsors after graduation, usually at market rates to cover the amount of money or time they were sponsored for the training. However, this depends on the number and types of partnerships the bootcamp provider has – for example AkiraChix does not guarantee employment.

Organizations that fit into this model in **Africa** include: CodeX, WeThinkCode_, CodeX and xPerience (South Africa); AkiraChix (Kenya); MEST (Ghana, Nigeria, and Kenya).

AkiraChix is a not-for-profit organization created to provide training to a variety of women, those in primary school, high school, and university, those working in technology and those who wish to have a career in technology, making it an effectively wholesome program and a marquee example of bootcamp+ model. Its training program offers women from marginalized backgrounds in Nairobi the opportunity to acquire technical and other critical life skills. The program includes training in web and mobile app development, communication skills, and entrepreneurship – key competency in the context of the Kenyan market facing job shortages.

3.1.3   Mini bootcamp

This model comprises very short-term training programmes lasting between two to three days to a month. It is one of the most commonly used strategies to raise awareness about the potential of programming as a career and the different employment opportunities associated with having these skills, especially for women. In addition to generating interest, they are often used for identifying and recruiting talent, as well as for outreach and community building. Some organizations also offer workshops specifically designed for professional developers to update their skills or learn a new technology. With the exception of the workshops that target professional developers, or specific groups such as women and girls, these programmes are usually open to all who are interested, without any admission requirements.

Though not necessarily employment-focused, mini bootcamps play a very important role in the coding bootcamp ecosystem in all regions alike. There are several organizations devoted exclusively to organizing mini bootcamps, while others utilize mini bootcamps as a supplement to their Ready-to-Work or Bootcamp+ programmes. Whether or not participants end up pursuing further training, they do come away with some introductory training in coding that may be translated into employment at some future time.

Organizations that fit into this model or offer this element as part of their training include:

- **Africa**: africacode week (17 countries), Code for Africa (Ghana, Kenya, Nigeria, and South Africa)

- **Asia Pacific**: Island Techies and DevCon (Philippines)

- **Americas**: Epic Queen (Mexico)

- **Europe**: Code to Change (Netherlands)

deVcon is a not-for-profit organization that organizes short-term technical workshops and events for students and tech professionals in the Philippines. For students, the day coding workshops are designed to expose them to the latest technologies and inspire them to pursue technology careers. For professionals, the organization offers them a viable way to upgrade their tech skills so they can improve their careers. In the Philippines, the coding bootcamp model is not really developed, and although there are many public and private IT schools that offer similar training they are often expensive, and generally lacking instruction in some of the latest technologies.

3.1.4   Early-Education model

This distinguishing feature of this model is that it is targeted at children, rather than people of employable age. It represents efforts to trigger interest in programming at an early age. It includes mini bootcamp style activities and events such as workshops, hackathons, and online platforms designed for children to learn the basics of programming. For example, Akirachix in Kenya runs high school and kids outreach programmes that consist of one-week bootcamps and biweekly training sessions for high schools, as well as one-week camps for kids. Likewise, KACE-AITI in Ghana has the i2CAP (I too can programme) initiative designed to teach programming skills to high school students. There are also more encompassing efforts currently underway in the United States and Europe to build coding skills into school curriculum at an early age.

Organizations that fit into this model or offer this element as part of their training include:

- **Africa**: Akirachix (Kenya), KACE-AITI (Ghana)

- **Americas**: program.ar (Argentina); Epic Queen (Mexico); code.org; Made with Code, Girls in IT, BlackGirlsCode (United States)

- **Europe**: 12 European Union Countries have begun to integrate coding skills as part of their school curricula

The remainder of this chapter delves into various defining characteristics of coding bootcamps in the developing world.

3.2   Coding bootcamp business models

There are three types of organizations currently providing coding bootcamp training in Africa, Asia Pacific, Europe, and the Americas:

- commercial organizations;

- social enterprises, and

- non-profit organizations.

All three types are found in each of the four regions, with non-profit organisations appearing to be more prevalent in Africa. A variety of sources of funding are used by bootcamp providers to sustain and grow their operations. In most cases they rely on a combination of two or more sources, rather than exclusively on one revenue stream.

1. **Student tuition**: Fees students pay to enrol in the programme. The amount varies depending on the organization and type of training. For example: Desafio LATAM, Codea, and World Tech Makers (Latin America); xPerience, and Moringa (Africa); and General Assembly (Hong Kong, China).

2. **Student contribution to the organization after they are employed**: A percentage of a student's monthly salary is paid to the bootcamp provider for a period of time while they are employed. This is both a revenue stream and a funding strategy for many bootcamp providers to ease the burden of up-front tuition payment. For example: Laboratoria (Mexico), and Founders & Coders (London- still in implementation process); and, The Dev School (Kenya).

3. **Employer hiring fees**: Fees charged to companies when they hire one of the bootcamp graduates. For example: Geek Skool (India); CodePath, and Ada Developers (United States).

4. **Start-up accelerators**: Provider helps students create a start-up and keeps a percentage of the start-up holdings. For example: AceHacker (India).

5. **In-house recruiting:** Provider has or creates a recruiting or web development agency to find prospective projects for graduates to work on. For example: Founders & Coders (London); Laboratoria (Mexico- still in development process).

6. **Licensing curriculum**: This revenue stream has not been implemented yet by any of the organizations documented. However, Learn Tech Labs (San Francisco), and Founders & Coders (London), are currently devising ways to implement this in the near future. The only difference between the two organizations is that the latter will share their curriculum as open source.

7. **Donations [cash or in kind]:** As expected, this is a particularly important funding source for non-profit organizations offering coding bootcamp training. The type of donation and the activities that donations cover varies from organization to organization. In some instances, in-kind donations are in the form of a physical space, Internet access, training space, or payment of utilities, for example. Cash donations are often used as seed investment to start the training programmes, expand the training to more people or additional types of training, or to sponsor student enrollment fees. For example: Laboratoria and Epic Queen (Mexico), McKinsey Generation Initiative in partnership with Iron Hack (Spain); DevCon (Phillipines); Code to Change (Netherlands).

Commercial organizations and social enterprises employ any combination or all seven of the above approaches, while non-profit organizations tend to rely on donations.

i_XPERIENCE South Africa | A different coding bootcamp business model

The organization was founded in 2014 by a tech entrepreneur initially offering summer coding bootcamps for students in the United States. The summer program combined four weeks of intensive learning with a four-week internship working with Uber, Accenture, and other high profile companies in Cape Town. From the start, the company wanted to develop programs that cater to education and social development at the local level. Now that it has achieved a sustainable business model through the summer abroad program, iXperience is partnering with Allan Grey (the biggest investment company in South Africa) to sponsor local students to participate in the program. In addition, the company is planning to offer a "Gap Year" program for high school students from marginalized backgrounds who can't afford attending college. The Gap Year program will offer six months of computer training and a six-month internship with a local company. The program will be free for students financed through partnering companies' referral fees.

3.3   Coding bootcamp training models

There are also variations in the approach to training taken by the different types of bootcamps, including the mechanisms used to recruit students, the length of their programmes, financial mechanisms available for students to cover training costs, and the type of employment services they offer. The discussion below considers the following features of the training models:

- Admissions process

- Demographics of targeted population

- Curriculum

- Format of the training

- Tuition costs and financing resources available for students

- Certification

3.3.1   Admission process

No admission requirements – Mini Bootcamp and Early Education models: Due to the outreach-oriented nature of their programmes, the Mini Bootcamp and Early Education models (offered by providers such as Epic Queen in Mexico, Code to Change in the Netherlands, and DevCon in the Philippines) do not typically have an admission process. Their goal is to attract as many participants as possible. For those mini bootcamp programmes that are used to assist in screening programme applicants, for the Ready-to-Work and Bootcamp+ models, there may be a requirement to have successfully completed an initial evaluation process.

Rigorous screening process – Ready-to-Work and Bootcamp+ models: The student admission process and recruitment efforts for the Ready-to-Work and Bootcamp+ models seem very consistent across regions. As with their United States and European counterparts, the admission process is rigorous and the acceptance rate is often low. According to Course Report (Alumni Outcomes & Demographics Study), top bootcamps in the United States accept only 3 to 6 per cent of interested applicants. A similar trend is found among many of the providers profiled in Asia Pacific, Africa, the

Americas, and Europe. Andela, for instance, reportedly has a 1 per cent acceptance rate.[42] In general, the admission process for Ready-to-Work bootcamps and Bootcamps+ follows these steps:

1. Programmes are publicized through diverse means including mini bootcamps (workshops, hackathons, bootcamp websites, community organization, and social media).

2. Prospective students complete an application form with basic information that includes explaining their motivation for applying and professional aspirations.

3. Applicants then take a logic test and a programming challenge (often from Codecademy) or provide some other form of evidence of their capabilities. This step serves two purposes: On the one hand, it allows the providers to determine the profile and technical learning propensity of applicants. On the other hand, it works as a self-assessment for applicants to determine if programming is really for them. Alternatively, as done by McKinsey Generation Initiative Spain, students may be asked to instead send a video representing themselves.

