CODING BOOTCAMPS

Building Future-Proof Skills through Rapid Skills Training

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AUTHORS AND ACKNOWLEDGMENTS

This note forms part of the Rapid Technology Skills Technical Assistance ("Decoding Bootcamps") initiative by the World Bank, which aims to collect and share examples and lessons of bootcamps in emerging markets, and measure the impact of bootcamp training on youth employment in selected countries.

The program seeks to establish a framework of best practice for future projects in technology upskilling in the developing world. The initiative has been piloted in three countries: Colombia, Kenya, and Lebanon. It includes this information note, which offers background on coding bootcamps, as well as a forthcoming publication on the impact evaluation and a policy guide. This initiative would not have been possible without the award of a grant from the World Bank's Jobs Umbrella Trust Fund, which is supported by the United Kingdom's Department for International Development, and the governments of Norway, Germany, Austria, the Austrian Development Agency (ADA), and the Swedish Development Agency (SIDA).

This note is based on desk research and interviews with six bootcamp providers operating in East Africa, Latin America, the Middle East, and the United States. It is meant to be noncomprehensive and informational with the objective of sparking further discussion and research on this topic.

Victor Mulas and Cecilia Paradi-Guilford, who lead the Decoding Bootcamps initiative, are the main authors of this report together with Elene Allende Letona and Zhenia Viatchaninova Dalphond. Yegana Baghirova, Martha Khomyn and Scott Henry contributed to this report through research and analysis of the case studies. The report was edited by Colin Blackman (Camford Associates) and designed by Jimena Vazquez. Ruta N (Medellín City Government) and the Secretaria de Juventud (Youth Secretary) of Medellín City are critical partners for this program and contributed to this note. The following partners and bootcamp providers also participated in this activity and provided critical information for the completion of the report: Berytech, CodeRise, HackReactor, iHub Research, Laboratoria, the Moringa School, SE Factory, and WorldTechMakers.

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EXECUTIVE SUMMARY

Technology-led transformation (the so-called "Fourth Industrial Revolution") has significant implications for the world economy. As the technologies that are enabling this economic transformation are improving in functionality and becoming more accessible and affordable, a number of job functions are increasingly susceptible to automation and digitization.

As one of the agents of disruption propelled by the tech-led economic transformation, start-ups adapt technologies to create new business models and, in some instances, entirely new business categories. In the long run, this results in creative destruction, where new jobs (as this business category did not exist before) are created and old ones are ultimately substituted or transformed, affecting the whole economic sector in question. Since technology trends are not stoppable, there is a growing focus on the generation of new sources of employment.

As start-ups grow and scale, they also need more workers with basic skills to expand the activities initiated by the core group of founders and initial workers. Basic tech skills (for example, website development, app development, and so on) can be acquired through short-term intensive training in tech skills. This has led to the emergence of a new kind of technical training: coding bootcamps. These are typically short-term (three to six months), intensive and applied training courses provided by a third party that crowdsources the demand for low-skills tech talent.

Coding bootcamps are not restricted to advanced economies; they have become a global phenomenon being present in emerging economies with active start-up ecosystems. Furthermore, they are expanding beyond the ICT sector to other key priority areas such as manufacturing. Given their role in the creation of low-entry tech job function skills (for example, junior developer), a better understanding of how bootcamps operate and their potential to benefit low-skill, low-income populations is critical for those policy makers who are seeking to increase employment opportunities, particularly new and better employment, in their economies.

"Bootcamp" is a broad term and is used to refer to one or two-day coding workshops through to structured programs of three to six months. This study focuses on the structured programs, which we refer as "coding bootcamps," as these are aimed at training students for employment in low-entry level tech positions.

The main characteristics of these coding bootcamps are:

1. They are intensive rapid skills training programs with a competitive selection process, typically lasting no more than six months.
2. Their teaching method follows a project-based, experiential learning approach.
3. Their curricula reflect current industry needs, with teaching subjects adapted according to local demand.

Typically, coding bootcamps aim to rapidly improve the tech skills of their students to enable them to find jobs upon graduation. Therefore, in many cases, a strong career development focus is part of the curriculum; it increases employability prospects upon program completion. Coding bootcamps also have their differences, including the skills level of the participants, content, business models, employment outcomes, and so forth. Bootcamps' business models can be based on a for-profit or nonprofit model. Fee structures vary according to the employment goals, target beneficiaries and business model. Some coding bootcamps focus exclusively on teaching specific technical skills, whereas some also have coursework covering socioemotional skills, such as business communication, time management, problem solving, or teamwork. The technical content of coding bootcamps is usually based on international best practice (for example, internationally acclaimed proprietary and free online courses, video tutorials, Massive Open Online Courses/MOOCs, and so on), but with customization based on local tech industry needs and characteristics of local culture. Socioemotional skills seem to be most extensively covered by those bootcamps that cater to marginalized populations, such as women, disenfranchised youth, and the poor.

The focus of this study is the Ready-to-Work model (hereafter synonymous with the term "coding bootcamp"). This is the standalone model that provides tech skills through short-term training akin to rapid vocational skills training aimed at low-entry level tech employability (for example, junior developer). The report includes five case studies of coding bootcamps: Hack Reactor (United States), Laboratoria (Peru), Moringa School (Kenya), SE Factory (Lebanon), and World Tech Makers (Colombia); complemented by an early education tech skills training program aimed at high school students: Coderise (Colombia).

From the case studies, there are two factors that seem to exert a major influence over employment outcomes:
1. selection criteria, and 2. extent of links with the local tech ecosystem.

Graduates have higher employment prospects when the bootcamp in which they have participated has a wider network of contacts in the private sector and offers greater exposure to prospective employers, for instance, through competitions or networking sessions.

High employability and employment rates in low-entry tech positions (for example, junior developer, freelancer, and so on) reported by coding bootcamps suggest an untapped potential of this form of rapid tech skills training. However, there is also criticism around bootcamp programs, which have been grounded in three key arguments: quality of programming skills, employability, and "short termism." Early evidence, which is based on a limited number of sources and mostly based on the data from bootcamp providers themselves, calls for additional, more representative, and holistic research.

The private sector alone is unlikely to tackle structural unemployment issues and the related lack of technology skills. Existence of a variety of business models of coding bootcamp attest to the fact that there is a niche to be filled by the public sector, civil society, and international donors, particularly with regard to inclusion of the underprivileged population and those with lower skills. Examples of public intervention include the Tech-Hire Initiative in the United States, or the case of Medellin in Colombia.

ABBREVIATIONS

AJAX	Asynchronous JavaScript and XML
API	Application programming interface
BPO	Business process outsourcing
CEO	Chief executive officer
CIRR	Council on Integrity in Results Reporting
CSS	Cascading Style Sheets
CTO	Chief technology officer
DOM	Document Object Model
EPM	Empresas Públicas de Medellín (Medellín Public Enterprises)
EU	European Union
HTML	HyperText Markup Language
HTTP	Hypertext Transfer Protocol
IADB	Inter-American Development Bank
IDE	Integrated development environment
iOS	iPhone operating system
IT	Information technology
ITU	International Telecommunication Union
JS	JavaScript
JSON	JavaScript Object Notation
LAMP	Linux, Apache, MySQL and PHP
M&E	Monitoring and evaluation
MNC	Multinational company
MOOC	Massive Open Online Course
MVC	Model-view-controller
MySQL	My Structured Query Language
NBC	U.S. National Broadcasting Company
NGO	Nongovernmental organization
npm	Node package manager
NYC	New York City
ORM	Object relational mapping
PHP	Hypertext Preprocessor (originally personal home page)
RCT	Randomized controlled trial
REST	Representational state transfer
Sass	Syntactically awesome style sheets
SME	Small and medium enterprise
SSOM	Standard student outcomes methodology
STEM	Science, technology, engineering and mathematics
UI	User interface
UX	User experience
VPS	Virtual private server
SQL	Structured Query Language
WTM	World Tech Makers

All dollar amounts are U.S. dollars unless otherwise indicated.

INTRODUCTION

This report provides an overview of coding bootcamps with a focus on emerging economies. It provides practical examples of how these coding bootcamps are being implemented in developing countries and their connection to entrepreneurial ecosystems and new tech-related job opportunities.

As rapid tech skills training programs, coding bootcamps are relevant to World Bank operations. Bootcamp programs focus on providing new tech-related skills for entry-level tech positions for the population without the need for tertiary education. The creation of these entry-level skills complements and connects with current programs and operations to support digital entrepreneurship and tech startup ecosystems more broadly, such as infoDev's mLabs and pan-Africa accelerator programs, as well as operations, such as the Kenya Industry and Entrepreneurship Project, which aims at, among other things, strengthening the local entrepreneurship and innovation ecosystem.

Entrepreneurship and innovation ecosystems create new companies, which in turn generate new employment opportunities. Digital and tech have been a driver of these ecosystems. Coding bootcamps provide an additional layer of support for developing country populations to obtain tech skills and prepare for these new tech-related job opportunities. For this reason, the Innovation and Entrepreneurship Unit of the Trade and Competitiveness Practice at the World Bank has been conducting activities on digital and entrepreneurial skills training through its infoDev program, including developing multiple entrepreneurship skills bootcamp programs, and supporting tech skills bootcamp programs, such as AkiraChix in Kenya.

This note aims to complement these activities and provide additional knowledge from practical examples of coding bootcamps implemented in developing counties to support upcoming World Bank operations as well as policy programs in developing countries in this field. This note is the first publication of the Decoding Bootcamp Initiative,[1] the goal of which is to evaluate the impact of coding bootcamps on youth employment opportunities. Three emerging economy locations were selected for the research: Medellín (Colombia), Nairobi (Kenya), and Beirut (Lebanon). These cities were selected on the basis of regional diversity, high youth unemployment, and a growing technology sector. A description of the initiative is presented at the end of this note. A follow-up publication will present the results of this analysis on employment and educational opportunities for the targeted populations, as well as offering a policy guide on how to catalyze and leverage coding bootcamps for employment.

A. Technology-led transformation is impacting labor markets but is also creating new opportunities

Technology-led transformation (the so-called "Fourth Industrial Revolution") has significant implications for the world economy. It is disrupting sectors, transforming industries, and causing traditional business models to be substituted

by new, digital-led ones. Many companies are struggling to adapt to the rapid pace of change in the competitive environment, which is resulting in transformative changes in core sectors of the economy, from hospitality to retail and urban transportation. Airbnb, Amazon, and Uber as some lighthouse examples of companies driving this transformation. Automation, digital manufacturing, sensitization, and big data are silently transforming head-to-toe core industrial sectors, such as manufacturing and automobiles. Inextricably, these changes are affecting labor markets. Estimates forecast that almost half of today's occupations could become redundant (Frey and Osborn 2013), and that 65 percent of children who enter primary school in 2016 will be engaged in completely new job types that currently do not exist (World Economic Forum 2016).

As the technologies that are enabling this economic transformation are improving in functionality and becoming more accessible and affordable, a number of job functions, if not entire occupations, are becoming increasingly susceptible to automation and digitization. A recent study highlighted categories of work that are particularly vulnerable because of current and projected advancements in prefabrication, automation, robotics, artificial intelligence, and unmanned vehicle technology. These include construction, food service, ground transportation, and farming. The impact goes beyond manual work categories, also affecting other jobs that involve cognitive tasks, including journalism, legal assistance, pharmacy, health diagnostics, and real estate brokerage (Frey and Osborn 2013). While the extent of the impact of new technologies on occupation or work area cannot be precisely determined, it is becoming evident that the jobs of tomorrow will require new skills that help workers to adapt to a constant tech-led changing world. These so-called "future-proof skills" will likely comprise a combination of technical and socioemotional skills, centered on intelligence, creativity, social competence, ability to learn how to learn, as well as the ability to engage with and exploit artificial intelligence for solving tasks of varied complexity (World Economic Forum 2016).

Arguably, tech start-ups come closest to the vision of the "employer of the future," as they actively source labor with future-proof skills. The past two decades have witnessed the emergence of new market categories because of the disruption to traditional business models by start-ups, which has guided entire sectors of economy, including transport, logistics, hospitality, transportation, and manufacturing, to name a few. Tech start-ups' forward-thinking founders and versatile personnel are at the core of this transformation.

The new tech employment generated by start-ups is not only those of the founding team and those with high tech-and business skills (for example, engineers, MBAs, and so on). As start-ups grow and scale, they also need less-skilled workers to expand the activities initiated by the core group of founders and initial workers. Many of the skills required to expand the business, either tech or non-tech, do not require higher education (that is, a university degree or above) and can be conducted by workers without tertiary degrees and with more basic skills.

Data from New York City's innovation ecosystem shows that 44 percent of the employment generated by the tech start-up ecosystem in the 2003-2013 period (during which the ecosystem expanded and matured from almost nonexistence to become one of the largest start-up ecosystems in the world) did not require skills above a bachelor's degree. Interestingly enough, these jobs that require relatively more basic skills are paid 45 percent higher than jobs with similar educational requirements offered by other industries (HR&A Advisors 2014). New York is not alone in proving that tech start-up ecosystems are generating new employment opportunities on a massive scale for all skills levels, particularly for the lower skilled. In Canada, Toronto's tech ecosystem has generated over 400,000 jobs, with its tech jobs becoming increasingly accommodating of the population without a university degree (Tech Toronto 2016). In the Department of Antioquia in Colombia, where Medellin is the capital city, 80 percent of the employment in IT companies is generated by only 18 percent of Medellín's IT companies (Ruta N Medellín et al 2015).