4. Selected applicants are invited for an interview to further assess motivation, discipline, soft skills, and their career objectives. These interviews usually happen face-to-face.

5. Mini bootcamp events like hackathons and workshops may be used as an additional form of pre-screening after initial recruitment.

The admissions requirements for prospective students vary depending of the skill level the programme demands. Generally, all providers are upfront about the minimum expectations of interested applicants – working English proficiency is one of the most commonly found. Most coding bootcamps profiled do not require any coding competency to enter the programme. They do emphasize the importance of qualities such as a particular type of problem-solving aptitude and commitment to the rigorous time and work demands of the programmes. Students are strongly encouraged to first assess their motivation, commitment level, and discipline before making the decision to apply.

moringa

Kenya | Selecting the best student pool for the program

Moringa School started providing training in January 2015, and it has become one of the leading coding bootcamps in East Africa. The school offers a variety of training programs including Android for mobile app development and HTML and CSS for web interfaces. The school has a very rigorous admission process with an acceptance rate of 6% from potential applicants. As a first step, students apply using a simple online form and automatically receive an email with a coding challenge. Based on their performance with the challenge, selected students go through a round of interviews where the school tests their math and logic skills and assesses their career aspirations allowing it to select the most promising students. According to the school, the hiring rate for their students is very high and most have experienced a significant increase in their income.

3.3.2   Demographics

According to Course Report research on the state of coding bootcamps in the United States and Canada, bootcamp students are on average, 29 years old, 71 per cent hold a University degree, and over 60 per cent are male. The age profile is similar to that of students in the majority of bootcamps profiled across other regions, with student ages ranging between 25-35 years (Figure 8). Although

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[42]   CNN. (24 June, 2015). The startup that's harder to get into than Harvard. http://edition.cnn.com/2015/06/24/africa/andela-start-up-nigeria/

the breakdown for educational level is not available, the professional background of students seems slightly more diverse in Africa, Asia Pacific, Latin America, and the one country profiled in Eastern Europe, Romania. The student body consists primarily of college or university graduates already working in a technology or non- technology profession, recent graduates with no work experience, as well as entrepreneurs with or without tertiary education. In very few instances, students may have just a high school diploma, e.g. Laboratoria (Mexico); and AkiraChix (Kenya).

Figure 8. Student profile in selected coding bootcamps in developing countries
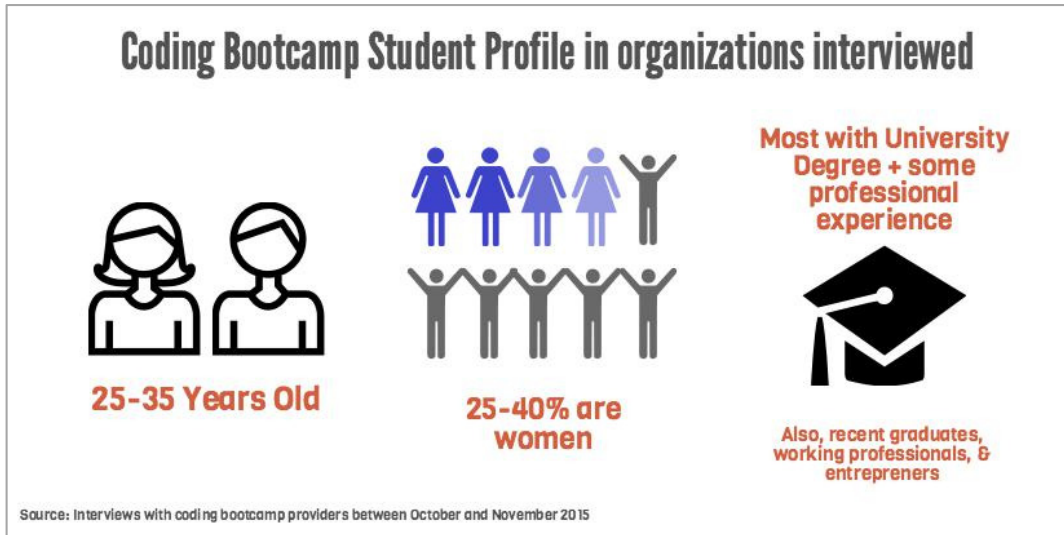
The regional outlook in terms of women's participation also follows similar trends to the United States and Canada. Women make up 25 to 40 per cent of the student body in the coding bootcamps reviewed (Figure 9). The highest rate of participation was found in the programme offered by the McKinsey Generation Initiative in Spain in partnership with Iron Hack, followed by Simplon in Romania with 40 per cent of women participating in their programmes. There are some training programmes, however, that are designed exclusively for women (Akirachix in Kenya, Laboratoria in Mexico, among others). Regardless of their current gender composition, all coding bootcamp providers interviewed expressed interest in increasing the female population in their programmes and several are devising strategies to meet this goal, as described in the next section.
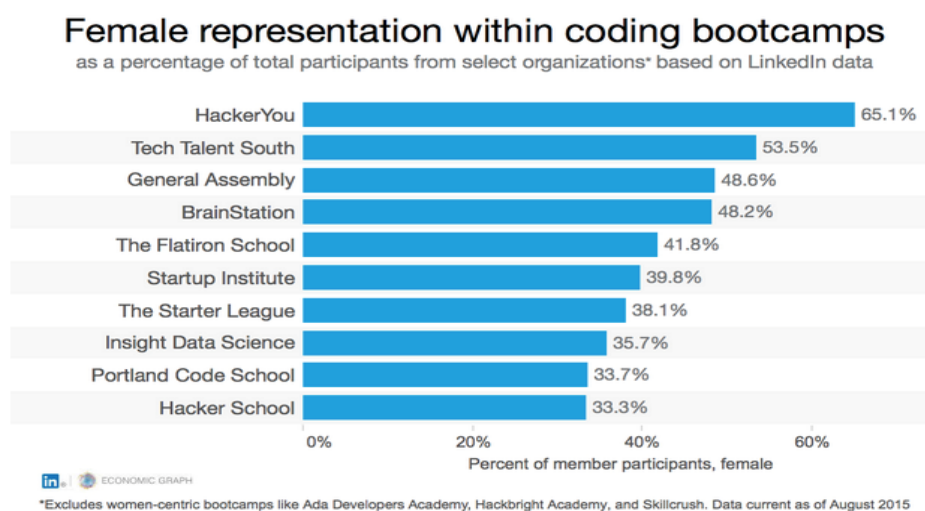
Figure 9. Participation of women in selected coding bootcamps in developing countries
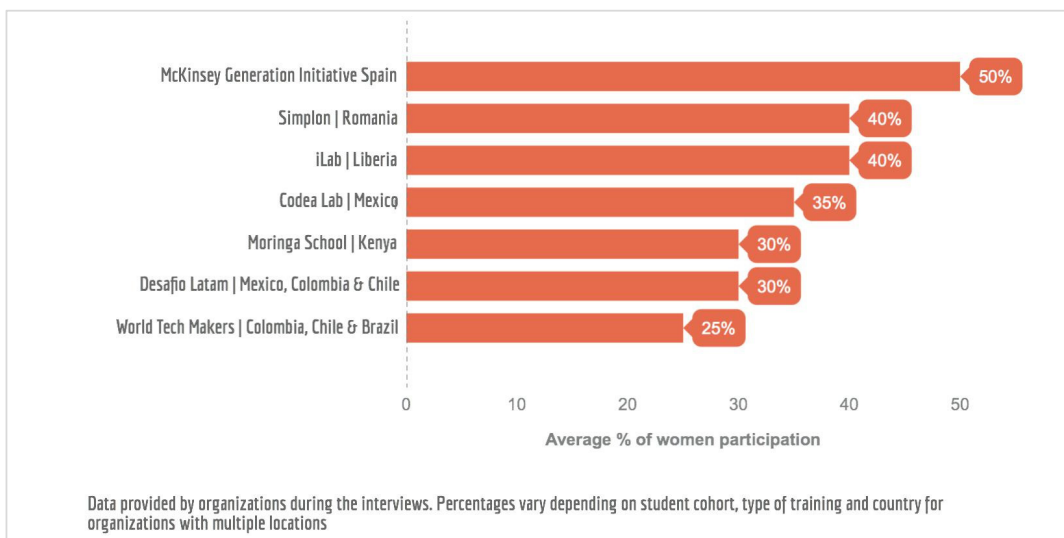
Strategies to increase women's participation in coding bootcamps: The ever-present challenge to achieve a more balanced representation of women in the technology industry has daunted scholars, practitioners, governments, training providers, and the technology industry itself for many decades. Discrimination and social barriers, such as discouragement of women from pursuing STEM-related careers (requiring a science, technology, engineering, or math-related degree) and perceptions of women's responsibilities as homemakers, contribute to sustaining the gender imbalance noticeable in the technology industry. Any efforts to address this situation must invariably include strategies not only to facilitate the participation of women in training but also to raise societal awareness about the possibilities of technology training as a potential for improved career paths for all genders. This is particularly important for less developed regions where, in many countries, social barriers to women working in the technology industry may be even higher.