Low-entry tech jobs skills include being able to build a simple website, a basic database, or a low-code web or mobile app. Populations with more basic skills and without tertiary degrees will

primarily benefit from these new work opportunities. Furthermore, low-entry tech jobs are not restricted to coding categories. As companies in industries as varied as healthcare, construction, retail, and mining become more sophisticated in integrating automation and artificial intelligence capabilities, workers will need to learn how to manage and reconfigure the new machines and understand design and high-level requirements to be able to oversee machine-led operation. The new technicians, manufacturing plant operators, and hospital janitors will need to understand how to operate with the new technology. As these tasks expand across sectors, basic tech skills would also need to be complemented with socioemotional skills such as problem solving, learning how to learn (as new software updates will be constant), and the ability to work in a team.[2]

This combination of basic tech skills (for example, website development, app development, and so on) and socioemotional skills can be acquired by workers without tertiary education (that is, those with a secondary level education) through short-term intensive training. This training is akin to traditional vocational training but adapted for newly demanded tech skills. Tech companies have traditionally provided this type training for low-skilled employment. Business process outsourcing (BPO) companies train workers in basic tech skills to provide outsource services. However, tech start-ups do not have the scale of these BPO companies to provide in-house training to new employees.

B. Newly emerging tech-skills training programs: coding bootcamps

This has led to the emergence of a new kind of technical training: coding bootcamps. These are short-term (typically three to six months) training courses provided by a third party that crowdsources the demand from those seeking low-skills tech work (for example, basic web or app programing) from multiple tech start-ups, providing a tailored curriculum of tech skills in a given ecosystem. One of the most notable examples of a coding bootcamp provider is General Assembly in New York City (NYC), which has become a basic tech-skills factory, producing hundreds of graduates per year trained in intense three-month courses.[3] General Assembly's graduates are directly employed by start-ups, by other tech or nontech companies, or become entrepreneurs. Interestingly, bootcamps have expanded to provide basic tech skills to people without tertiary education. Another NYC initiative, Coalition for Queens (C4Q), provides rapid skills training with access to mentorship resulting in direct employment of low-income people, with over 80 percent of their "graduates" gaining employment.[4]

Coding bootcamps are not restricted to advanced economies; they have become a global phenomenon being present in emerging economies with active start-up ecosystems. Today, bootcamps are present in Peru, Colombia, Kenya, India, and Lebanon, to name a few. While the exact number of coding bootcamp providers and students are difficult to estimate globally, a study by LinkedIn Economic Graph shows that there were at least 16,000 bootcamp graduates by 2015 – more than doubling the total number of bootcamp graduates in the previous year – resulting in a wide diversity of employment from start-ups to large tech and traditional companies requiring tech talent (Gan 2015). These training programs are likely to continue gaining popularity and impact, driven by high youth unemployment, employers' inability to fill positions because of skill shortages, and expansion of the digital and tech sectors following the economic transformation.

Given their role in the creation of these new low-entry tech skills, a better understanding of how bootcamps operate and their potential to benefit low-skilled populations is of interest for those working on policies and programs who are seeking to increase employment opportunities, particularly newly created employment, in their developing economies. The report studies the coding bootcamp model and explores how it is been implemented in developing countries' context. It presents five case studies of bootcamps operating in emerging economies and one early-education program introducing tech skills in secondary education, describing their operational model and impact. This analysis includes the categories of tech training, the role of coding bootcamps in accessing new employment opportunities, and the applicability of each of these programs in the environment of emerging economies.

ORIGIN AND CATEGORIES OF CODING BOOTCAMPS

Coding bootcamps are a relatively new phenomenon that emerged around 2012 in response to the growing business needs of fast-growing technology companies in North America. The first movers were General Assembly and Dev Bootcamp in NYC and San Francisco, respectively.

As of 2016, there were over 91 full-time coding bootcamp providers in 69 U.S. and eight Canadian cities. Cumulatively, they were expected to train close to 18,000 students by the end of 2016, with a 70 percent market growth rate compared to 2015, and 700 percent growth compared to 2013 (Course Report 2016). Other cities quickly followed suit, with the highest number of coding bootcamps emerging in London, Barcelona, and Berlin, among others.

The rise of these training programs could be explained by the growing tech skill gap that leaves hundreds of thousands of programming jobs unfilled in high-income U.S., Canadian, and EU economies.[5] Additionally, the promise of high postbootcamp employability (99 percent in certain cases), with higher than local average salaries attracts those seeking to switch careers by reskilling or upskilling. Finally, coding bootcamps offer skills training compressed into a short time span, at a fraction of the cost of traditional computer science university programs.

The rationale for stimulating bootcamps' growth outside of high-income economies is similar, as shown in the case studies of the five bootcamp providers in this report: Laboratoria (Peru, Chile, Mexico), Moringa School (Kenya), SE Factory (Lebanon), WTM (Argentina, Brazil, Colombia, Chile) and the early-education tech skills training program (CodeRise, Colombia). These are described in detail in Appendix B. Interestingly, at least one cofounder of each of the studied bootcamps was a U.S citizen or had studied in the United States, acquiring contacts in the U.S. tech or entrepreneurship scene before moving forward with their ventures in emerging markets.

A. Categories of Bootcamps

Coding bootcamp is a term that is applied generically to intense rapid tech-skills training programs. This kind of training varies in duration, depth, curriculum, and programs, and connection with employment opportunities. A study commissioned by the International Telecommunication Union (ITU) made an initial classification of these programs (ITU 2016). Supplementing this initial assessment with additional research and inputs from field experience, these newly emerging tech skills training programs can be

classified as shown in Table 1. The three models of the Professional Tech Skills category (Prebootcamp, Ready-to-Work, and Bootcamp+) complement each other and work as a value chain for tech skills. The example of Kenya (see Figure 1), where these three models operate, shows how the models interact and address entry-level tech skills opportunities at different points in the tech skills value chain. Notably, graduates from the

TABLE 1 - MODELS OF NEWLY EMERGING TECH SKILLS TRAINING

Category	Bootcamp Model	Description
Professional Tech Skills: Preparation for low-entry level tech jobs	Prebootcamp Model	Part-time online or in-person program providing basic digital and tech skills to prepare students for the "Ready-to-Work" model. The Prebootcamp Model varies in form and length and can be limited to basic digital skills or expanded to also provide basic socioemotional or life skills (e.g., Akirachix in Kenya).
	Ready-to-Work Model (Coding Bootcamp)	Intensive three-six months full or part-time rapid skills training program that prepares people to qualify for employment shortly after the training ends (e.g., Moringa in Kenya, Laboratoria in Latin America).
	Bootcamp+ Model	Extended training approach which includes an intense coding bootcamp and continues with practical or "on-the-job" training to equip students with a higher level of tech and socio-emotional skills. In the most advanced stages, this model includes on-the-job training for two to four years (e. g., Andela in Kenya).
Educational: Introduction to tech skills to potential workers or school students	Mini Bootcamp Model	Very short-term training programs 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 (e.g., NegaWatt Challenge Bootcamps).[a]
	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 (e.g., CodeRise in Colombia).

Source: ITU 2016, and authors' analysis.
Note: a. http://www.negawattchallenge.com/.

Prebootcamp (AkiraChix) apply to the Ready-to-Work model (Moringa), feeding this program, and the graduates of the Ready-to-Work program apply to the Bootcamp+ program (Andela),[6] also feeding this program. This relationship suggests a buildup of tech skills among these three programs from the basics to advanced internationally competitive tech skills, with the Ready-to-Work model being the central piece connecting the skills progression through the three models.

The focus of this study is the Ready-to-Work model, which we will refer to as "coding bootcamp" throughout this report. This is the standalone model that provides tech skills through short-term training akin to rapid vocational skills training aimed at tech low-entry level jobs (for example, junior developer) in a given domestic market. The Ready-to-Work model is central to the creation of entry-level tech skills. The Prebootcamp model complements the Ready-to-Work model but by itself does not generally lead to employment in entry-level tech positions. The Bootcamp+ model is more complicated and longer in duration (not being rapid skills training), including a lengthy on-the-job training process, and it is not as widespread across countries as the Ready-to-Work model.

The study also provides an introduction to the Educational Category by featuring a case of the Early Education Model (CodeRise in Colombia).

FIGURE 1 - PROFESSIONAL TECH-SKILLS BOOTCAMP MODELS COMPLEMENTARITY AND MARKET ACCESS IN KENYA

	AkiraChix Pre-Bootcamp Model	**Moringa** Ready-to-Work Model	**Andela** Bootcamp+ Model
Skills	Basic tech and living skills	Entry-level developer skills	Advanced developer skills to project manager
Market	Domestic	Domestic	International
Training duration	3 months (pre) / 9 months (core)	5 months	6 months bootcamp + 3.5-year in-the-work training program
Population focus	Female only	No restriction	No restriction
Students per year	20-30 (pre) + 10-15 (core)	130	100
Entry-level job readiness	Awareness & Basic Skills	Jr. Software Developer (Domestic Market)	Jr. Software Developer (International Market)

Source: Authors' analysis and interviews.

MAIN PRINCIPLES OF CODING BOOTCAMPS

Coding bootcamps are intensive short-term programs designed to train participants in programming skills to make them immediately employable in entry-level tech positions (Meng 2013). In essence, they combine characteristics of traditional vocational training programs with the intensity of military bootcamps for new recruits, intermingling socioemotional and tech skills learning in an intense manner, in what could be referred to as "skills accelerators."

Coding bootcamps follow a structured process with three main characteristic features: 1) intense rapid-skills training, 2) experiential learning approach, and 3) curricula based on, and continuously adapting to, industry's demand. The coding bootcamp model is summarized in Figure 2.

A. Coding bootcamps are intensive rapid skills training programs, typically lasting no more than six months

The majority of programs have a multistage application process requiring admitted students to show full-time commitment to learning (in some cases students need to dedicate no less than ten hours per day, six days a week). The application process is similar across bootcamps, relying on online applications and interviews. At first, interested applicants are invited to fill out a short questionnaire providing basic personal information on education, interests, employment, and so on. Then, eligible applicants are invited for an interview: either face-to-face or via telephone/Skype. Some bootcamps are more selective than others. For example, Moringa School has two rounds of interviews, and Laboratoria assesses its applicants using psychological tests designed by professional psychologists. Other bootcamps might require previous coding experience. Probably one of the most complex procedures is that of Hack Reactor, which is comprised of at least two coding assignments (challenges), the solving of which is a condition of acceptance.

Competitive application processes aim to screen out the least capable and select the most motivated (see Box 1). As a result, the acceptance rate of bootcamps is low and is comparable to that of highly ranked universities. Hack Reactor accepts only three percent of applicants, Moringa School eight percent, and Laboratoria and WTM 10 percent.

Coding bootcamp programs typically last three months. However, programs can last up to six months (Laboratoria). Some bootcamps, such as San Francisco-headquartered Hack Reactor,[7] have started a four-month online bootcamp in addition to a physical course, and 50-70 hours of prebootcamp training. In the Middle East and

Africa, a "standard" bootcamp lasts three-months, is full-time, and intensive. However, the Moringa School in Kenya started a one-month prebootcamp program to offer a better foundation for future bootcamp candidates following Hack Reactor's footsteps. According to Moringa, such an approach helps prepare students for the intensive three months to follow, while also helping administrators filter out those who would otherwise drop out because of the high intensity of training, lack of skills, or unrealistic expectations. Laboratoria is also experimenting with a two-week preadmission program, asking applicants to participate in introductory classes and complete normal coursework. It tests how well a student would perform during the full six-month program.

In addition to standard offerings, Latin American providers (for example, WTM, Laboratoria) are experimenting with longer-term, part-time, and online programs. Additional program offerings are driven by the particular learning needs of their student base. In the case of Laboratoria, the bootcamp schedule had to incorporate an additional track with a sufficient degree of flexibility (that is, 18 months part-time) to enable its female students to combine learning either with work, university studies, or caring for children or older family members. WTM is trying to capture a new market by rolling out a new online program with flexible duration, which would specifically cater for young people that are unable to attend a physical bootcamp in one of their city locations.

FIGURE 2 - CODING BOOTCAMP MODEL

Selection From Talent Pool

Entry-level Requirements

Minimum literacy and basic digital skills

Online prelearning prepares students for application

Higher selection criteria is attitude and willingness ("hunger") to learn

Some providers employ psychometrictests

Data tools assess skill levels and pretraining needs

Core Curriculum 3-6 months

Experiential Learning

Learning curriculum is experiential: learning by doing

Focus on soft 21st C skills: ability to learn how to learn, teamwork, problem solving, time-management, receiving and giving feedback, presentation skills, self-assessment, etc.

Short-term, intense training with a cohort structure and heavy on simulations-based learning

Demo-day (pitch) to employers at end of course

Technical curriculum adapted based on demand. New technical knowledge piece can be plugged into experiential core methodology.

Data tools track student progress and match with employers

Industry <-> Start-ups

Constant Connection to Demand

Curriculum is developed based on skills demand assessment of industry; can be tailor-made; Job placement department constant dialogue with industry

Guest trainers from industry ensure constant interaction through learning experience

Agreements of regular supply of employees and ad hoc recruiting

Data tools provide visibility of students progress and graduates performance and support forecast demand/ curriculum needs

Source: Authors' analysis.

BOX 1 - CODING BOOTCAMPS' SELECTION PROCESS

Coding bootcamps' selection process focuses on motivation rather than technical skills. Most bootcamps, however, have a minimum set of tech or coding understanding and knowledge that is required, but proficiency is rarely sought. In order to get to this minimum technical skills base, many bootcamps offer a prebootcamp. For instance, Moringa in Kenya, offers a one-month online prebootcamp to prepare potential students.

The coding bootcamp selection process usually consists of:

1. **An online application form:** It serves to preselect the candidates that meet minimum criteria defined by the bootcamp provider (for example, age, gender, previous studies, employment status, level of literacy, and so on).
2. **A basic online coding test/interview to assess the technical skills of the applicants:** Some bootcamps require previous coding skills, others require the applicants to take online preparatory training in order to take this test, and some others do not require previous coding experience, just basic computer skills.
3. **A personal interview:** Once the applicants meet the minimum criteria set by the bootcamp, the interview (in person or by videoconference) serves to assess the motivation, perseverance, and commitment (among others) of the participant to take the bootcamp training. The ones that rank highest in these socioemotional skills are usually selected, as this indicates that they will be able to finish the bootcamp despite the intensive effort it requires, minimizing the number of dropouts.

The order of 2 and 3 may vary, depending on the bootcamp provider.

B. Coding bootcamps' teaching method follows a project-based, experiential learning approach

Students learn coding "by doing," hence basic 21st century skills, such as teamwork, problem solving, and critical thinking, are integrated into the education process. Teaching sessions are usually combined with inspirational talks from industry specialists as well as mentorship, aimed at helping students to determine their career path.

Unlike computer science university programs, coding bootcamps focus much less on teaching theory than on the practical application of concepts in order to recreate a software engineering job environment. The latter is usually carried out through interactive teamwork or peer learning. Certain gamification aspects – from point scoring to competition with others – may be incorporated into the learning process to drive engagement among students, boost their spirit of competition, and master basic skills.

The teaching philosophy of most bootcamps draws on agile software development methodologies, a set of principles that encourages collaboration, iteration, and self-organization within product teams. Conceptualized in 2001 by U.S. software developers, agile methodologies are now used in the largest multinational companies. Beyond the tech sector, they are now defining procedures in organizations and functions in other industries. The Agile Manifesto sets out four key values and 12 operating principles to underpin a mindset known today as "agile."[8] Table 2 presents the key values of flexibility and adaptability that lie at the core of this method, and Table 3 presents its operating principles.

The bootcamp providers studied emphasize that they are building "life skills", enabling their graduates to be competitive irrespective of the industry in which they choose to work; for example, the ability to master new knowledge quickly and efficiently, effectively work in a team, meet tight deadlines, develop a growth mindset, and so on. Evidently, these "life skills" belong to the subset of future-proof socioemotional skills.

TABLE 2 - THE AGILE MANIFESTO'S FOUR KEY VALUES

	Value	Socioemotional Skills
1	Individuals and interactions over processes and tools	Teamwork, communication
2	Working software over comprehensive documentation	Critical thinking, rapid results, interactive communication
3	Customer collaboration over contract negotiation	Teamwork, communication
4	Responding to change over following a plan	Adaptability, rapid learning

TABLE 3 - THE AGILE MANIFESTO'S OPERATING PRINCIPLES

	Operating Principle	Socioemotional Skills
1	The highest priority is to satisfy the customer through early and continuous delivery of valuable software.	Rapid results, interactive communication
2	Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.	Adaptability, rapid learning
3	Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.	Rapid results
4	Business people and developers must work together daily throughout the project.	Teamwork, communication
5	Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.	Teamwork, communication
6	The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.	Interactive communication
7	Working software is the primary measure of progress.	Rapid results
8	Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.	Interactive communication, rapid learning
9	Continuous attention to technical excellence and good design enhances agility.	Critical thinking, rapid results
10	Simplicity – the art of maximizing the amount of work not done – is essential.	Critical thinking, rapid results
11	The best architectures, requirements, and designs emerge from self-organizing teams.	Teamwork, communication
12	At regular intervals, the team is to reflect on how to become more effective, then tunes and adjusts its behavior accordingly.	Adaptability, critical thinking, teamwork

Source: http://agilemanifesto.org/principles.html.

Besides a strong push towards developing the socioemotional skills of the students, bootcamps also embed career advisory services, so as to provide students with the right tools to find a job after the training.

C. Coding bootcamp's curricula reflect current industry needs, with teaching subjects adapted to local demand

Coding bootcamps tend to pursue a "glocalization" approach in their curricula design: they create "in-house" study programs by mixing internationally recognized tech education products (for example, proprietary and free online courses, video tutorials, Massive Open Online Courses/ MOOCs) with the curricula which respond to the needs of the local tech ecosystem and reflect local cultural characteristics. Many programs are so connected to the local start-up ecosystem that their trainers are at the same time employees within the industry.

The local tech scene – from small private firms to multinational corporations (MNCs) to industry associations – is encouraged to participate in curriculum development. There are several avenues for such collaboration, from providing inputs to the content to more substantive cooperation, for instance, by providing projects for students throughout the bootcamp or delivering specific technic subject-focused talks.

It is common for bootcamp providers to base their assumptions of which IT subjects or programming languages are in demand by monitoring publicly available online sources (for example, data from national statistical and labor agencies) and private market intelligence data. Typically, bootcamp providers engage local tech sector stakeholders – and even IT outsourcing companies located abroad – through meetings and surveys to understand existing and projected demand for certain skills. Some of their survey samples are quite representative. For example, Moringa School can tap into a pool of over 40 partners while Hack Reactor has over 300 partners to call upon. In a similar way, bootcamps can determine the teaching emphasis by surveying their graduates. Hack Reactor, Laboratoria, and SE Factory attest that tech sector interactions are crucial in helping them determine programming languages relevant to local employers.

The frequency of curriculum reviews and adaptations vary, but it is much higher than in traditional curricula in academia. Laboratoria reviews its course on a biannual basis, consulting its "Laboratoria Company Network" of partner companies. WTM has pivoted several times to iterate its curriculum having consulted students and applicants. Moringa School frequently updates its technical core curriculum, and is currently in the process of changing its teaching paradigm moving towards more paced education, purposed learning, and lifelong learning.

Coding bootcamps act as skills demand aggregators (see Box 2), crowdsourcing demands from multiple companies in the ecosystem (from start-ups to medium and large tech companies) and conducting a sort of "in-house training" for local IT SMEs, MNCs, start-ups and tech-related businesses. Moreover, coding bootcamp methodology has potential application beyond coding (see Box 3).

BOX 2 - AGGREGATING DEMAND FROM THE TECH ECOSYSTEM

Coding bootcamp providers have a close relationship with the local tech ecosystem where they operate. They build their curricula based on local demand, and adapt to the industry needs by updating content frequently. In a sense, bootcamp providers aggregate demand from multiple ecosystem stakeholders' need for low-entry level tech skills (from large companies to SMEs and start-ups) to design their curricula. There are several mechanisms coding bootcamp providers use for this:

1. **Continued dialogue with hiring companies.** Coding bootcamps build a close relationship with hiring companies, with whom they establish a close ongoing dialogue. Many coding bootcamps have a department or position in charge of relationships with hiring companies. This relationship is complemented with research through surveys or focus groups of hiring managers.
2. **Close working relationship with hiring managers.** Coding bootcamps also develop a close working relationship with the hiring managers from tech companies. For instance, many programs employ hiring managers and experts from industry (many of which come from hiring companies) as visiting lecturers and mentors through the program. Many coding bootcamps also provide "demo days" for their graduates, where the graduating students pitch to a pool of hiring companies. By embedding hiring managers and industry experts through their program and showcasing students to a pool of industry mentors and experts, bootcamps can learn directly the needs of hiring managers, being able to respond rapidly to new skills needs or address gaps in their curricula.
3. **Analysis of demand and trends.** Coding bootcamp providers also analyze tech skills trends and industry needs from external sources. Increasingly, as coding bootcamps get more data from the market and their networks (including from alumni and hiring companies), providers are using data analytics to refine their curricula (addressing gaps in specific skills detected) or including entire new curricula.

BOX 3 - CODING BOOTCAMP METHODOLOGY APPLIED TO NEW INDUSTRIAL TECHNICAL SKILLS BEYOND CODING

Coding bootcamp experiential learning methodology can be applied to technical training beyond coding. As automation and digitization expands through industry, technical functions increasingly require technology skills to understand how to program machines, understand design specifications, and even repair plant equipment through digital manufacturing techniques. Industry is reporting a shortage of potential employees that are skilled in these technology industrial skills, which traditional technical and vocational education programs are not providing at the pace of industry needs (Elejalde-Ruiz 2016). Coding bootcamp experiential methodology with its close connection to demand is an appropriate mechanism to fill this gap in new technology industrial skills. Manufacturing is an area where bootcamp methodology has been applied with specific programs targeting "advanced manufacturing" skills (that is, new skills required for digital and automation manufacturing equipment) in the United States and other advanced economies.[9]

DIFFERENCES BETWEEN CODING BOOTCAMPS

Coding bootcamps mainly differ according to their business model, course structure, and employability outcomes. International coding bootcamps that have partnerships with well-established U.S. or Canadian bootcamps (or act under their franchise internationally) tend to adopt similar programmatic activities and course content, and have similar employability results.

A. Business Model

In the United States and Canada, coding bootcamps providers are typically for-profit companies, often with a social mission that finds reflection in their programmatic activities. By the end of 2016, U.S. and Canadian bootcamp providers were expected to train close to 18,000 students, with projected revenues of about $200 million. These bootcamps' revenues heavily rely on the ability to secure job placement for graduates. On average, bootcamps charge a fixed tuition fee of $11,451, with a range of between $5,000 and $20,000, for a 12.9-week program (Course Report 2016a). Providers justify their high fees because of their employment track record (Course Report 2016b) (see "C. Employment Outcomes" below).

U.S. and Canadian bootcamp providers are increasingly using alternative lenders to accommodate those who lack, or who have poor, credit history. Student and personal loans are offered through these third parties on favorable terms, thus ensuring upfront payments released to bootcamp providers and hence their constantly positive cash flow. For example, Hack Reactor has entered into a special partnership with two alternative online lenders issuing, loans for up to three years to support those who cannot afford its onsite (tuition cost: $19,780) or online program (tuition cost: $17,780). The Moringa School in Kenya has also partnered with Kiva[10] to offer interest-free loans to bootcamp participants, as well as introducing payment by instalment.

Some coding bootcamps operate more like recruitment agencies (for example, App Academy) in that they do not charge any tuition fee at all, but rather take a fixed percentage of postbootcamp salary within the first year of employment. There are also those that rely on partner employers to cover tuition fees. For example, bootcamp participants are exempt from fees if they are offered employment with one of the partner firms. In some cases, in-house scholarships are offered to offset at least part of the tuition costs and/or living expenses. In others, bootcamp providers make arrangements with other entities (for example, government agencies) to provide subsidized training for specific vulnerable groups (for example, U.S. veterans, prisoners, or low-income

TABLE 4 - CODING BOOTCAMP AND EARLY EDUCATION MODEL PROVIDERS EXAMINED IN THIS REPORT

Coding Bootcamp	Location	Brief Description
HACK REACTOR	Austin, Los Angeles, San Francisco, and New York City, United States	For-profit company that operates a 12-week full-time coding bootcamp, along with a remote online bootcamp. The bootcamp focuses on a single core program that teaches students JavaScript and full-stack software engineering.
LABORATORIA	Lima and Arequipa, Peru; Santiago, Chile; Mexico City, Mexico	A coding bootcamp and a continuing education program that combines applied coding education, psychological training, and deep employer engagement to create opportunities for students. It targets low-income women.
MORINGA SCHOOL	Nairobi, Kenya	One of the pioneer bootcamp providers in Africa that aims to transform African higher education starting with software engineering in an education-to-employment model. It accepts students from all over Africa and operates as a for-profit entity.
WORLD TECH MAKERS (WTM)	Bogotá and Medellín, Colombia; Sao Paulo, Brazil; Mexico City, Mexico	Technology education company offering onsite coding bootcamps and STEM eLearning solutions for individuals and organizations. It specializes in vocational training for youngsters and adults, along with K-12 STEM training for children and teenagers.
SE FACTORY	Beirut, Lebanon	Lebanese coding bootcamp that teaches the technical and socioemotional skills necessary for professional full-stack web development. It equips computer science graduates with the necessary practical skills.
Early Education	**Location**	**Brief Description**
CODERISE	Medellín, Colombia	Colombia-based bootcamp that seeks to empower high school students by teaching them how to build web applications.

students in the case of Hack Reactor). Additionally, some business models (for example, Rural Sourcing Inc[11]) rely on the onshore outsourcing business model, and run bootcamps specifically to train their coders for upcoming projects.