Research in the United States praises the coding bootcamp industry for taking steps to address the gender imbalance (see Figure 10). A recent LinkedIN blog post observes that women make up almost 40 per cent of graduates from the major coding bootcamps, "which is a significant improvement over the 20 per cent average female representation of Software Engineers in the Technology Industry."[43] With the rise of women-centric bootcamps such as Ada Developers, HackBright Academy, and others, this percentage could increase still further.

Figure 10: Female representation within coding bootcamps in United States and Canada

Female representation within coding bootcamps
as a percentage of total participants from select organizations* based on LinkedIn data

*Excludes women-centric bootcamps like Ada Developers Academy, Hackbright Academy, and Skillcrush. Data current as of August 2015

Source: LinkedIN Economic Graph

By far the most frequently mentioned challenge coding bootcamps face in relationship to attracting women is **recruitment**, derived from the tendency for the technology industry to be seen as a male domain, as well as difficulties associated with the time commitments required to complete a bootcamp programme. Second, and just as important, is the challenge of ensuring **meaningful participation**, which requires creating a safe space where women, once recruited, feel comfortable learning their new programming skills and can build their self-esteem. The recruitment challenge is typically tackled through awareness creation and demonstration events targeted specifically at women and girls, as well as in through the design of programmes with more flexible attendance requirements. The meaningful participation challenge is not as clearly evident but is presumably tackled by offering women-only programmes where participants can focus on building their skills without the added pressure of competing with their male peers.

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[43]   Gan, L. (17 September, 2015). As Coding Bootcamps Grow the Skills Gap Could Shrink. *LinkedIn Blog*.
http://blog.linkedin.com/2015/09/17/as-coding-bootcamps-grow-the-skills-gap-could-shrink/

Addressing the female recruitment challenge

- **Awareness-raising**. These strategies range from organizing mini-bootcamps, day or weekend coding workshops, and events that bring in women from the technology industry to act as role models and mentors, or simply create a supportive community. For example, Code to Change (Netherlands) organizes events featuring women in the technology sector who share their knowledge and skills, and try to motivate other women to be more comfortable with technology work. Epic Queen in Mexico organizes similar events. For example, with over 70 volunteers in seven countries, it has facilitated connections between more than 30 000 women in mentorship and other supportive relationships related to women working in the technology industry. The organization is now partnering with Desafio LATAM, a coding bootcamp provider with offices in Mexico, Colombia, and Chile, to offer full scholarships to qualifying female applicants. Recruiting efforts of this kind are not uniquely implemented by women-centric coding bootcamps – several of the providers interviewed mentioned some kind of effort aimed at reaching out to women.

In addition to these strategies, there are the Early-Education model coding programmes targeting young girls. In addition to their in-house programmes, they frequently join in the activities of national or international initiatives such as the ITU annual Girls in ICT Day. Some examples include:

- Program.ar in Argentina (http://programar.gob.ar/de-que-se-trata/)

- Epic Queen in seven Latin American countries, Spain, and the United States (http://epicqueen.com/)

- Akirachix Kids Program in Kenya "(http://akirachix.com/kids-program/

- Made with Code in United States (https://www.madewithcode.com/)

- Girls in IT in United States (https://www.ncwit.org/resources/girls-it-facts)

- Black Girls Code in United States (www.blackgirlscode.com/)
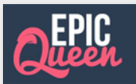
Mexico +7 countries | Girls learn coding basics in Code Parties

Epic Queen is a not-for-profit organization founded in 2013 devoted to increase the participation of women and girls in STEM careers. Among the different programs it offers, the organization partnered with Google Mexico to organize Code Parties for girls between the ages of 6-11. These three-hour coding workshops offer girls the opportunity to learn the basics of programming, meet women currently working in technology as role models, and inspire them to become creators of technology. In addition to the basics of programming, Code Parties teach girls team work and communication skills. Since the program started, over 800 girls in Mexico and 200 in Colombia have participated with the number of girls expected to increase this year.

- Programme design. To provide incentives for women to sign up for coding training, organizations offer solutions that adapt the format, length, and financing mechanisms to the reality of local perceptions about women's social roles (e.g. family responsibilities and higher priority of male education). Measures include:

- Sponsorship to cover tuition cost, including in some cases a stipend for living expenses where programmes require full time commitment, for example: Ada Developers in Seattle (United States); World Tech Makers (Colombia, Brazil, and Chile). There are also instances of non-profit coding bootcamps partnering with commercial providers to cover the cost of tuition for female participants (Laboratoria partnership with Desafio LATAM; Epic Queen with Codea Lab in Mexico, to name a few).

- Part time programmes that enable women to enroll while keeping their responsibilities as homemakers and/or income providers for their family, for example: Desafío LATAM (Chile, Colombia, and Mexico); Laboratoria (Mexico and Peru).

<laboratoria> **Mexico, Peru, & Chile | Bringing different women into the tech world**

laboratoria is a not-for-profit that started in Peru in 2014 offering coding bootcamps for women who either did not attend or complete their university studies. Based on its demonstrated success, the program was quickly adopted in other countries in the region. For example, Laboratoria, Mexico partnered with some women's organizations to recruit 27 students who successfully graduated from its web development training program in November 2015. Laboratoria programs are designed for women between the ages of 20-35 from different educational levels, with only a third having completed a university degree but working in jobs outside their area of study. From this perspective (educational and professional background of participants), Laboratoria is one of the most diverse coding bootcamps that specifically target women. The organization builds relationships with potential employers, mainly in the digital marketing industry, and negotiates a fair salary for students who get hired (between 8,000 – 12,000 pesos). Laboratoria recently partnered with Codea Lab, a commercial coding bootcamp provider in Mexico, to offer scholarships for these women to pursue more advanced coding skills training.

3.3.3   Curriculum design and content

Coding bootcamp curriculum stands in stark contrast to that of the typical university computer science course. While universities tend to offer more comprehensive coursework and a broader theoretical base of programming principles, training at coding bootcamps is centered on imparting practical and career development skills.[44] The coding bootcamp learning experience is project-based with lectures, collaborative work, and online exercises making up the instructional framework. Figures 11 and 12 below outline the differences between university and coding bootcamp training, and the pros and cons of the latter in relation to learning and employability goals based on the United States market.

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[44]   Drost, S. & Farquharson, M., (2016) CODING BOOTCAMP Enhancing Your Skills Through Programming Bootcamp. Computer Science Online 2016. www.computerscienceonline.org/coding-bootcamp/

Figure 11: Differences between university and coding bootcamp education

	COLLEGE	BOOTCAMP
Time Commitment	Associate degrees typically take two years, while a bachelor's degree in computer science takes four or more years	Approximately 8 to 12 weeks
Curriculum	Well-rounded coursework, including general education classes outside of computer science. Provides a broader study of theory and programming principles	No instruction in computer theory, but a greater focus on skill building in Web development, HTML, CSS, and programming languages
Instruction Format	Lecture-based with some hands-on programming	Minimal lectures with practical instruction in coding through individual and group projects
Cost	Typically ranges from $15,000 – $40,000+	$5,000 to $20,000
Career Services	Some career and internship placement assistance post-graduation	On-site job fairs and access to hiring managers (varies by program)

Source: Computer Science Online 2016 www.computerscienceonline.org/coding-bootcamp/

Figure 12: Pros and cons of attending a coding bootcamp

PROS AND CONS OF ATTENDING A CODING BOOTCAMP

PROS	CONS
Practical, career-focused skill development	Demanding and intensive learning environment
Less expensive than a four-year degree	Likely requires relocation to attend program
Head start on career opportunities	Lack of well-rounded education
Less time to graduate	Lack of deeper understanding of computer science theory
Develop technical skills current in the industry	Less time to explore professional fit
Instruction from professional programmers	Does not result in college degree
No student loans	No financial aid and minimum payment assistance programs

Source: Computer Science Online 2016 www.computerscienceonline.org/coding-bootcamp/

3.3.3.1 Curriculum Design

Most of the organizations profiled develop their curriculum using their in-house knowledge, the expertise of their trainers, and in the case of smaller organizations, the founders themselves. The

design process is often vetted through the organization's network of employers and technology experts. The higher the quality of the courses provided, the higher the likelihood that students will find employment, and since most of the bootcamps do not offer official certification, the quality of their graduates and their job preparedness is their most reputable asset.