For bootcamps located outside high-income markets, limited market data is available. Available data suggest that these programs are implemented by for-profits, nonprofits, and social enterprises, with nonprofits most commonly found in Africa (ITU 2016). Selected coding bootcamp providers studied for this report show that social enterprises (for example, Moringa School, Laboratoria, WTM) are gravitating towards eventual transformation into for-profit social businesses.

The five coding bootcamp providers and the early education model examined in depth for this report are shown in Table 4, and are described in detail as case studies. An Early Education Model is also described in detail for purposes of comparison with these coding bootcamps in the context of emerging economies.

Typically, coding bootcamp tuition fees range from $500 to $2,500 in Africa, and $1,500 to $3,000 in Latin America. In Asia, where franchises of U.S. bootcamps are taking root, the cost of training can reach as much as $10,000 (ITU 2016). Some bootcamp providers offer special arrangements for vulnerable groups. For instance, WTM, whose coding bootcamp cost varies from $2,000 to $3,500 per location, makes arrangements for low-income students.

As in North America and Europe, some coding bootcamps in emerging markets rely on a fixed tuition fee, while others fund their activities by charging participants a fixed percentage of their postbootcamp salary plus a nominal payment for

BOX 4 - TYPICAL SOURCES OF FUNDING FOR CODING BOOTCAMPS IN DEVELOPING COUNTRIES

The ITU-commissioned report on bootcamps in developing countries has discerned the following typical sources of funding for coding bootcamps. In the majority of cases, more than one revenue stream is being used to sustain bootcamp operations.

1. **Student tuition:** Fees students pay to enroll in the program. The amount varies depending on the organization and type of training.
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 certain 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 upfront tuition payment.
3. **Employer hiring fees:** Fees charged to companies when they hire one of the bootcamp graduates.
4. **Start-up accelerators:** Provider helps students create a start-up and keeps a percentage of the start-up holdings.
5. **In-house recruiting:** Provider has or creates a recruiting or web development agency to find prospective projects for graduates to work on.
6. **Licensing curriculum:** This revenue stream has not been implemented yet by any of the organizations documented. However, some are currently devising ways to implement this in the near future.
7. **Donations (cash or in kind):** This is a particularly important funding source for nonprofit 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 programs, expand the training to more people or additional types of training, or to sponsor student enrollment fees.

Source: ITU 2016.

the duration of the bootcamp (for example, $10 in the case of Laboratoria). To ensure full cost recovery and maintain healthy margins, coding bootcamps in emerging markets usually have to rely on more than one revenue stream. Box 4 provides an outline of typical sources of funding for coding bootcamps.

Laboratoria, in Latin America reports that 30 percent of graduates fail to repay their coding bootcamp tuition (at least $1,800) owing to the difficulty in finding employment. This has led this bootcamp provider to introduce a continuing training program for developers to generate a more sustainable cash flow. This program would be open to Laboratoria graduates as well as non-Laboratoria developers who are working alongside graduates. For a company that has employed a Laboratoria graduate, if this graduate and multiple other employees need to learn a certain technical skill, they could all be trained within the same class. The Laboratoria coder would receive a steep discount while other employees would be charged the full price. In this way, Laboratoria partner employers can become paying clients.

Moringa School (Nairobi) already has a diversified revenue mix. In addition to implementing coding bootcamps, Moringa offers other types of training in the form of short-term workshops and it also provides job placement services. To support those students with low capacity to pay the tuition costs upfront ($2,500), Moringa partnered with international nonprofit lending platform Kiva to provide student loans. According to the Kiva website data, between mid-December 2015 and August 2016, $37,050 was borrowed within the partnership with Moringa School. These loans were issued for an average period of two years, and the average loan amount was $2,091. Kiva had offered the loans interest-free, however an additional annual interest of 10 percent was added by Moringa to cover administration fees. Moringa has recently reduced its fees to $1,200.

Nonprofit bootcamp providers typically rely on sponsorship and in-kind contributions (for example, provision of training venues) from the private sector and international donors. Some, however, charge students nominal payments. For example, SE Factory in Beirut follows this approach by charging $100 in a commitment fee: if the person enrolls in the training but drops out in the process, they lose this deposit.

Seeing the market potential, all of the studied bootcamps are trying to expand, either nationally (SE Factory) or regionally; Laboratoria and WTM are planning to scale up their operations in Latin America, and Moringa is supporting a bootcamp in Hong Kong (Accelerate) and plans to expand to Nigeria, Ghana, and South Africa.

B. Course Structure

Although the course structure of most coding bootcamps is similar, there are differences based on the bootcamp's goals, target demographics, and the strength of linkages to local employers.

Some coding bootcamps focus exclusively on teaching specific technical skills, whereas some also have coursework covering socioemotional skills, such as business communication, time management, or portfolio management. Socioemotional skills seem to be most extensively covered by those bootcamps that cater to marginalized populations, such as women, disenfranchised youth, and the poor.

The technical content of coding bootcamps is usually based on international best practice (for example, internationally acclaimed proprietary and free online courses, video tutorials, MOOCs, and so on), but with customization based on local tech industry needs and characteristics of local culture. Tech skills curricula have become more diverse in recent years, with providers expanding their course offerings from basic web and mobile development to more complex tech subjects. Still, full-stack web development is the most widespread program offered, teaching skills related to server, network and hosting environment, relational and nonrelational databases, application programming interfaces, user experience, and project management.

A typical U.S. bootcamp curriculum covers programming fundamentals, such as working with application programming interfaces (APIs), database modelling and object relational mapping (ORM), understanding the model-view-controller

(MVC) framework, and executing application deployment.

Developing country bootcamps cover similar content, although specific programming languages may vary depending on the employers' needs. In a selected sample of coding bootcamps from Colombia, Kenya, and Lebanon, JavaScript is the most common programming language, although the majority of the technical content is dedicated to front-end web development, that is, CSS and HTML. Local demand from prospective tech employers exerts a key influence over the choice of programming languages. For example, SE Factory teaches PHP (server-side programming language for web development, which can also be used in general-purpose programming) rather than Ruby (object-oriented general-purpose programming language), since in Lebanon the demand for PHP programmers is much higher.

The socioemotional skills curriculum structure in developing countries is similar to U.S. bootcamps, with varying degrees of emphasis on career skills. For-profit bootcamps (for example, Moringa School) and bootcamps charging relatively high tuition fees (for example, social enterprises like WTM and Laboratoria) tend to devote more resources to career development, employer networking, and postgraduation support with job search. As for nonprofit bootcamps, their resource constraints typically limit the career development component. SE Factory, a newly founded Lebanese bootcamp, spends the majority of sponsorship money on providing a quality teaching experience and relevant content, and limits the career component to industry-focused presentations from partner employers. On the other hand, Moringa School, a for-profit bootcamp, does offer postgraduation career support.

C. Employment Outcomes

Employment outcomes of bootcamp students are a testament to the quality of one's skills and competencies, as well as one's audacity in job searching. Even located in areas with a low supply of tech jobs, one is generally able to find an outsourcing opportunity in the global digital economy, as long the individual has market-ready skills, a working Internet connection, and a bank account which accepts payments initiated abroad. At the same time, employment outcomes reflect how effectively coding bootcamp providers reach their stated goals using their job matching or placement strategies.

Typically, coding bootcamps aim to rapidly improve the tech skills of their students to enable them to find jobs upon graduation. A coding bootcamp graduate should have sufficient skills to undertake, at least, tasks for entry-level or junior developers (web or app, or both). This work can be carried out within the development team of a large company, as a developer in a start-up, as an entrepreneur, or as a teaching assistant in a coding bootcamp.

A strong career development focus is part of the curriculum; it increases employability prospects upon program completion. For those bootcamps that work towards immediate employment of their graduates, positive employment outcomes could be broadly defined as: full-time employment, part-time employment, freelance employment, self-employment (including entrepreneurship), or internship (paid or unpaid). The majority of providers monitor their graduates' job placement status up to 180 days following bootcamp graduation, collecting feedback directly from graduates and employers.

Some providers, such as Laboratoria in Latin America, go as far as to track their students' progress three years after graduation. One of the most significant parts of Laboratoria's monitoring and evaluation (M&E) framework is a feedback loop that determines the success factors for admitted applicants. Once the data is gathered about the performance of its graduates, the insights are applied to selecting the next round of candidates. Although the provider admitted discovering a number of false positives within their selection criteria, they continue to iterate their operations using data-driven inferences.

Hack Reactor has another sophisticated proprietary M&E framework, which relies on rigorous quantitative data collection and analytics. Their Standard Student Outcomes Methodology (SSOM) classifies each student according to clear definitions and strict documentation standards,

providing standardized formulas to calculate a placement rate, graduation rate, and average graduate salary. The aim is to document each student's result in a transparent and verifiable way. To attest to the validity of its statements on the high employment outcomes of its graduates, Hack Reactor underwent an independent audit from certified public accountants. In 2016, Hack Reactor made this framework publicly available for any bootcamp to use, thus aiming to establish the SSOM as an industry standard. It can even be used retroactively, that is, even if the provider used a different documentation standard before.

Concerning average employment outcomes, U.S. and Canadian coding bootcamps report impressive results. In 2016, 73 percent of their graduates were employed in a full-time job that requires the skills taught by the bootcamp. Their average salary increased by 64 percent, and they experienced an average salary lift of $26,000. Some programs report increasing job placement rates since 2013 (Course Report 2016b). For instance, Hack Reactor, one of the market leaders, reports a 98 percent graduate hiring rate with a $104,000 average graduate salary.[12]

Interestingly, the bootcamps' effect has been most positive for those with a low-income and/or do not have tertiary education. According to Course Report, low-income students have benefitted most with a $39,190 lift in salary, relative to a $2,347 lift in salary for high-income students. Similarly, students with a high-school certificate experienced the highest lift in salary of $33,300 (Course Report 2016b). Global figures are not available disaggregated by gender although many bootcamps specifically aim to attract women (see Box 5).

Despite poor availability of comparison data on the performance of bootcamps outside North America, the ITU report establishes that Ready-to-Work coding bootcamps in developing countries report equally high job placement of their graduates in the range from 60 to 100 percent, depending on the organization (ITU 2016).

These conclusions mirror those derived from the case studies of selected African, Latin American, and Middle Eastern coding bootcamp providers conducted for this report. Moringa School reports a close to 95 percent employment rate and 350 percent salary increase based on data on 97 graduates from its full-time bootcamp. WTM, with 650 graduates, reports 75 percent employment rate[13] within 120 days for its 2015 cohort, and 90 percent for 2016. Laboratoria, with 400 graduates, reports 75 percent occupation within 90 days, with a triple income increase. SE Factory, which had graduated only 22 students at the time of writing of this note, reports 90 percent employment and a triple income increase.

D. Bootcamp Factors Influencing Employment Outcomes

From the case studies, there are two factors that exert a major influence over employment outcomes: 1) selection criteria, and 2) extent of links with the local tech ecosystem. Graduates have higher employment prospects when the bootcamp in which they have participated has a wider network of contacts in the private sector and offers greater exposure to prospective employers, for instance, through competitions or networking sessions.

For example, Moringa School, which guarantees almost 100 percent job placement, positions itself as a world-class career accelerator thanks to a number of activities and networks accessible to its students. Four hours per week are devoted to career sessions and, additionally, students are introduced to the tech ecosystem in Kenya via weekly presentations by industry experts. During the course, students are encouraged to pursue individual projects, which they get to pitch publicly to prospective employers from the private sector during the Demo Day at the end of the bootcamp. Moringa maintains relationships with over 40 hiring partners who are encouraged to provide students with internships or job contracts. Furthermore, the school closely cooperates with Moringa DevShop, which is one of the companies under the Moringa umbrella (but separate from the school) that can hire graduates to work directly on outsourcing projects for U.S. and European-based clients. Last but not least, the school is working towards concluding a partnership with Carnegie Mellon University in the United States to place selected Moringa graduates

BOX 5 - CODING BOOTCAMPS AIM TO INCREASE GENDER DIVERSITY, HELP REFUGEES AND THE VULNERABLE

According to the latest research from Course Report, a coding bootcamp industry monitor, a typical graduate of an average North American coding bootcamp is 30 years old, with 6.8 years of work experience, with at least a bachelor degree, and no previous experience in programming. 43.3 percent of bootcampers are women (by one measure, this is almost three times higher than the share of female undergraduate students in computer science in local university programs) (Course Report 2016b).

An ITU report shows that the age of a typical coding bootcamp student in developing countries ranges between 25 and 35 years old. Similar to North America, these providers have 25 to 40 percent of women in their student bodies. Most students in these bootcamps (mostly in developed countries) possess a university degree and some professional experience. Student bodies are equally composed of recent university graduates, working professionals, and entrepreneurs.

Overall, coding bootcamps seem to have been quite active proponents of gender diversity in the tech industry. In high-income economies, many of them partner with corporate sponsors and nonprofits offering scholarships to women, typically contributing $500-$2500, or 5-25 percent of tuition fees. For example, Dev Bootcamp offers $500 scholarship to all women, regardless of their financial need, while Hack Reactor recently partnered with Optimizely to provide full scholarship and internship training for women. Some bootcamps work exclusively with women. One prominent example is U.S.-based women-centric Hackbright Academy, which runs a 12-week software engineering bootcamp for women, with women-friendly learning tracks and mentorship. Women-centric coding bootcamps are also emerging in emerging markets: for example, Laboratoria (Peru, Chile, Mexico), Epic Queen (Mexico, Colombia), AkiraChix (Kenya). Latin American bootcamp, Laboratoria, targets low-income women 18-30 years of age in Peru, Chile, and Mexico through its six- and 18-month technical and socioemotional skills program. It also offers personalized support to graduates for up to one year upon graduation. Laboratoria's tuition scheme allows for low or no fees for low-income students, which are later recouped through a 10 percent contribution from salary for 24 months once they graduate and are employed. Diversity and inclusion go hand in hand, especially with respect to the providers outside of high-income economies. Mainstreaming inclusion typically means widening access to the bootcamp for low-income participants. Some bootcamps (for example, SE Factory in Lebanon, and TechHire in the United States) explicitly focus on promoting upward social mobility, and therefore design their promotion campaigns, admission procedures, and tuition schemes so that candidates from diverse backgrounds are able to participate. According to Andrea Cornejo, Coderise Founder, free-of-charge attendance and transportation grants for those commuting from suburban areas allows the bootcamp to achieve a mix of students from different backgrounds and diverse social classes.

Characteristically, all of the coding bootcamp providers studied for this report have a clearly defined social mission, in addition to their main goal to rapidly improve IT skills and education-to-employment prospects. Coderise aims to foster upward social mobility for adolescents. Laboratoria supports low-income young women. Moringa's vision is to transform African higher education through its activities. SE Factory focuses on the underprivileged computer science graduates from second-tier universities. WTM aims to stop the IT brain drain out of Latin America.

Bootcamps have also focused on supporting Syrian refugees to access the labor market. ReBootKAMP (RBK), supported by Hack Reactor (which is a founding member), reserves half of their places for Syrian refugees. The program has a pathway for non-English speakers and operates both a prebootcamp and a coding bootcamp of 12 weeks. Students do not have to pay tuition until they are employed, allowing the Syrian refugee population to access this training with no monetary requirements. The bootcamp, which is also supported by the donor community, reports a 100 percent employment rate through local partners.

Sources: Course Report 2016a; ITU 2016; RBK website, http://rbk.org/faqs/; and authors' analysis.

into its master's degree programs.

Having some background knowledge in coding has been found to contribute to successful completion of the bootcamp and better employment outcomes. Coding bootcamps try to address this issue in various ways. For example, the Moringa School has introduced additional training through a prebootcamp course, which could level the playing field between those with some and those with no background in coding, allowing the bootcamp provider to better prepare and screen candidates. SE Factory recruits from computer science faculties to ensure a minimum background knowledge, albeit mostly theoretical. Andela, which offers a bootcamp to its fellowship candidates, on the other hand, does not require any coding experience or prior knowledge, but they focus on cognitive and problem solving skills and extensive training after acceptance.

MAIN CHALLENGES OF CODING BOOTCAMPS

The impact of coding bootcamps could be limited because of the challenges of affordability, retention, or even in terms of expansion. In many cases, the fee for taking part in a coding bootcamp is an impediment for low-income or even middle-income population segments, in particular in the absence of student loans or other financial instruments.

In Kenya, the fee to participate in Moringa's bootcamp starts at $1,400. Although student loans have been extended to also cover bootcamps in the United States, this is not the case in many emerging markets. However, some student financing platforms, such as Quotanda, work with code schools to offer financing programs for international students. See above for more details on different payment options.

Expansion of bootcamps to new cities or sectors also presents a challenge for bootcamp providers since not only does it require seed capital but also, even more importantly, a high penetration of the local tech ecosystem as well as a careful balance between quality and tailored training and an increased volume of participants. Some bootcamp providers have started a franchise model but quality assurance can be an additional challenge in that case. Building up a strong relationship with the tech ecosystem prior to initiating the bootcamp is one of the keys to success.

Finally, because of the intensity of the training, some students drop out. This can be a problem especially for those bootcamps where students pay once they are employed and not upfront, where commitment is reduced to complete the training, as Laboratoria reports.

To tackle this issue, some bootcamps, including Laboratoria, have developed advanced data analytics platforms to measure not only the performance of their students, but also to continue improving their selection and training delivery processes, so that they can make course corrections and minimize dropouts.

CRITICISM AND NEED FOR ADDITIONAL RESEARCH

High employability and employment rates reported by coding bootcamps suggest an untapped potential of this form of rapid tech skills training program. However, early evidence, which is based on a limited number of sources – mostly based on data from bootcamp providers themselves – calls for additional, more representative, holistic, and independent research.

Wider research on focused employment youth programs shows that just more than a third of those employment programs (many of them rapid skills training) are successful. However, these youth employment programs have been more successful in middle- and low-income countries (Kluve et al 2016).The potential of the coding bootcamps model to provide increasingly needed tech skills (with the focus on low-entry tech skills) and potential impact in emerging economies is significant enough to deserve more rigorous research.

This note is part of the Decoding Bootcamps initiative of the World Bank, which aims to address the knowledge gap in coding bootcamps. Beyond this initial overview and practical case studies of coding bootcamps in emerging economies, the initiative will contribute to this research gap by conducting an impact evaluation of three coding bootcamps programs in emerging economies (Colombia, Kenya, and Lebanon). A description of this initiative is provided at the end of this report. If the coding bootcamp methodology proves able to provide low-entry level tech skills, it may become a new tool in the policy maker's arsenal to address skills gaps and unemployment in the low-skilled population. Indeed, the early evidence points to creation of both new employment opportunities in this low-level entry tech bracket as well as new educational opportunities (by being able to access new longer-term technical training, for example, preuniversity technical courses).

However, coding bootcamps are not without criticism. Controversy surrounding coding bootcamps has centered on the general implausibility of the promise to be able to teach programming from scratch in only 10 to 20 weeks of intensive training. Bootcamp participants assert that knowing the programming basics is absolutely necessary, and having prior coding experience increases one's chances of success, according to bootcamp providers. Overall, the criticisms of bootcamp programs have been grounded in three key arguments: quality of programming skills, employability, and "short termism."

First, bootcamp critics argue that focusing on graduating beginners into high-paid jobs in as little as 12 weeks results in graduates with poor

quality programming skills. This commoditization of programming skills possibly leads to bootcamp graduates lacking in-depth understanding of the code.

Second, post-bootcamp employment rates, which are typically self-reported by bootcamp providers, tend to be exaggerated (Bloc 2015). As the argument goes, job placement data are often skewed towards successful graduates, do not always differentiate between programmer versus nonprogrammer jobs, and do not always differentiate between the period after graduation. For example, employment rates reported 90 days after graduation and those one year after graduation might not be directly comparable, as different factors might play a role in finding employment, depending on the time period involved. Moreover, as some new bootcamp programs have been in operation for only a short period of time, one cannot yet make valid conclusions about the graduates' career paths and ultimate return on investment.

Third, critics argue that bootcamps capitalize on short-term skill gaps only, and will not be able to deliver sustainable improvements in skills (Nichols 2015). As technology evolves, programming languages might become less important, because of more interactive user interfaces. According to this argument, bootcamps will not survive for long, because the majority of low-skill programming tasks will be performed using plain languages or straightforward user interfaces.

The bootcamp market has grown rapidly, especially in high-income countries. However, the majority of bootcamp providers have not been in business long enough to have their effectiveness evaluated with rigor. Multidimensional assessments on the impact of coding bootcamps and their sustainability should draw on quantitative and qualitative research techniques involving feedback and data from providers, graduates, and employers.

While such rigorous evaluation is pending, there are several factors that can be considered in terms of addressing some of the above criticism, including signaling from employers and the methodology that extends beyond technical skills that are currently in demand.

First, coding bootcamps offer a short but immersive and intensive learning process that produce entry-level developers. Signaling through hiring of graduates of bootcamps is indicative of whether a particular bootcamp is meeting expectations by employers for entry-level developers.

Second, bootcamps can have "over-the-horizon" benefits. The method of training, combined with self-learning and collaborative problem solving, builds skills that go beyond the core technical skills that are in demand, and could equip bootcamp graduates with the capability for continuous, self-driven learning and improvement. As technology changes, employers look for employees with such abilities, since they will be continually required to adapt and innovate.

Third, bootcamps are expanding to other sectors beyond programming and ICT, leveraging the same methodology but adjusting the content. This highlights the need to look beyond their current saturation in ICT, and examine their potential across industries.

EXAMPLES OF POLICY INTERVENTIONS

The private sector alone is unlikely to tackle structural unemployment issues and the related lack of technology skills in emerging economies. The challenges outlined above and the existence of a variety of business models of bootcamps attest to the fact that there is a niche to be filled by the public sector, civil society, and international donors, particularly with regard to inclusion of the underprivileged population and those with lower skills.

While further evidence is needed to fully evaluate the impact of coding bootcamps, there are examples of policy interventions that have targeted bootcamps to support employment, social inclusion as well as competitive growth.

For example, the U.S. Department of Education called for partnerships between rapid technical skills training providers, such as bootcamps (See Box 6), and extended federal education loans for bootcamp participants. The objective of this intervention was to introduce university students to rapid and applied skills development that complements their formal education as well as to encourage links between the bootcamp training methodology and university curricula. Through exposure to the bootcamp methodology, universities can integrate more practical and socioemotional skills development that is aligned with the current and future demand for skilled labor.

The case of Medellín (see Box 7) provides another example of this kind of policy intervention. Through the formation of public-private partnerships and evaluations of bootcamps, policy makers can also catalyze the expansion of effective training programs by connecting providers to further information on demand and to potential new clients and sectors. Public-private partnerships can also lower the risk for both the providers in terms of market entry as well as for employers in terms of the quality of the training provider and commitments around hiring.

In the United States, where student loans are a widely used instrument to fund education, the Department of Education linked to the TechHire Initiative, launched by the Department of Labor, to support their extension to coding bootcamps. TechHire also provided grants for rapid technical training organizations, including coding bootcamps, to increase training for qualified youth and disadvantaged population segments, such as veterans. In the case of Kenya, where student loans only just began to cover technical training and have a capped upper limit that falls below bootcamp fees, the Moringa School

BOX 6 - AN EXAMPLE OF GOVERNMENT INTERVENTION

TechHire – Collective impact partnerships and $150 million in competitive federal grants to expand rapid technical skills training and help connect disadvantaged people to more and better jobs

The U.S. government has provided support to coding bootcamps under the TechHire initiative, which began as a commitment to action from 21 cities, states, and rural areas and more than 300 employers committed to innovative hiring practices and exploring sourcing talent from new and nontraditional programs, including coding bootcamps. This was highlighted in a high-profile announcement by President Obama in 2015. To provide support for this type of innovation, and to ensure that it would include disadvantaged workers and provide new pathways to the middle class, the Department of Labor launched a $150 million competitive grant program to support public-private partnerships to help train young people and disadvantaged groups with barriers to employment for rapid-growth sectors including tech, healthcare, and advanced manufacturing.

Since the launch of the White House call to action, participation has grown to more than 70 geographies, ranging from New York City, to Albuquerque, New Mexico, to rural Eastern Kentucky. In addition, over 1,300 employers are signed on and over 4,000 people have been placed into in-demand tech jobs. An independent nonprofit, Opportunity@Work, has created a national learning network for the leaders across these 70 communities to share best practices, and Opportunity@Work has created staff positions to manage the network, provide professional development support and playbooks for local leaders, and broker additional national partnerships that have potential to accelerate outcomes.

The Department of Labor TechHire grant program is supporting 39 public-private partnerships across the country, and the agency has estimated that more than 18,000 people will receive services through the grant program. Many of the funded partnerships are part of the national learning network run by Opportunity@Work, but a number are not – the competitive program was open to the nation, and it did not require participation in the voluntary network. Over $125 million of the grants were awarded to partnerships that specifically target, train, and support young people, ages 17-29. In addition, $24 million was allocated to partnerships that help other disadvantaged groups with barriers to employment, including veterans, people with disabilities, people with limited English proficiency, and people with criminal records.

The U.S. Department of Education also launched a pilot in 2016 under the Educational Quality through Innovation Partnerships experiment to extend federal loans and grants to students in nontraditional unaccredited education programs such as coding bootcamps, but only if they have teamed up with an accredited college or university and a third-party quality assurance entity to measure and track outcomes. The pilot focused on providing access to low-income undergraduates and diverse students in nontraditional education and training programs. Though the U.S. Department of Education received more than 70 applications, only eight teams of partners (nontraditional provider, higher education institution, quality assurance entity) were selected to participate in the pilot, which is expected to last at least three years.

Source: White House TechHire Initiative:
https://www.whitehouse.gov/issues/technology/techhire.