The training is generally modular – the core foundations remain the same, and new modules are added as technological trends change. The modular structure enables providers to be highly responsive to the marketplace – the curricula for coding bootcamps is frequently updated to reflect technological developments that lead to employers demanding new employee skillsets. This industry responsiveness is one of the strongest assets bootcamp providers have, but also one of the main reasons they face accreditation challenges (see section 3.3.6). Joe Lipper, a curriculum developer for coding bootcamps, explains why in-house curriculum development is a common practice:

> "... Software languages, libraries, and frameworks improve at a breakneck pace, and relying on a book, tutorial, or series of videos from another source can affect the degree to which students are up-to-date on the latest conventions or best practices. In-house development allows for short feedback loops for updating content.
>
> ... If a bootcamp sources information from multiple authors or producers, they have to try and glue the pieces together to create a cogent learning narrative. Bootcamps with in-house curriculum can control the narrative, ensuring that each subject or unit of learning fits well and makes sense in context."[45]

For example, Founders & Coders in London, used Udacity materials to build their courses at the very early stages of the programme. The initial six-week training using these free materials yielded a mixed result which moved the organization away from using external online materials and towards building its own curriculum, which it designed with a team approach. Muzinda in Zimbabwe, on the other hand, uses Treehouse (another online training platform) curriculum adapted to in-person training and so far its experience with this approach appears to be positive.

3.3.3.2 Programming languages taught

Although the range of programming languages currently being taught varies slightly, it is concentrated around web development and mobile app development. Globally, the most popular languages are Ruby on Rails, JavaScript, HTML, CSS, and PHP. Programming for Android, followed by iOS, tops the list of operating systems for which training in mobile app development is offered. This trend resembles closely the trend in the United States and Canada where Ruby on Rails and JavaScript were the two most popular languages taught in coding bootcamps in 2015 (see Figure 13).[46]

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[45]   Quora, 1 June, 2015 https://www.quora.com/What-are-the-downsides-to-programming-bootcamps
[46]   Course Report. 2015 Coding Bootcamp Market Size Study. https://www.coursereport.com/resources/course-report-2015-bootcamp-market-size-study

Figure 13: Most popular programming languages taught in coding bootcamps in United States and Canada

Table 3: Top Teaching Languages
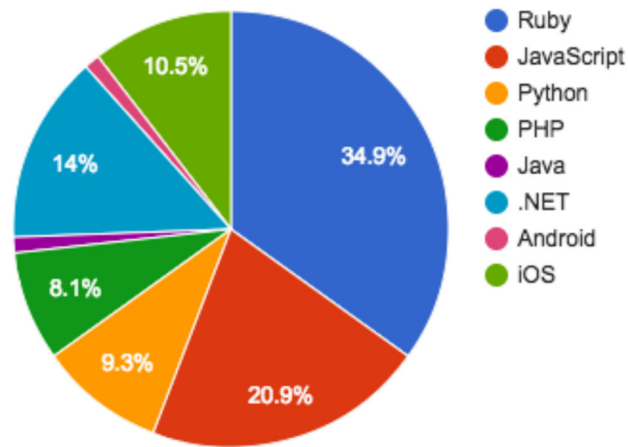
Source: 2015 Coding Bootcamp Survey: https://www.coursereport.com/2015-coding-bootcamp-market-research.pdf

The selection of programming languages offered by each of the providers depends on the industries driving the demand for coders. For example, in Latin America coding bootcamp providers focus their training mostly on web development because it is primarily the digital and online marketing industry driving the demand for these skills. On the other hand, the most popular courses offered by General Assembly in Hong Kong, China are programming skills for data science and data analytics given that the largest proportion of the demand for coders comes from the financial industry.

Each programming language has different uses, as outlined below:

- JavaScript: Web browsers

- Python: multi-purpose

- SQL: databases

- PHP: Web pages

- Ruby: Web pages and websites

- C++: hardware programs, Windows operating systems

Among the providers reviewed, Python, Drupal, WordPress, and languages to manage databases such as MySQL were taught by a handful of bootcamps. None of these organizations have conducted formal market research to assess the coding skills demanded by employers. Instead, founders and trainers at these organizations tap into their own technology networks to identify new technology trends, assess skills needs, and offer the most updated training possible to ensure that the skills taught are in tune with the needs of the market.

Few coding bootcamp providers have full-time instructors; rather programme instructors tend to be technology industry professionals, recruited either on a paid or voluntary basis to teach part-time in their areas of expertise. Some providers such as CodeaLab in Mexico and Desafio LATAM in Mexico, Colombia, and Chile have training programmes for their instructors, to ensure they have adequate teaching skills. The programmes that are peer-led (such as Founders & Coders) recruit mentors from their graduate pool. Across all regions, the recruitment of trainers is one of the most pressing challenges coding bootcamps face. Finding qualified developers to teach the courses is not the problem; the real challenge is finding trainers that possess both programming experience and pedagogical know-how.
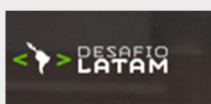
**Mexico, Colombia, & Chile | On why it teaches Ruby on Rails**

Desafio LATAM is a commercial coding bootcamp founded by two tech entrepreneurs in Chile in 2012 which expanded into Mexico and Colombia shortly thereafter. The company grew out of the vision of these entrepreneurs of transforming Latin America from a commodity-based economy to a digital services-based economy. According to one of the founders, the company focuses its training on Ruby on Rails which as a beginner coder language, is more user friendly and has one of the biggest developer communities making it easier to exchange knowledge and consult on errors. Ruby, most importantly, is the most demanded programming language in the Latin American market.

3.3.4   Mode of training (online | in-person | blended)

Length of training period: Although at present, programme length is one of the defining characteristics of coding bootcamps, there are a number of shifts occurring that are beginning to complicate the very definition of a coding bootcamp. The dominant model remains the 10 to 12 week programme. However, especially in developing countries, a variety of more flexible options are emerging to enable part-time or scaled-down participation routes: Part-time programmes spanning longer time periods enable students to get the same training without sacrificing their current employment or other responsibilities. Very short-term programmes (such as mini bootcamps) enable people to dabble to test their aptitude, or focus on acquiring a much more limited set of skills without taking too much time off from work. Longer term programmes (such as the Bootcamp+ model) provide sufficient time for students to acquire more skills.

Training mode: By far the most common mode of training is in-person. Practically every bootcamp programme reviewed, whether traditional, extended, or mini, has at its core an in-person element. This is consistent with the concept of a bootcamp, and some of the providers interviewed in the United States and Europe explained that the intense nature of the training programme requires a level of immersive commitment and focus that is difficult to achieve remotely. They suggest that the ideal scenario is to train in-person. In fact, some training programmes are not only in-person but residential. Examples are KACE-AITI and MEST in Ghana which require students to live on campus for some programmes (MEST provides scholarships for food, lodging, and a stipend).

However, online and blended options have emerged to cater to an increasingly diverse population of interested applicants who cannot commit to full time physical attendance. Some providers, such as SamaSchool in the United States, offer full-time online versions in addition to in-person training. General Assembly and Dev Bootcamp recently launched fully online versions as well. Others offer a blended programme in which some training takes place in person, while other elements can be done remotely. In Kenya for example, SamaSource training follows a blended approach, with a significant in-person component, but incorporating some flex time to work at home or online (e.g. one day of the week dedicated to personal project time that does not require presence at the training site).
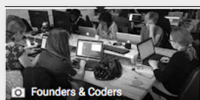
Founders & Coders in UK | A 4-month peer-led coding program

F&C is a non-profit cooperative that provides training on software development for the web teaching of JavaScript in the London area. The four-month training encompasses ten weeks in which students work on weekly projects that increase in complexity as the training progresses. The classroom is organized in teams of four students that work together during the first half of the course. After ten weeks, students start working on a real world project – usually an internal project that the organization is likely to use or that can be shared more broadly as open source. The last four weeks are devoted to work on commercial or semi-commercial projects where students learn how to interact with clients, communicate their ideas, and develop their expertise . Students devote around ten hours a day to their training including class time and homework.

3.3.5   Cost and financing facilities

Programme costs vary widely, with some programmes being free or subsidized. While most of the programmes come with a high price tag (running up to ten thousand dollars or more in some cases) several of the programmes in low and middle income countries are offered at no cost to students. Students may receive conditional or unconditional scholarships to cover programme costs, and there is usually an element of corporate or donor agency sponsorship for the free programmes. Corporate sponsorship often comes with some conditions such as a commitment to work for the sponsor or the bootcamp provider for a period of time after graduation. The range of programme financing options are listed below:

- Student's personal funds

- Free (scholarships for all participants)

- Scholarships for select participants

- Tuition waivers

- Deferred payments – monthly instalments over a two or four-year period

- Discounts for early registration or full payment

- Payment through credit agency partners

- Monthly payments of a percentage of salary to cover cost

- Graduate supports organization's next training sessions - this is most relevant for non-profit organizations

- Graduate receives some money back when they complete a certain portion of the training

- Graduate receives some money back when they get a job

3.3.6   Certification

Bootcamp graduates can usually expect to receive a certificate of participation or attendance from the bootcamp provider. More formal nationally or internationally recognized documentation is rare,

since most bootcamp providers are not accredited as educational institutions.[47] This is largely because of the volatility of the coding industry, which requires constant updating of the training curriculum to respond to industry trends. Lack of a stable curriculum presents a problem for accreditation agencies.