BOX 7 - MEDELLÍN, CATALYZING BOOTCAMPS INITIATIVE IN A CITY

An example of a relevant government intervention is the Municipality of Medellín in Colombia, which has supported the expansion of coding bootcamps in the city in partnership with the World Bank (as part of the Decoding Bootcamps initiative), in particular to target young people with limited skills and low income with technical training. Ruta N,[14] a public joint venture between the city of Medellín and the Empresas Públicas de Medellín (EPM) conglomerate whose mission is to promote innovation in the city, took the lead within the city government to introduce bootcamps. Ruta N subsidized the first bootcamp to be provided in the city to test its feasibility and reception by local industry and employees. After the positive market response, Ruta N with the World Bank expanded the scope of bootcamps to train young people with lower incomes, offering subsidies according to the participant's income level. The Youth Secretariat of the Municipality of Medellín, the EPM Foundation, and Microempresas de Colombia donated space and lent computers for the training. Ruta N also assessed the market potential for junior and senior developers in the city (to evaluate the gaps and need for bootcamp education) and partnered with the World Bank for the impact evaluation, which forms part of the Decoding Bootcamps initiative, in order to evaluate the impact of the coding bootcamp on youth employment in Medellín.

Sources: http://www.rutanmedellin.org/es; http://www.decodingbootcamps.org/about/.

BOX 8 - FINANCIAL SUPPORT SCHEMES

With tuition fees typically of about $1,200 or higher in developing countries, there is a risk that this training option is not feasible for those on low incomes. To facilitate local social inclusion and access to the opportunities offered by bootcamp training, financing support based on income may be provided. Policy makers can support by catalyzing financing options from the private sector or charities or alternatively provide support directly through government programs. The two most common intervention mechanisms are: (i) direct subsidies to students based on family income (for example, Medellín); and (ii) financial support to students through soft loans offered by a financial intermediary.

Typically, financial support schemes provide soft loans (at zero or low interest rates) to students that qualify (that is, candidates accepted for bootcamp with income levels within a certain threshold) to cover tuition fees (or part of it). The loan has to be repaid after completion of the bootcamp if they are employed (usually there is a deferral period of 1-3 months) until repayment. Usually this function is assigned to a financial intermediary. The funds for this option function as a revolving loan facility and can be reused for future batches of students.

An advantage of schemes that provide financial incentives is that they reinforce life and business skills that are provided as part of the curriculum in many bootcamps related to financial management. However, this option can be more complicated to operationalize.

has experimented with low-interest loans tied to employment outcomes as well as an instalment structure to enable lower income students to afford the training course. However, this requires increased risk and shifts in their business model and new fundraising efforts targeting public and private funds. In Lebanon, SE Factory raises funds to reduce bootcamp fees, and World Tech Makers in Medellín was supported by the World Bank and Ruta N to offer high subsidies for trainees from low-income segments, which has enabled a significant increase in participation from income strata 1 and 2 of the population (see Box 8).

Through public-private partnerships, policy makers can also encourage and lower the risk for private-sector employers to test the hiring of bootcamp graduates from all backgrounds for low entry-level tech jobs. In Kenya for example, several tech start-ups that hire from the Moringa School revealed in discussions with the authors of this report that they pay little attention to the formal education background of candidates, rather focusing on testing their ability to do the job and continuously grow and learn.

However, many more traditional companies still place greater emphasis on formal education even though they report a dissatisfaction with the skill quality of university graduates. Such a partnership may encourage employers to shift their hiring practices towards a more efficient and more inclusive approach. For example, the U.S. government formed public-private partnerships through the TechHire initiative to secure new apprenticeships for trainees from disadvantaged population segments, such as veterans.

CASE STUDIES

In selecting the following case studies, the World Bank has chosen bootcamp providers that were well established within developing countries that: 1) have a mature (or maturing) innovation ecosystem, or; 2) have partnerships with bootcamps in developing countries, helping catalyze these programs.

READY-TO-WORK MODEL	HACK REACTOR LABORATORIA MORINGA SCHOOL SE FACTORY WORLD TECH MARKERS
EARLY EDUCATION MODEL	CODE RISE

HACK REACTOR

LOCATIONS & PARTNERSHIPS:

GENERAL INFORMATION:

Legal structure
For-profit enterprise

Number of years in operation
4 years

Number of students trained (to date)
~3000 students

BOOTCAMP PROGRAM:

Cost to participants
$17,780

Duration of the bootcamp
12 weeks for onsite and online programs

Bootcamp participants
Open to all participants

Bootcamp curriculum
Full-stack software engineering and JavaScript programming

Hack Reactor is a for-profit company that operates a coding bootcamp in San Francisco, Los Angeles, Austin, and New York City, as well as a remote online bootcamp. Hack Reactor partners with Moringa school in Kenya and ReBootKAMP, RBK, a bootcamp supporting Syrian refuges across the Middle East and North Africa (MENA). In providing expertise and curriculum support, these partnerships have been instrumental in kickstarting the creation of these bootcamps in emerging economies.

Hack Reactor focuses on a single core program that teaches students JavaScript and full-stack software engineering. The program is highly intensive, as a 12-week full-time program that requires approximately 66 hours per week and a part-time program that spans nine months. About 3000 students have graduated from the program to date with 470 graduating in 2015. Program tuition is $17,780, but 91 percent of students are employed within six months, with an average salary of $105,000 (in San Francisco). To help finance tuition, Hack Reactor works with Climb and Pave, both alternative online lenders focused on student loans and personal loans respectively.

About the Bootcamp

The founding team started Hack Reactor with a mission to empower people to get a software job using an outcomes-focused curriculum. Whereas a formal university education teaches and shapes students using theoretical learning, Hack Reactor's only objective is to prepare students to step into a software engineering role after graduation.

Business Model

Hack Reactor is a for-profit company that charges a tuition fee to students for its training program. Students can take up to three years to pay for their tuition, through the aforementioned lending partners, and these partners can also provide loans for housing and other expenses. Since lending is done through third-party providers, with interest costs passed on to students, Hack Reactor is able to collect full upfront payment for tuition from each student. Other affordability options for the onsite program include the Hack Reactor Scholarship Fund, a $1.3 million award funded by Hack Reactor for people who demonstrate a commitment to launching their career in software engineering. There are also sponsored scholarships with community partners such as Women Who Code ($600 scholarship) and corporate sponsors such as Docker and Optimizely (full scholarship). Hack Reactor offers scholarships for the online Remote Beta program for those that have attended other coding bootcamps in the past as well as for U.S. veterans.

Hack Reactor's Remote program is a highly immersive online program that mimics the experience of being onsite. Within the Remote program, there is a full-time option (12 weeks) or a part-time option (nine months). Mentors, classmates, and pair programming are still part of the program, through video conferencing and online collaboration tools. However, programming lectures are recorded and shared with enrolled students, with marginal costs of instructor lecture time. Another cost advantage with the online program is savings on real estate; the bootcamp can enroll more students without expanding their space and square footage.

The most important factor in Hack Reactor's success is its network of employers. The bootcamp has 300 hiring partners, including Microsoft, Intuit, JPMorgan Chase, Slack, and Booz Allen Hamilton. In initial cohorts, class sizes were fifteen to twenty people. Currently, cohorts are capped at eighty students and new cohorts begin every seven weeks. At this projected rate, Hack Reactor should train 550-600 students per year, translating to $11.5 million to $12 million in annual revenue from the onsite program.

Curriculum and Program

The Hack Reactor curriculum is highly intensive, beginning with 50-70 hours of prebootcamp preparation. During this period, admitted applicants are expected to submit deliverables and hit milestones or risk their admission into the program being revoked. Once the bootcamp begins, student schedules are generally fixed at

eleven hours per day for six days a week, with no absences allowed except for illness and family emergency. The vast majority of in-class time is focused on technical skills. However, time is allocated for students to attend fitness classes at a local gym, with membership subsidized as part of tuition. Also, events are held during each of the six evenings per week; these events feature guest speakers from local technology companies, allow students to undergo mock interviews with mentors, and encourage students to work on miniprojects with various guest teachers, most of whom are industry professionals.

In addition to typical lectures and demonstrations of programming techniques, the curriculum emphasizes pair programming, where two programmers work together on the same project at the same time. The students alternate at the keyboard and the person not actively programming watches for errors, actively giving feedback. Pair programming has been proven to "improve design quality, reduce defects, reduce staffing risk, enhance technical skills, and improve team communications at statistically significant levels" (Cockburn and Williams 2000). Students work in pairs to complete two-day "sprints," which mimics work deadlines, collaboration, and communication. Overall, the entire curriculum is designed to simulate a software engineering job environment. For instance, projects and sprints often include simulated broken tests (programs written to test other programs that do produce coherent results) and incomplete documentation (insufficient information on how an application, tool, or library works and is meant to be used).

Some of the specific skills taught within the program include JavaScript, Node.js, Angular.js, Backbone.js, jQuery, HTML, CSS, and agile software development. From conversations with program alumni and employer partners, Hack Reactor instructors are able to determine the skills, platforms, tools, and frameworks that are most relevant in the workplace. This is primarily a qualitative approach, with decisions driven by informal conversations with industry professionals. They also ask for feedback from their network of employers several times each year to inform curriculum decisions. Hack Reactor's largest curriculum decision, the language on which to focus, was based on specific feedback from employers. The team was told that JavaScript was most in demand, so they formed their curriculum around the language.

The core curriculum of the program is completed in the first six weeks, with the next six weeks dedicated to completion of a personal project. Hack Reactor Part-Time has a similar layout, but is spread out across nine months. Some of the projects that have come from Hack Reactor students include SongLink (featured on Lifehacker and Product Hunt), Purify CSS (featured on the front page of Hacker News), and Dreamify (featured on Wired, NBC, and The Next Web). Personal projects are selected based on the ideas and personal interests of each participant; it is the participant's responsibility to conceive and brainstorm features for a product, with guidance from the instruction team. Hack Reactor prioritizes its students working on projects in which they are interested, even if there may not be market demand for their product.

Bootcamp Participants

Applications begin with a basic JavaScript programming challenge as well as a written application. After an initial screen of written applications, applicants are given an interview. A majority of the interview is spent on an interactive coding challenge that an instructor guides applicants through. The application process optimizes for a genuine interest and motivation to learn, assessed through how much time an applicant has spent learning JavaScript on their own prior to the interview.

According to Hack Reactor, the program is not intended to bring a student from "0 to 100" but rather from "20 to 120," meaning participants need a baseline level of JavaScript knowledge to excel. Students are generally not unemployed but rather are hoping to make a career switch; the vast majority of these students have a postsecondary degree not related to computer science or software engineering. Still, there have been cases where homeless applicants were given scholarships to participate, through a partnership with Code Tenderloin, an organization that encourages technical education in San Francisco's lowest-income neighborhood.

Impact of the Bootcamp

99 percent of onsite graduates and 95 percent of online graduates are employed in full-time software engineering roles within six months, with average salaries of $104,000 and $94,000, respectively. Salaries ranged from $50,000 to $179,000 in 2015. The one percent of onsite graduates not employed in full-time roles within six months were all employed in technical internships. These employment figures exclude exemptions accounting for 19.7 percent of students. Six percent of students opted out of Hack Reactor's career services program, but the remaining 13.7 percent of exemptions include students who did not have legal authorization to work in the United States, were hired by the school itself, started companies, or had family emergencies.

In addition to Hack Reactor's own partner employers, program graduates have been hired by companies including Google, Facebook, Palantir, Adobe, LinkedIn, and Uber.

The employment track record stems from a curriculum built to serve employer needs as well as interview and résumé preparation sessions. Technical interviews often have a specific format with similarly structured questions, so Hack Reactor is able to prepare students for these types of interviews. The format generally involves asking the student to apply or create an algorithm or data structure to solve a simulated problem.

In 2014, Hack Reactor partnered with Moringa School, creating a pathway to Kenya's growing tech sector. Hack Reactor provided support in curriculum design, consulting services and also sent graduates to the Moringa School to work with teachers and students in a seven-week fellowship. Hack Reactor is also a founding partner of ReBootKAMP, RBK, a bootcamp provider operating in the Middle East supporting Syrian refugees.

In June 2016, Hack Reactor developed a proprietary coding bootcamp monitoring and evaluation (M&E) framework called the Standard Student Outcomes Methodology (SSOM). This methodology creates standards around listing students, assigning outcome codes, assigning job search dates, computing metrics, and obtaining student response confirmations. The framework has been made publicly available for any coding bootcamp to use in order to publish reliable outcomes data.

In March of 2017, Hack Reactor became a founding member of the Council on Integrity in Results Reporting (CIRR). CIRR is the industry gold standard for educational outcomes reporting and every coding bootcamp in CIRR will use a unified outcomes methodology, allowing for standard comparison of schools. Fourteen other leading bootcamps have joined Hack Reactor in this new coalition.