The challenge exists in all regions. However, in some countries there is an additional perceived preference amongst employers for formal high school or university degrees, thought to carry more weight than professional qualifications. In a move to address the certification challenge, several bootcamp providers in the United States have come together to form an association (New Economy Skills Training Association or NESTA) in order to "establish best practices, standards, and increase accountability for outcome-based NESTA organizations".[48]

As the number of coding bootcamps continues to grow and expand in different countries, the issue of certification remains at the forefront. In the context of the United States, the fact that these schools are not accredited as educational institutions limits the ability of prospective students to apply for federal student loans and other government-aid.[49] Nevertheless, the technology sector in the country is transforming its recruiting practices, rendering a certificate less important than a candidate's project portfolio and his or her performance in a programming interview[50] with a company senior developer in the hiring process. Javier Ibarrola, the founder of Codea Lab (www.codealab.mx/) in Mexico, succinctly illustrates the role of certification in the context of the local labour market.

> "Certification is a very controversial issue within the coding industry. The controversy also takes different tones depending of the market. In the United States, companies hiring technology talent have very good recruitment practices reviewing the portfolio of projects for potential candidates and engaging them in a show-and-tell peer programming exercise during the interview. In Mexico, these practices are still in their infancy. At the beginning, we decided not to offer certificates for the training programme but for both students and employers, the certificate is very important so we start offering certificates of completion for our graduates."
> Javier Ibarrola (Interview, 13 October 2015)

While examples of accreditation are limited one can be seen in Australia from the Coder Factory Academy bootcamp. The Australia Government accreditation system is based on the Australian Qualifications framework. This is a very structured approach to competency-based training that revolve around vocational qualifications with specific learning outcomes and discrete elements that make up each individual qualification. Once a bootcamp curriculum is appropriately structured, it can be mapped to an existing vocational qualification. Gaps in the bootcamp curriculum can be filled using existing courseware that has been designed for specific qualifications.

In the Coder Factory Academy case in Australia, the most suitable qualification to map against was the Diploma in Software Development. This qualification consists of 16 subjects (units), some of these subjects mapped neatly across to the curriculum developed for their bootcamp course, however some of the subjects had no clear comparative content. This required the provider to include extra content in their bootcamp course to ensure they covered the learning outcomes in the full diploma qualification. They then had the choice of delivering their own non-accredited course or adhering to

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[47] Schmidt, C. (2015. Coding bootcamps don't need accreditation, so why we are chasing it? LinkedIN Blog. https://www.linkedin.com/pulse/coding-bootcamps-dont-need-accreditation-so-why-chasing-clint-schmidt

[48] www.thenesta.org/

[49] Belkin, D. White House Readies Accreditor for Computer Boot Camps. *The Wall Street Journal*. 6 November, 2015. www.wsj.com/articles/white-house-readies-accreditor-for-computer-boot-camps-1446855579

[50] A programming interview is a technical job interview in the software industry to test candidates' technical knowledge, coding ability, problem solving skills, and creativity about computers. Candidates usually are asked to solve programming problems, algorithms, puzzles, and/or computer related technical questions. https://en.wikipedia.org/wiki/Programming_interview

compliance requirements in order to issue a nationally accredited qualification. Some key changes that were required to deliver the nationally accredited qualification were:

- Creating very clear assessment tools to demonstrate that each subject had been assessed appropriately and that learning outcomes were achieved.

- Partnering with a registered training organization (government approved) in order to adhere to a range of compliance requirements.

- Ensuring structured delivery and assessment plans had been created.

- Ensuring that all trainers held the necessary industry and trainer qualifications.

Ongoing curriculum developments works in two ways. When the bootcamp content is updated, they must ensure that it again maps across to the subjects within the qualification chosen. The actual qualifications content also changes every five years and is driven by industry standards, steering committees, and employer feedback. They must ensure that they use the most current version of the training package and remap changing curriculum to the nationally accredited content. Raman Nambiar, founder of Coder Factory Academy a bootcamp provider in Australia, explains the benefits of accreditation particularly for students.

> "This is a complex undertaking, but the major benefits are that students not only receive quality up-to-date training, but also receive nationally accredited qualification. Often these qualifications (particularly in high-demand industry areas) attract government funding and a variety of student support mechanisms that would otherwise be unavailable. It is up to bootcamp providers to determine if the higher investment in time, costs, and regulatory requirements is worth it for them in the market that they operate within." (Raman Nambiar: interview 22 March, 2016)

3.4   Employment strategies | Employment paths

The employment strategies and extent of job services available for coding bootcamp students depends on the type and primary goal of the programme - ranging from full job services (interview training, project portfolio development, referrals to jobs, etc.) to career fairs and basic mentorship throughout the job hunting process.

Ready-to-Work and Bootcamp+ coding bootcamp programmes usually offer the most comprehensive basket of services to support job searches immediately after graduation from a programme. In some of the programmes profiled under this model, the type of job services available for students is related to the time commitment, length, and mode of instruction. For example, General Assembly in Hong Kong, China offers a more limited set of services for students in their part-time and online programmes, compared to the services available to full time in-person programme graduates.

Mini bootcamps, on the other hand, being more geared towards professional development, building community, and general awareness creation, tend to have none or less integral employment services. All the same, the professional networks they foster can be seen as enhancing employability opportunities for participants.

The basket of employment services available for students includes the following:

Immediate employment

a.   Internal placement in those bootcamps that run their own web development, mobile app development, or other digital services agency, for example: Andela and SamaSource (Kenya) both recruit students specifically with internal placement in mind; Laboratoria (Mexico) and Founders & Coders (United Kingdom) both have this option in the pipeline.

b.   Internships that are built into the actual training programme, for example: xPerience (South Africa) and Ada Developers (United States).

Introduction to potential employers

a.   Connection to potential employers through career fairs, sharing job openings, project demonstration with potential employers, among others.

b.   Marketplace for developers to sell their app products, for example eMobilis (Kenya).

Job hunting skills training and mentorship

a.   Development of project portfolio and CV, and an online platform to share this portfolio. This is perhaps one of the most important employment services coding bootcamp organizations provide for the students. Since the training is not certified, student portfolios become the most obvious channel through which they can showcase their skills and talent.

b.   Mentorship and coaching for interviews and salary negotiation.

c.   Soft skills training (communication and public speaking skills).

3.4.1   Job placement rates

The most important asset coding bootcamp programmes have is the quality of the students they turn out. It is precisely through the quality of junior developers or interns they produce that these organizations gain legitimacy with potential employers. Job placement rates are the most important measure of their success and the most valuable asset to build their brand (this applies to both commercial and non-profit organizations). This is particularly important for Ready-to-Work bootcamps and Bootcamp+ training programmes, and is in part the reason why their admission process is so rigorous and highly selective.

The job placement rates of the organizations profiled range from about 40 per cent to as high as 100 per cent of graduated students finding employment within weeks to a few months of graduation. These numbers, however, can only be considered indicative, since some of the programmes have only recently started operating and therefore have only graduated one class while others have been operating for a longer time period. Another consideration is that this rate is self-reported and organizations may have different ways of measuring the job acquisition rate. For example, it is currently not clear how long after graduation students found a job and if this job is sustained for a certain period of time. Only one of the organizations in the sample mentioned following up on the employment situation of students 30, 60, and 90 days after they completed the programme (Desafío LATAM in Chile, Colombia, and Mexico). As a point of comparison, 66 per cent of coding bootcamp graduates in the United States and Canada found full-time employment in a job requiring skills learned at the bootcamp, according to Course Report (Alumni Outcomes & Demographics Study).

3.4.2   Types of jobs coding bootcamp students obtain

Coding bootcamp programmes profiled in Asia Pacific, Africa, the Americas, and Europe all train students for three types of jobs: 1) Junior web developers; 2) Entrepreneurs – either working freelance or establishing a start-up; and 3) Interns and Apprentices. There is limited information available regarding the length of employment in these positions, type of contracts, and salary levels. The type of jobs acquired in these regions are similar to the jobs secured by graduates from bootcamps in the United States and Canada, with the exception of developers (a higher level than junior developers), a position not mentioned by any of the organizations in the sample.

In very general terms, all coding bootcamps profiled target the local technology industry and/or international companies with coding-related outsourcing needs. The founders and trainers at these programming schools have very strong connections to the technology industry or are themselves insiders in the technology industry. The importance of these connections extends beyond the employment opportunities they proffer. Through these connections, coding bootcamp providers can also assess the skills demanded in the market, as well as future trends in programming languages.

3.5   Partnerships

Institutional partnerships are a common feature in the coding bootcamp training industry. They include partnerships with potential employers, governmental and non-governmental agencies, credit companies, and other educational institutions. These relationships serve a variety of purposes depending on the organizations involved. Unsurprisingly, the dominant partnerships are with potential employers and funding organizations.

1. Potential employers: All the providers reviewed have or are trying to build partnerships with organizations that could hire their graduates. In some cases, these are formal relationships providing guaranteed employment for programme graduates, but the majority appear to be based on more informal networks through which training providers try to line up employment opportunities for their students. A variation of potential employer partnerships is where the partners are essentially clients of other branches of the bootcamp providers' operations that offer web development and other IT-related services on a commercial basis. Graduates are hired internally to service those clients. Moringa School and Laboratoria both indicated that they have about 30 hiring partners. Andela graduates are assured of four years of employment working on jobs for Andela clients.

2. Funding organizations: Training providers that offer scholarships or other forms of financial aid to students invariably have established sponsorship-related partnerships with local or international not-for-profit organizations, social enterprises, and commercial entities. The forms of sponsorship identified include scholarships to cover tuition and/or other student expenses, sponsorship of outreach events such as workshops or hackathons, or providing other in-kind support such as office space, equipment and access to software packages or educational platforms.

Generation **Spain | A social initiative partners with a commercial bootcamp**

Generation is the first program of McKinsey's Social Initiative designed to improve the skills gaps and employment prospects of youth in different countries in the world. Currently, the program offers a variety of job-ready training programs in Kenya, India, Mexico, Spain, and the United States. Generation Spain focuses its training on programming skills. Partnering with Iron Hack, one of the leading commercial coding bootcamps in Spain, Generation sponsored 100 students to enroll in a one-month programming class in digital marketing in Madrid and Barcelona from which 90% of the graduates found a job. Currently, Generation is working towards expanding the program to enroll 500 students in January in different cities of the country.

3. Credit Agencies: Some bootcamp providers have arrangements with one or more lending companies to provide low-interest credit to students. For example, Moringa School in Kenya partners with These Numbers Have Faces to secure low-interest loans for students. After they are employed they repay the loan within one year.

4. Other educational institutions: Partnerships may be built with other educational institutions (e.g. other bootcamps, tertiary institutions, training platforms) to run programmes jointly, for access to established training materials and platforms and/or for accreditation of programmes. In Latin America, for instance, Laboratoria partners with CodeaLab to fund two students to take CodeaLab coding training, while Desafio LATAM has a similar partnership with the Universidad de la Frontera y San Sebastian. In Africa, Tech Learn on the other hand is planning to license its curriculum to other bootcamp providers, and eMobilis has partnered with the University of

Nairobi, School of Computing Science to make key consumer insights and research from the university available to eMobilis students. In Ghana, KACE-AITI uses training materials from a host of other universities[51].

5. <u>National and international governmental agencies:</u> National partnerships are rarer and seem to be a primary challenge for the smaller bootcamp operators in particular. Partnerships with governmental agencies typically take the form of obtaining accreditation to be recognized as a training institution or for particular course. A different type of arrangement was described by Desafio LATAM, where the organization is in talks to obtain support from a government agency that provides support to local companies to expand their businesses to international markets. International organizations, including political and economic frameworks such as the EU and the World Bank, have also provided funds for various IT training initiatives, some in partnership with bootcamp providers.

Liberia | Partnership with WeTech to increase women's participation

iLab is a non-profit computer laboratory providing training, events and meet-up spaces for a variety of people interested in technology. Facing low participation of women in their trainings, the organization partnered with Women Enhancing Technology (WeTEch) a consortium of partners led by the [Institute of International Education,](#) designed to help women and girls succeed in technology careers, and Google. Through these partnerships and grants, iLab raised funds to help bring more women into its programs seeing a dramatic shift in their participation. In the social media course, for example, the effect was immediate and women's participation almost doubled compared to the previous cohort. The organization has also successfully used the grants to design a coding workshop on Python for girls.

3.6   Challenges in the coding bootcamp industry

As a nascent development, the coding bootcamp industry faces several challenges. These are related to the ability of providers to offer strong programmes, perceptions of their value for employability, as well as the ability of their target populations to participate in programmes.

Challenges related to provider operations

<u>Funding:</u> Providers lack the financial resources to design bootcamp programmes, recruit participants, run programmes and provide post-programme support, especially for the volume and socio-economic status of people they are aiming to train. As observed in the larger programmes in the United States and elsewhere, tuition fees can be very high; in developing economies this means that providers need to find significant scholarship and other sponsorship resources to enable low-income populations to benefit from the training.

<u>Accreditation:</u> Bootcamp providers have to deal with accreditation challenges in both advanced and developing economies. In advanced economies, with the exception of Australia where bootcamp accreditation efforts are currently underway, due to the constant updating of their curriculum to respond to industry trends it is difficult for providers to obtain accreditation for their programmes. In developing economies, higher value tends to be placed on traditional qualifications such as university degrees. This makes it challenging for bootcamp programmes to gain the recognition they might

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[51]   http://videolectures.net/academia/

merit, and also for graduates to have their training accepted by employers who rely on certificates as evidence of skill acquisition.

Lack of support from government and other potential stakeholders: While most countries have shown commitment to developing a skilled labour force, the majority of initiatives seem to place a higher emphasis on general entrepreneurial training than on the type of specific coding training that bootcamps provide.

Misperceptions among different stakeholders: Government, employers, international organizations, and other institutions do not have a complete understanding of the different coding bootcamp models and the learning and employment outcomes that could be achieved through each model. Each coding bootcamp model plays a different role in the employability path for youth (e.g. raising awareness versus introduction to programming or acquisition of work-ready skills). Therefore any employment strategy based on coding bootcamps should recognize these roles and develop policy and project approaches accordingly.

Challenges related to student participation and performance

Unfamiliarity of bootcamp concept among students: The need for discipline and personal responsibility for learning associated with coding bootcamps is quite different from the educational experience that students in these regions are more familiar with (especially people with already limited educational background). The high stress and intensive nature of these programmes may also be difficult for some individuals to handle.

Low basic IT skill levels: Low-income underserved populations tend to also have varying but generally low levels of basic computing skills. This means an initial layer of preparatory training is needed before students could be ready for even basic coding skills training at the bootcamp pace. Less coding-intensive skills such as those needed for typical BPO outsourcing jobs are not as vulnerable to this challenge.

Time commitment of bootcamps: Due to the intensive and immersive nature of bootcamp programmes a lot of potential participants are probably unable to sign up because they cannot take the amount of time away from work or family obligations.

Location of bootcamp premises: Related to the intensity challenge, bootcamp training tends to be in-person with the training premises being located in urban centers. Potential and actual participants face transportation and general distance-related challenges.

Gender stereotypes: In most economies, there is still a strong tendency for programming in particular (and work in the IT sector in general) to be seen as a male profession. Added to the expectation that women focus on domestic rather than formal employment, gender stereotyping is a significant barrier to women developing an interest in coding skills, as well as to them getting family support if they want to participate in bootcamp programmes.

Challenging home or community environments: A variety of factors such as poor Internet, infrastructure, lack of access to technology at home, violence, and lack of family support can make it difficult for students to be successful in bootcamp programmes even if they have the aptitude.

3.7   Summary

This chapter has presented four different models of coding bootcamps, and described some characteristics of their operations. While the origins of the coding bootcamp lie in the United States, this model of rapid skills training is quickly spreading to developing countries in Africa, Asia Pacific, and Latin America. Highlighting some of the bootcamp provider organizations in these areas showcases the innovative ways in which the concept is being adapted to serve local context and needs. Success stories such as the college graduate who found a well-paying job after completing a coding bootcamp

programme noted in chapter 1 abound in places like the United States and Canada where coding bootcamps have quickly grown over the past four years. Indications are that coding bootcamps in developing countries have the potential to deliver similar success stories, although several challenges remain to be addressed for such results to be experienced on a large scale.

In the next chapter, some recommendations and considerations are offered for governments, international agencies and other stakeholders to consider if investing in coding bootcamps for the employability sphere.

4   Conclusion and recommendations

Setting aside some degree of hype, there is significant demand for IT professionals with practical web and mobile app coding skills. It is also clear that the formal educational system in most countries is not turning out graduates with the level of practical readiness that employers are looking for in coders, and that bootcamps as practical training grounds are filling this gap. Still, much is being said and projected, while relatively little is known with reasonable certainty. This is a space to watch and to explore in order to make informed ventures into the arena.

There are also some important considerations to bear in mind when discussing this training model as a strategy to address youth unemployment:

1. **The coding skills shortage is predicted to run through at least 2020:** As discussed in chapter 2, the skills shortage is projected to persist at least until 2020. Moreover, if the scale of the shortfall is as large as indicated (running into hundreds of thousands), then there is plenty of opportunity to make a significant impact on unemployment by using the bootcamp approach to equip the youth of today with job-relevant skills to fill the shortfall. Furthermore, as the speed of technological change accelerates it will be important to be prepared for associated changes in workforce needs – any strategies employed should incorporate opportunities for lifelong learning (such as those provided in the Bootcamp+ model) to enable workers keep pace as well as to facilitate sustainability of the livelihoods secured after graduation.