Sources

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CS50
Mayúscula
DELL
ThinkPad
CHAMBEAR, VENDER, Y COBRAR
satisfaction

LABORATORIA

LOCATIONS & PARTNERSHIPS:

GENERAL INFORMATION:

Legal structure
Nonprofit social enterprise

Number of years in operation
2 years (mid-2014)

Number of students trained (to date)
400 students

BOOTCAMP PROGRAM:

Cost to participants
$1,800 for graduating the program, ~$2,500 for students that get employed

Duration of the bootcamp
24-month program (6 months bootcamp + 18 months of continuing education)

Bootcamp participants
Low-income women from 18 to 35 years of age

Bootcamp curriculum
Technical skills (HTML5, CSS3 and JS) and soft skills

Laboratoria is a coding bootcamp and a continuing education program that combines applied coding education, psychological training, and deep employer engagement to create opportunities for students. The bootcamp has four locations within Latin America that target low-income women from 18 to 35 years of age. Laboratoria is a social venture where students pay for the program in low monthly installments, but after they have completed the six-month bootcamp and only when they have a secured job.

Laboratoria's curriculum is designed to produce globally competitive front-end web developers. Students learn to code user interfaces for web applications using HTML5, CSS3, and JavaScript. Four hundred students had graduated from the program by the end of 2016.

About the Bootcamp

Laboratoria began with its first pilot in Lima, Peru in mid-2014. The founding team had met while completing their Master's of Public Administration at Columbia University. They gravitated toward social entrepreneurship but began by starting a web development agency in Lima. In this endeavor, they experienced the increasing demand and lack of supply of technical talent first hand. Around the same time, they noticed a number of coding bootcamp initiatives were having success in the United States and realized that a number of their top employees had come from bootcamp training. In addition, they saw the lack of gender diversity in tech, which prompted them to start Laboratoria as a coding bootcamp for low-income women. Their primary mission is to empower their students to find employment and career opportunities.

Business Model

Laboratoria is a nonprofit social venture that charges a fee for its programming course. However, the fee structure is unique. Students start paying for the 24-month program (six month bootcamp + 18 months of continuing education) after their graduation and only once they find a job. Laboratoria has tried different accessible paying methods and this is the one they introduced from 2017 onwards. The organization depends on fundraising initiatives at local and regional levels to cover their costs, and their goal is to become self-sustainable by 2021. They have obtained about $1.5 million in funding for 2017-2019 from regional and local partnerships with Omydiar Network, DRK, Peery Foundation, the Inter-American Development Bank (IADB) through the Multilateral Investment Fund (MIF), the Government of Chile, and companies such as Google. They have introduced a continuing education program to keep training their students once they enter the workforce, because they believe that a blended model of work-training will help them become world level coders in two years. Additionally, this will also generate a more sustainable business model for Laboratoria, mixed with student payments and payments from developers outside Laboratoria who will join the continuing education program in its second phase of implementation. At a company that has employed a Laboratoria graduate, if this graduate and multiple other employees need to learn a certain technical skill, they can all be trained within the same class. The Laboratoria coder would receive a steep discount while other employees would be charged the full price. In this way, Laboratoria employers can become paying clients.

The organization's entire model relies on deep relationships with partner employers. Initially these companies were small to mid-sized web agencies but several larger organizations have come on board as well, like Accenture, Everis, and the Inter-American Development Bank (IADB). Originally, they tested an internship model but they have found that full-time hiring is more effective. The goal of Laboratoria is to find a personalized match between a student and an employer, an equation that includes both technical skills and personality type. Monitoring is a significant part of this relationship as Laboratoria follows up with employers for three years after hiring, including monthly surveys or calls during the first year. Most partner companies are highly satisfied with the students and many eventually hire more than

one graduate at a time. Through an iterative approach, Laboratoria has been able to use empirical data and qualitative feedback from employers to determine the skills they demand from potential employees. Most partner employers are located in the same city as the bootcamps themselves, but international employment has begun to occur, with companies like Crowdbotics in Boston through remote work.

Curriculum and Program

The Laboratoria curriculum blends technical skills education (60-70 percent of program content) with personal skills training from professional psychologists (30-40 percent of program content). From the technical standpoint, students learn to code user interfaces for web applications using HTML5, CSS3, and JavaScript, while personal skills taught include teamwork, collaboration, creativity, and resilience. This combination is important when considering the high-level objective of Laboratoria's training program: to triple each student's economic value.

Technical skills taught center around front-end web development. This includes: (i) the ability to develop cross-browser interactive web apps using HTML5, CSS3, and JavaScript, (ii) integrating API's REST services to their products using AJAX, (iii) applying programming fundamental concepts to solve logic problems, and (iv) using productivity and collaboration tools like git, npm, gulp, and Sass. Laboratoria chose front-end web development as their focus area because of both demand-side and supply-side factors.

To understand demand for certain skills, the Laboratoria team meets with companies in the Laboratoria Company Network to ask them about specific needs and hiring possibilities. Companies also participate in a survey that includes questions about the tools they use and are planning to use. This all results in bi-annual curriculum reviews.

Meanwhile, personal support is a strong component of Laboratoria's syllabus through its live skills program, which begins at the screening process with psychological testing and evaluation, continues throughout the whole bootcamp with specific activities relating self-consciousness, self-esteem, teamwork, and work abilities and with continued support after graduation. Support includes open lines of communications and frequent check-ins. Laboratoria has found that teaching coding is not necessarily the most challenging part, given the background of their students, the true challenge is usually related to managing logistics, self-esteem, personality, and family issues. The bootcamp has made a number of programming and curriculum pivots since starting. Based on feedback from partner employers, they realized the need to introduce computer science subjects, such as algorithms and data structures. Laboratoria had not been teaching these concepts, but starting to include them based on feedback from graduates and from hiring companies. Also, initially HTML and CSS components of the curriculum took the first month but instructors have begun asking students to learn the languages on their own first, taking free online courses. They came across this approach to learning at other bootcamps and decided to try it themselves. Prompting students to learn some of the basic curriculum on their own has made in-class hours significantly more productive.

The program is full-time over the course of six months including an intensive training schedule. Similar to many bootcamps, Laboratoria can be seen as a more applicable and cost-effective alternative to training and learning offered by more formal education institutions. Moreover, since their target students are low-income women, they are often unable to participate in the formal education system owing to reasons of affordability.

Bootcamp Participants

Laboratoria's model begins with a rigorous selection program that identifies young women with the potential to learn web development. For most recent cohorts of the program, 400-1000 applications were received and 65-85 students were accepted. The screening process begins with a basic written application followed by cognitive, emotional, and personality testing. Applicants that perform well then participate in a two-week preadmission process, in which they trial the Laboratoria experience intensively and the team evaluates their performance, to ensure

potential candidates' commitment to completing the program and finding a job in the industry. Finally, the cohort is selected. One of the most significant parts of Laboratoria's monitoring and evaluation (M&E) structure is a feedback loop that determines the success factors for admitted applicants. As Laboratoria gathers more data on successful graduates, lessons are applied to selecting the next round of candidates.

Impact of the Bootcamp

Laboratoria boasts a 75 percent postgraduation employment rate, with graduates tripling their income within three months of graduation. About half of their students had previously attained a postsecondary education at some point but only 16 percent had obtained a degree. Those who had obtained a degree had often done so from lower-ranked institutions and were unable to get a well-paid job after graduating. Accepted applicants are generally either unemployed or underemployed. The holistic approach to instruction, that includes technical skills education, personal skills training, and job matching, is critical to the bootcamp's overall impact on students and employers. Students are not only educated but matched with job opportunities, mentors, and continuing education at partner companies.

Feedback from companies has been positive, with many of them appreciating the attitude of Laboratoria's graduates: students are trained to ask for help, ask questions, and take the initiative to volunteer for additional tasks. On average, employers rate the quality of graduates at 4 out of 5 and most employers state that they would hire another Laboratoria graduate.

One negative effect that Laboratoria has been looking for ways to mitigate is the traditional role of women at home in many of the families from low-income backgrounds. Some students face family challenges during the program and once they are working and empowered with economic opportunity, since they no longer want to follow a more traditional family path. At the bootcamp phase, they engage the family of each student early in the process, to help them to understand the experience that their daughter, wife, or mother will undergo and why their support is so important both for the success of the student as well as for the family. Currently, they engage with the families of the students at least twice throughout the bootcamp. Laboratoria holds a Welcome Day, where students and their families are invited to learn about the organization, the commitment required from students, skills they might acquire, and the future opportunities within technology. In addition, families attend the graduation day to celebrate the progress and learning of their loved ones

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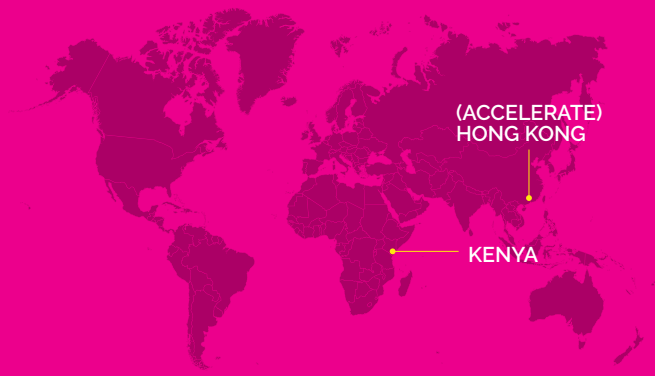
MORINGA SCHOOL

LOCATIONS & PARTNERSHIPS:



GENERAL INFORMATION:

Legal structure
For-profit organization

Number of years in operation
2+ years (since January 2015)

Number of students trained (to date)
97 students in Moringa 1.0
262 Moringa Prep, 99 Core

BOOTCAMP PROGRAM:

Cost to participants
$400 for Prep Full-Time,
$450 for Prep Part-Time,
$1,200 for Core

Duration of the bootcamp
6 months for onsite
and on-line programs

Bootcamp participants
Open to all participants

Bootcamp curriculum
Full-stack software engineering
and JavaScript programming

Moringa School is one of the pioneer bootcamp providers in Africa that aims to transform African higher education starting with software engineering in an education-to-employment model. Nairobi-based Moringa School accepts students from all over Africa and operates as a for-profit entity. The technical curriculum, which includes Android, Ruby on Rails, UI and UX, HTML, CSS, and JavaScript, was developed based on local market needs, taking into account best practices of Hack Reactor and Epicodus, leading U.S. coding bootcamps, to ensure that the quality of Moringa graduates is world-class.

Moringa School has graduated almost 100 developers from Moringa Core and over 260 from Moringa Prep Part time and Full time in Kenya alone. Moringa attracts applicants from more than 10 countries in Africa. Moringa School has plans to expand to three other African countries and open up new skill verticals by 2020. As for other projects and expansion, Moringa School also powers a coding school in Hong Kong (Accelerate), runs Nairobi Tech Week, Sub-Saharan Africa's largest developer event, and an open-source project to create and distribute introduction to coding content to secondary schools across Kenya.

About the Bootcamp

Moringa School was founded in 2014 by Audrey Cheng, who had a background in education, marketing, tech and social innovation, and was formerly with the Savannah Fund and True Ventures. Moringa launched operations in January 2015 and is led by Audrey and Savannah Kunovsky, the chief technology officer (CTO), who had previous experience working with Hack Reactor. Since then, the school has graduated around 200 software engineers within its bootcamp program and over 260 with its pre-bootcamp program, and trained over 5000 students within workshops, other school training and Nairobi Tech Week.

Business Model

Moringa School operates as a for-profit firm, and relies on several revenue sources, namely, tuition fees ($400 for Moringa Prep Full-time, $450 for Moringa Prep Part-time and $1,200 for Moringa Core), school training ($150 per two-week course), and job placement fees (first month's salary).

Moringa School aims to attract high-potential students irrespective of their socioeconomic background. Students have the option of borrowing funds for tuition fees from Kiva, an international nonprofit with a mission to alleviate poverty. Partnership with Kiva was secured because of its proven track record of close to a 95 percent employment rate for Moringa School graduates, and a 350 percent increase in their salaries. Moringa is currently finalizing partnerships with third-party loan providers to take the responsibility of loan collection out of the school.

Curriculum and Program

The objective of Moringa School is to transform higher education in Africa, starting with software engineering. Moringa's vision to improve access to high-quality, market-driven education is reflected in the bootcamp curriculum. Moringa Core's 19-week, project-based course focuses on peer-to-peer learning and practical applications of the material, using a blended learning pedagogy where top technical mentors help students throughout the process. Students are in the classroom from 8:30am to 6pm Monday to Friday, with optional evening and weekend opening hours. During that time, students work through practical project- and skills-based assignments, in pairs, groups, and individually. Morning "standups," adopted from agile methodology, are morning student-run lectures with the purpose of ensuring that all students are on track with content. Evening peer-review is a peer and self-reflection period where students give feedback on themselves and their pairs. Each week, Moringa's students experience talks by industry insiders, feedback sessions, one-to-one sessions with technical mentors, and team-building games. The Moringa team is currently in the process of developing an updated curriculum that would incorporate new career-focused activities, and reflect the changing paradigm of education: paced education, purpose learning and lifelong learning, concepts similar to the Stanford2025 project. Their ambition is to pioneer Education 2.0

in Kenya, relying on emerging best practice from world class education providers: for example, by switching from major-based learning to purpose-based learning. The expansion plans are therefore rooted in quality rather than quantity.

In September 2016, Moringa School moved from a traditional lecture-style teaching method to a blended learning approach, in which students have more ownership over their own learning experience. This learning model has also proven to scale extremely effectively – into Hong Kong already and more markets in Africa in 2017.