2. **Coding bootcamps will vary in career outcomes depending on length, training format and content:** This is perhaps one of the most important distinctions that must be considered in any strategy that is built on this form of training. Full- and part-time in-person immersive programmes lasting a minimum of three to six months usually offer the opportunity to learn the most solid set of skills and provide more comprehensive employment and career services than online options; therefore these are more relevant as a youth employment strategy. Mini-bootcamps, coding workshops, and hackathons are viable options for raising awareness and interest in coding skills and nourishing a community, but are not designed to prepare participants for the work force and should not be considered as employment strategies if not complemented by further training. Extended models prepare more rounded graduates but require greater investment in time and financial inputs. Furthermore, it seems much of the success of these programmes stems from the quality of training, which is more manageable in smaller groups, and likely harder to manage at scale.

3. **The concept of a bootcamp needs to be scoped appropriately based on the target population:** Bootcamps must be conceptualized with the employment situation of the different types of youth in mind. The typical full-time immersive three-month programme may work as a training-to-employment alternative for a segment of youth whose socio-economic conditions enables them to stop working and participate in the programme. For other youth, and especially for women, who in addition to working for an income share responsibilities as homemakers, such intensive programmes may not be feasible. A part-time less immersive programme may be a better option for them.

4. **Bootcamp success designed to prepare youth to work in the domestic market often hinges on existence of a strong technology ecosystem**: A successful IT-employment generation environment depends to a large extent on the existence of certain conditions that enable a strong technology ecosystem to emerge. Following Adomavicius, Bockstedt, Gupta and Kauffman's conceptualization, a technology ecosystem is "the interrelated set of technologies and forces (especially social and technical forces) that may impact innovation, development, and adoption."[52] A recent study by the Washington Technology Industry Association attributes the high demand for coders in the state to the siting of technology giants such as Microsoft and Amazon, as well as "a vibrant start-up ecosystem" (i.e. numerous small technology start-ups - over 8 600) in the ICT industry.[53] Strategies should differentiate the potential of regions and countries within regions to become technology hubs or new Silicon Valleys that would generate the demand for technology talent.

5. **Linked to technology ecosystems, bootcamps are currently mainly found in urban settings.** To date, it would appear that urban environments may be more conducive for the development and growth of a technology ecosystem, as well as having the appropriate telecommunication infrastructure to support coding bootcamp programmes. This is a trend to watch as rural and peri-urban connectivity further develops, allowing for distance coding work.

6. **Coding bootcamp training is disruptive in that it competes with university or self-directed online courses.** Because the coding the bootcamp learning experience is different from existing models, it may be seen as disruptive, generataing resistance from more traditional learning providers which may play out in challenges to accreditation or licensing. These challenges may be overcome if the success of its training methodology and benefits to employers facing skills shortfalls can be well documented.

Notwithstanding the above considerations, coding bootcamps appear to be promising in helping young people gain access to better employment. Even if the numbers are small at present, there is a palpable opportunity for more and more people to be trained for new, relatively high-paying jobs. What can vested interests do in this space? There are three broad areas in which national or international actors can contribute to developments in the bootcamp landscape: *knowledge*, *relationships*, and *implementation*. In essence, the key to appropriately exploiting the coding bootcamp trend is to understand it, foster opportunities and test it.

Knowledge

<u>Raise awareness about current trends in coding bootcamps:</u> There is currently both a lack of awareness of coding bootcamp models, in particular the Ready-to-Work model, as well as a lack of clarity on terminology. For example, lack of awareness on the need to link Ready-to-Work models with the technology ecosystem in urban environments as well as the need to adapt curriculum to industry needs could jeopardize employment outcomes. And even where decision-makers may be familiar with the term "coding bootcamp," the flexible use of terminology often leads to mis-conceptions about coding bootcamps. For example, referencing awareness-raising models, including mini bootcamps and hackathons as "coding bootcamps" may cause confusion when the same term is used to refer to Ready-to-Work models.

This report is designed to raise awareness among decision-makers on this new trend and on the opportunities it may provide to promote youth employment. It also aims to explain the difference between the coding bootcamp models currently available, to provide clarity on which of these models are more appropriate for promoting employment and the environments in which they are most likely

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52 Adomavicius, G., Bockstedt, J. C., Gupta, A., & Kauffman, R. J. (2004). An ecosystem model of technology evolution: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.519.7117&rep=rep1&type=pdf

53 Schutzler, M. (16 March, 2015). Washington's information and communication tech (ICT) companies creates jobs faster than any other industry—and WTIA has the analysis to prove it. GeekWire. http://washingtontechnology.org/washingtons-information-and-communication-tech-ict-companies-creates-jobs-faster-than-any-other-industry-and-wtia-has-the-analysis-to-prove-it/

to succeed. It takes a step forward in clarifying the characteristics and main purposes of each model. Further research and analysis in this regard will be important to inform decision makers and ensure that the most suitable models are used to achieve the desired results.

Cut through the hype: In view of the apparent potential but mostly unsubstantiated and/or unverified claims about the employment outcomes of coding bootcamp training, and the absence of much empirical data on this phenomenon, the field needs more thorough examination by neutral parties. Outstanding questions include: *What conditions support the emergence of a coding bootcamp industry? Do coding bootcamps lead to decent work?*[54] *Who benefits and who is excluded from the opportunities offered by coding bootcamps?* While the touted benefits may be true, more insights will lead to better informed decisions about if and how to apply this as a solution to the youth unemployment problem.

Options for advancing knowledge include:

i.   Actively monitor developments in the industry.

ii.   Commission in-depth studies of the current coding bootcamp industry, the associated technology ecosystems and career outcomes.

iii.   Run experiments with new initiatives (see Implementation discussion above).

Academia has an important role to play in monitoring developments, while governments could both establish mechanisms to monitor employment outcomes and fund implementation exercises.

Relationships

Foster opportunity: The path from coding bootcamp training to some form of employment is highly dependent on the nature of relationships between training providers and employers. Again assuming that there is indeed a glut of coding jobs waiting for suitable coders, a sure-fire approach to filling this gap is creating the conditions for supply to meet demand. This should include addressing demand, supply, and the policy environment as well. Opportunity-generating relationships could be sought with existing coding bootcamp providers, employers, educational institutions, and governing bodies (local, regional, and national). For example:

i.   Leverage existing training stakeholders to:

• identify organizations that need coders and foster links between them and existing and new providers;

• produce instructors to teach relevant coding courses;

• provide bootcamp-style coding training;

• lobby for policies to promote acceptance of coding bootcamp credentials.

ii.   Partner with traditional and non-traditional educational institutions. While there has been a lot of criticism of the practical readiness of computer science graduates for coding jobs, formal tertiary education does play a role in the development of a country's workforce. This includes certain deeper elements of preparation that traditional bootcamps cannot address due to their intensive and compressed structure (such as general critical thinking, entrepreneurial, and other life skills). Coding bootcamps and existing educational institutions could complement each other's efforts. Collaboration can take a variety of forms including:

• pooling resources with educational institutions to run coding bootcamps for their students during vacation periods;

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54   ILO, Decent work agenda: www.ilo.org/global/about-the-ilo/decent-work-agenda/lang--en/index.htm

- encouraging and facilitating partnerships between coding bootcamp providers and educational institutions for certification as well as sharing of complementary knowledge and resources;

- exploring the potential for coding bootcamp providers to extend training to less privileged students and/or students who need a longer learning curve.

iii.   Explore the potential of building organizational and national policy-oriented alliances similar to NESTA (New Economy Skills Trade Association- a trade association for bootcamps currently aiming to establish a standard for publishing bootcamp completion and employment outcomes verified by third parties) and the TechHire Initiative (a United States government initiative seeking to facilitate the technology ecosystem through multi-sector activities). Many governments may have agencies responsible for developing the software or business process outsourcing (BPO) industry or technology innovation ecosystems that could foster such alliances to collect and publish verified data on job placement for coding bootcamp graduates as well as establish accreditation or certification criteria for coding bootcamps. Accreditation and certification is often needed both for job placement as well as funding for scholarships.

iv.   Collaborate with intermediary organizations (such as cybercafés, libraries, telecentres, co-working spaces, technology hubs, incubators, and other community-based organizations) that facilitate access to the technological tools needed to participate in the digital economy. Some of these organizations may exist primarily to enhance computer and Internet access or to support entrepreneurs, but could also facilitate access to online bootcamp training courses, provide digital literacy or other foundational training to meet prerequisites for acceptance into coding bootcamp programmes, or even extend their services to the actual provision of training bootcamps. They could also be avenues for publicizing training events and counselling potential students/jobseekers. In view of the limited access to Internet resources in many communities, partnerships with intermediaries could go a long way to increase the chances of reaching the talent residing in more disadvantaged populations.

v.   Collaborate with organizations dedicated to women in ICT or technology as in iv above, with a special focus on providing training, including coding bootcamp programmes or publicizing existing coding bootcamps among young women. Many of these organizations are listed on the ITU Girls in ICT Portal at www.itu.int.girlsinict.org/.

vi.   Raise awareness on available platforms where people can explore their interest and aptitude for coding such as Code Academy, Treehouse or coding MOOCs.

Implementation

Test and invest: The newness of the bootcamp phenomenon provides an opportunity for some experimentation to test the appropriateness and scalability of coding bootcamp training for youth and women in developing countries. For example, the four training models identified in this study (Ready-to-Work, Bootcamp-+, Mini Bootcamps, and Early Education) each have strengths and limitations, but it is too early to be certain of the extent of each model's suitability for the particular environments and employment goals in developing countries (although there is some indication that the bootcamp-plus model may be emerging primarily in African countries). With the rapid timeframes for mini and Ready-to-Work bootcamps, it should be possible to assess results in a relatively short time span, while evaluating the outcomes of bootcamp-plus and early education models implies a longer timeline (depending on the age of the programmes being assessed). Based on the results, decisions about scaling up and/or sustaining implementation can then be made. Approaches to implementation could include:

i.   Leverage existing training structures to design and run experimental coding bootcamp programmes tailored to the local contexts. Aspects that could be tested through practice include different approaches or models, different types of public/private sector relationships, and different types of support facilities for bootcamp students. To support stakeholders interested

in developing coding bootcamps, ITU has developed curriculum on coding bootcamp methods, management and training.[55]

ii.   Form alliances with individual or groups of existing coding bootcamp providers to:

a.   Run coding bootcamp programmes in specified locations. Working in this manner with existing providers will depend on their interest and capacity. Based on our interviews, it would seem that the larger providers in North America and Europe have no immediate interest in setting up bootcamp training in developing countries, unless the financial and organizational resources for this are provided by some other party. Existing providers in developing countries on the other hand, are fairly small outfits and may lack the capacity to handle large programmes. Therefore, the approach and resources required to work with either of type of provider will differ.

b.   Gain access to training curriculum and approaches to training. One area where new development is arguably unnecessary is in the development of curriculum, considering the vast range of resources (both proprietary and free) available through existing programmes and platforms. However, it may be necessary to test different curricula to determine if any localization is needed, and/or if any are particularly suited to the implementing entity goals.

Conclusion

Addressing high unemployment, especially among youth and women, is a priority in many nations of the world. It is imperative that policymakers and other stakeholders explore every avenue—including emergent opportunities such as the bootcamp model—to mitigate this condition and improve the earning prospects of youth worldwide. With adequate understanding of the bootcamp phenomenon, informed decisions can be made about their relevance to the expansion of decent work opportunities, and what it would take to make the most of their potential.

Glossary

API	Application program interface
ICT	Information and communication technologies
ILO	International Labour Organization
ITU	International Telecommunication Union
NESTA	New economy skills training association
MOOCs	Massive open online courses
OECD	Organization for Economic Cooperation and Development
STEM	Science, technology, engineering, or math-related
UX	User experience
UI	User interface

Key Definitions

Employability	"Employability is commonly defined as the combination of factors and processes that enable people to progress toward employment, to remain employed, and/or to advance in the workplace." Garrido, et. al (2012, p.19)

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[55]   For more information, contact ITU.SpecialInitiativesBDT@itu.int.

| ICT jobs | "… jobs, which are directly created through the production of ICT and through the intensive use of ICT." (p.8) "the ICT sector creates ICT jobs for specialists who produce ICT, and ICT-intensive users who consume ICT." Raja et al. (2013, p.8-9) |
| ICT-enabled work | "arises from how ICTs as tools are empowering workers by making labor markets more transparent, innovative, and inclusive…. ICTs have also been creating new forms of work, including microwork." Raja et al (2013, p.8-9) |

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Appendix A: Methodology

The analysis of the coding bootcamp landscape in the Africa, Asia, and Latin America is based on extensive desk research and on22 interviews conducted with providers that agreed to participate in the project. A total of 40 organizations were documented during this research effort (See Appendix B for the list of bootcamp providers). Coding bootcamp providers were selected mainly based on their availability in low- and middle-income countries and where information was available in English or Spanish. The depth of information available for each provider varies depending on the degree of information provided in interviews or accessible via desk research. The research also included some providers in the United States and Europe to gain a deeper understanding of the differences in the evolution of the bootcamp models in developing countries.

For the purpose of this research, coding bootcamps are defined as: Intensive, accelerated in-person training programmes that teach beginner programming skills such as web development, mobile application development, data science, digital marketing, among other digital skills, with instruction times lasting an average of ten weeks or more. These training programmes are usually full-time and the vast majority also offer some form of employment services that can range from basic job fairs to career services that include portfolio development, interview preparation, and access to an extended network of employers for their students.

Table A: List of coding bootcamp providers included in the research

Name	Region	Country(ies)	Business Model
Moringa School	Africa	Kenya	Commercial
iXPerience	Africa	South Africa	Commercial
Akirachix	Africa	Kenya	NFP[1]
Meltwater Entrepreneurial School of Technology (MEST)	Africa	Ghana, Nigeria, Kenya	NFP
KACE-AITI	Africa	Ghana	Commercial
Muzinda	Africa	Zimbabwe	NFP?
africacodeweek	Africa	Benin, Botswana, Cameroon, Egypt, Ethiopia, Ivory Coast, Ghana, Kenya, Madagascar, Morocco, Nigeria, Rwanda, Senegal, South Africa, Togo, Tunisia and Uganda	NFP
eMobilis	Africa	Kenya	Commercial
MIT Global Start up	Africa	United States	N/A
iLab Liberia	Africa	Liberia	Mixed
IT Varsity	Africa	South Africa	Commercial
The Dev School	Africa	Kenya	commercial
CodeX	Africa	South Africa	Commercial
WeThinkCode__	Africa	South Africa	Commercial
General Assembly Hong Kong	Asia-Pacific	Hong Kong, China	Commercial
Coding is the New Literacy	Asia-Pacific	India	Commercial

Name	Region	Country(ies)	Business Model
Ace Hacker	Asia-Pacific	India	Commercial
Island Techies	Asia-Pacific	Philippines	NFP
GeekSkool	Asia-Pacific	India	Commercial
Usbong	Asia-Pacific	Philippines	Social enterprise
DevCon	Asia-Pacific	Philippines	NFP
Simplon Romania	Europe; Americas	Canada, France, Romania	Commercial
Code to Change	Europe	Netherlands	NFP
Founders & Coders	Europe	London	NFP Cooperative
McKinsey Generation Initiative Spain	Europe	Spain	Private Social Initiative
Iron Hack	Europe; Americas	Spain, United States	Commercial
Laboratoria	Americas	Mexico, Peru	NFP
Desafio LATAM	Americas	Chile, Colombia, and Mexico	Commercial
CodeaLab	Americas	Mexico	Commercial
World Tech Makers	Americas	Brazil, Colombia, Chile	Commercial
Epic Queen	Americas	Mexico (and now in five LATAM countries), Spain, United States,	NFP
progam.ar	Americas	Argentina	n/a
Acamica	Americas	Argentina	n/a
Andela	Americas; Africa	Nigeria (Lagos), United States	Mixed
Samasource Samaschool	Africa; Americas	Kenya, United States	NFP
Learn Tech Labs	Americas	United States (San Francisco. Plans to expand operations to Philippines and India)	Commercial
Ada Developers Academy	Americas	United States (Seattle)	NFP
General Assembly Seattle	Americas	United States (Seattle)	Commercial
Galvanize Seattle	Americas	United States (Seattle)	Commercial

Appendix B: Interview protocol coding bootcamp providers

Name of Provider:

Name of Interviewee:

Position:

Contact information:

Geographical Market:

Year in operation:

Date of Interview:

History of bootcamp training company/organization (how did it start, vision, etc.):

I. Characteristics of training model(s)

- Admission process:
- Target Group (gender, age, education, professional background):
- Percentage of women in cohorts:
- Training offerings (types):
- Why these offerings? (based on employer needs assessment, popularity among students, other)
- Selection process for curriculum(s) (development, content updates attending to changing market needs)
- Modes of delivery (online/offline/blended):
- Reasons for selected delivery method(s):
- Length of instruction:
- Recruitment and training of trainers:
- Frequency of updates (types of offerings, curriculum, etc.)
- Cost and payment methods (student pays all, employers pay for hired, employer pays for near hires, students pay back after getting a job, other)
- Financial aid available for students (type and funding mechanism)
- Certification (availability and type/s):

II. Employment path for students

- Job placement services offered:
- Job placement rates:
- Types of job students generally get (level, salary, contractual/fixed):

III. Employer needs assessment

- Main coding/skills needs in the market(s) where provider works:
- How is the demand assessed? (in partnership with companies, based on student demand, other?):
- Main industries targeted by provider/students for job placement:
- Frequency of employer coding skills needs assessment:

IV.   Partnerships

- Who are the partners (tech companies, government, NGOs, universities, others):

- Nature of partnership by type of partner (recruitment, promotion of courses, awareness, etc.):

- Existing partnerships with International Governmental Organizations (UN, ITU, EU Commission, World Bank, other):

- If YES, nature and lenght of partnership:

- If NO, interest in developing this kind of partnerships:

V.   Perception of benefits and challenges of this kind of training for increasing youth and women employability in market(s) where present

- Benefits:

- Challenges:

VI.   Interest in expanding training to developing countries if not currently providing in these settings.

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