According to Audrey Cheng, the cofounder and chief executive officer (CEO) of Moringa School, evaluating the local demand for programmers and specific coding languages has been challenging, as limited market data is available for Kenya and other local markets. Hence, the school collects market research data itself, focusing on the needs of its partner employers and collecting their feedback. One part of Moringa School curriculum (including workshops) was developed in-house in order to take into account the needs of local employers, while another part (particularly tools and teaching methodologies) was adopted from Hack Reactor and Epicodus, two of the major U.S.-based bootcamps.

The partnership with Hack Reactor and Epicodus revolves around mentorship and advice on best practice in the curriculum and teaching methods. One former Hack Reactor employee also joined the Moringa team as the CTO.

The Admissions Process

Through the admissions process, potential students apply online to Moringa Prep in which they share the core of their interest in learning how to code. After students apply online, they are invited for a face-to-face interview with a technical mentor so that the Moringa team can assess whether the applicant is a strong cultural fit for the Moringa Prep program. Once accepted, Moringa Prep serves as an extended admissions process into Moringa Core. Students must demonstrate strong interpersonal skills and ability to learn and apply quickly through Moringa Prep in order to qualify for Moringa Core. Applicants who wish to skip Moringa Prep and directly join Core undergo a more intensive admissions process, where they need to complete coding assignments and discuss this assignment with a technical mentor in a longer interview. These applicants must demonstrate the practical skills that all students learn from Prep and be able to successfully complete all of the projects that Prep students finish before joining Core.

Moringa's Course Offerings and Career Support

The intensive Moringa Prep and Core courses run five days a week from 8:30am to 6:30pm. Moringa Prep covers the fundamentals of programming, while Moringa Core is track-based (either full-stack or mobile). In the full-stack track, students undergo five week modules on JavaScript, Ruby, and Rails, and a four-week project period. In the mobile track, students undergo 5 week modules on JavaScript, Java, Android, and a four-week project period. Every Friday, and the 5th week of each module, students undertake a project to creatively apply the skills they have learned up to that point.

The school sees itself as a world-class career accelerator with direct education-to-employment; hence, strong career focus is one of the key characteristics of their program. The career component is integrated throughout the bootcamp program, with ongoing professional development sessions; students are also introduced to the tech ecosystem in Kenya via weekly presentations by speakers from the industry. Moringa maintains relationships with over 50 hiring partners who provide speakers for weekly presentations, attend the Hiring Day at the end of the program, and conduct interviews for open positions in software engineering in their firms. Students pursue full-time employment with these firms upon completion of Moringa Core. The school constantly collects feedback from partner employers in order to provide necessary updates to the curriculum and stay relevant to the job market's needs.

Bootcamp Participants

Moringa School applicants come not only from Kenya, but also from other countries across Africa, including Nigeria, Burundi, Rwanda, and South Sudan. Moringa 1.0's selection process was highly competitive: according to Audrey Cheng,

the cofounder, around 1000 people applied for the bootcamp program between January 2015 and September 2016, over 10 times more than those who were admitted and actually received the training (97). Moringa 1.0's dropout rate has been low, with only three students leaving the program without graduating. Moringa 2.0 (Moringa Prep and Core) continues to attract students from over 10 countries on the continent and sees a much higher admissions rate, because the demand for Moringa is high and the team believes in greater access to high-quality education.

Overall, Moringa School looks for inquisitive, intelligent students with great capacity to learn. In order to be successful in the bootcamp, students should be open to feedback, receptive to being coached, and willing to lead others. Finally, successful bootcamp participants not only seek technical skills, but want to provide the best possible user experience through the products they develop, and be holistic contributors to the tech industry.

Moringa School targets high-potential students: in its first cohort, Moringa only accepted five students out of 120 applicants, and it has sustained a competitive acceptance procedure, with about an 8 percent acceptance rate up to September 2016. In Moringa 2.0, the team decided to continue its tough selection process for the Core course, but open up access to the introductory course to more students across Africa. This increases the likelihood of students who have never programmed before to be able to successfully join Core. Being selective in its admissions is part of the School's philosophy: the founders emphasize the focus on quality of students and teaching as the primary goal, which also helps ensure high-employment rates postgraduation. The bootcamp program of Moringa School attracts students with diverse backgrounds: 64 percent are university graduates, 24 percent are current university students, and 12 percent are high school graduates. In terms of gender, 64 percent are male, and 36 percent female. The focus of the bootcamp is to make its graduates employable; in fact, only 28 percent of participants have jobs before the bootcamp, hence the skills they acquire are paramount to finding jobs upon graduation.

Prior knowledge of coding is not required to participate in the Moringa School bootcamp. While some students have degrees in computer science, few have worked as programmers before. Through Moringa Prep and Core, the bootcamp ensures that students have a certain degree of technical proficiency and potential to grow.

In order to do well during the bootcamp, it is important to ask questions, work as part of a team, especially helping others, as well as be tenacious, driven, hardworking, passionate and patient. After the bootcamp, interviewing skills and communication skills in general are particularly important, as is determination to find a job. Moringa School offers a comprehensive professional development and post-Moringa job support program to graduates.

Impact of the Bootcamp

Moringa School has trained over 500 students through its various programs (including workshops, school training and full-time courses). In addition to the full-time program, Moringa has provided more than 20 workshops to the external community, as well as hosting and organizing the Nairobi Tech Week, Sub-Saharan Africa's largest tech event. Moringa also organizes training at secondary schools (for example, Oshwal Academy) to improve coding skills among young people, and in 2017 is releasing a free, open-source coding curriculum to secondary schools across Kenya. Moringa School has graduated over 260 Moringa Prep students and almost 100 Moringa Core students in Kenya alone. Through partnerships with hubs or organizations across the African continent, Moringa School plans to train over 180 students externally through Moringa Prep. Moringa School also provides curriculum and training advice to Accelerate bootcamp provider in Hong Kong.

Moringa School reports a 95 percent job placement rate, with graduates working at leading tech companies, such as Safaricom, Barclays Bank, Cellulant, and Craft Silicon. After the bootcamp, Moringa graduates find employment as full-time software engineers, freelance consultants, or become entrepreneurs and found their own companies. Few students go back to uni-

versity to continue their studies. As a rule, students' incomes improve dramatically after the bootcamp: with an average of 350 percent salary increase and full-time employment as software engineers, bootcamp graduates improve both their social standing and the caliber of tasks they are exposed to. With the level of skills learned, they can contribute at a high level to the projects on which they have been hired to work.

Moringa School sees its programs as complementary to local university courses as a way to address the practical skill-set necessary for employment in software engineering. However, in its effort to improve the quality of education in Africa, Moringa School has established a partnership with Carnegie Mellon University in the United States to fast-track bootcamp graduates into its masters programs.

Moringa School targets regional demand for programmers not only in Kenya, but across the African continent: 10 different African countries are represented among bootcamp applicants. As for bootcamp participants, they come from Kenya, as well as from South Sudan, Nigeria, and Rwanda. The school relies mostly on informal channels (for example, feedback from partner employers and through surveying developers) in order to evaluate demand. While Kenya was chosen as a bootcamp location because of the founders' familiarity with the local market and prior experience of working there, the presence of students from other African countries has led to cross-border focus in terms of partnerships and job market targeting. Irrespective of geography, key reasons to apply for the bootcamp include effective teaching of highly relevant for the market skills, proven track record of placing students in high-quality jobs, and a network of employers and alumni that form a lifelong community. The bootcamp positively influences individual students, as well as society in general: training world-class Kenyan developers and contributing to the backbone of the African tech ecosystem.

According to Audrey Cheng, the bootcamp cofounder, the program has already had effects beyond Kenya: first, Moringa School provides informal mentorship to other bootcamp programs across the world (some examples include Israel and Zimbabwe); second, it has proven effective in preparing people for jobs in other countries (for example, Hong Kong). Moringa School also reaches people across social spheres, as it offers affordable tuition-fee loans through its partnership with Kiva. The bootcamp is currently trying to attract more women to improve the gender equality component of its program.

The main positive effect of Moringa School is building life skills that enable bootcamp graduates to be competitive in any industry. Students can use the steep learning curve employed throughout the bootcamp as a model to emulate when learning new skills throughout their careers. Currently, bootcamps typically do not provide continued training after the course end. However, Moringa School is in the process of addressing this issue, as they are soon to launch a "lifelong learning" service offering additional courses to its community of alumni and team members. Hence, members of the Moringa School community will be able to take additional courses even after finishing the bootcamp – both to learn new skills and to enhance their expertise in their own area of work.

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TOSHIBA

SE FACTORY

LOCATIONS & PARTNERSHIPS:

GENERAL INFORMATION:

Legal structure
Nonprofit organization

Number of years in operation
1+ year (since March 2016)

Number of students trained (to date)
22 students

BOOTCAMP PROGRAM:

Cost to participants
$100

Duration of the bootcamp
3 months, 3 times a year

Bootcamp participants
Computer science/engineering graduates

Bootcamp curriculum
Full- stack web development (Apache, SQL, PHP, etc.)

SE Factory (Software Engineering Factory) is a Beirut-based, Lebanese coding bootcamp that teaches the technical and socioemotional skills necessary for professional full-stack web development. The motivation to found the SE Factory bootcamp was rooted in trying to solve a two-fold problem in the Lebanese tech scene: on one hand, companies face the shortage of developers, and on the other hand, computer science graduates (especially those from second-tier universities) lack the skills to find employment as software engineers.

The bootcamp seeks to solve this problem by equipping computer science graduates with the necessary practical skills, hence increasing their employability and providing the final push necessary to improve their earning capacity

The bootcamp only accepts applicants with preexisting foundational knowledge in computer science, and thus typically computer science/engineering students or graduates, and seeks to provide them with the most up-to-date programming languages and tools to make them employable as junior web developers. SE Factory operates as a nonprofit organization with a mission to improve employability and improve economic prospects for computer science graduates from less-privileged backgrounds. The bootcamp curriculum covers full-stack web development technologies, including LAMP (Linux, Apache, MySQL, PHP), HTML/CSS, JavaScript, and so on, in addition to tools and best practice expected of professionals in the field. As of March 2017, SE Factory has graduated 22 students in Beirut through two sequential batches, achieving 90 percent employment success postbootcamp, with a third batch currently underway, and is aiming to expand into other cities in Lebanon in the coming years.

About the Bootcamp

SE Factory was founded in March 2016 by Fadi Bizri, a Lebanese venture capitalist with a background in engineering (currently Partner at B&Y Venture Partners and previously cofounder at Seeqnce and Speed@BDD, respectively the first and second tech start-up accelerators in Lebanon) and Zeina Saab, founder of Nawaya Network, a youth empowerment NGO. This initiative builds on two NGOs –Bader Young Entrepreneurs Program and Nawaya Network– in both of which the SE Factory founders have been deeply involved. The bootcamp seeks to solve the problem of unsatisfied demand for skilled software engineers in Lebanon by providing the necessary training in modern programming tools to underemployed computer science/engineering graduates, in addition to the necessary socioemotional skills (teamwork, interviewing, conflict management, pitching, and so on) that enhance success in the workplace. The founders' background in the Lebanese tech industry led them to develop a good intuition for the needs of the ecosystem, and hence the bootcamp emerged as a response to the lack of programmers. One differentiating factor of this program is its focus on below average income earners, as SE Factory seeks to strengthen Lebanese middle class and improve employability prospects of computer science/engineering graduates from second-tier universities. Hence, affordability of the bootcamp is paramount to its mission.

Business Model

SE Factory currently operates as a nonprofit, funded by grants from international organizations, as well as via sponsorship. The first session was supported by the Asfari Foundation, Al-Mawarid Bank, Bank Audi, and Berytech. These donations covered the costs of running the bootcamp, which are estimated at $30,000-40,000 per batch (three months teaching to about 15 students as well as marketing and outreach to attract applicants). Student contributions of $100 each cover less than 4 percent of the operational costs, but serve as a commitment tool rather than a means of financing the bootcamp training. This funding model was chosen to deliver highly affordable training in line with the mission of facilitating upward social mobility, without compromising the quality of the bootcamp curriculum.

SE Factory places great emphasis on the quality of instruction. According to Fadi Bizri, the Program Manager and cofounder, one of the key success factors has been finding the right person for the

position of Technical Director, who is responsible for the curriculum and instruction. Because top professionals in the IT sphere are typically well compensated by working in the industry, attracting highly motivated and particularly skilled instructors who would share the mission of the bootcamp might be a challenge. In line with this rationale, the Technical Director's remuneration accounts for 40-50 percent of the bootcamp cost. All of the bootcamp's technical instruction is currently undertaken by the Technical Director, but further expansion of the program will call for more instructors. The 2 to 3 weekly socioemotional skills workshops and talks by speakers are provided on a pro-bono basis. Other costs include hiring premises and small operational items such as stationery.

SE Factory works with universities in trying to attract its students. Its outreach campaign focuses on finding champions of its bootcamp program among university students, professors, and staff, to encourage students to apply. Attending university events and word-of-mouth from other bootcamp graduates are also used as promotion channels. Overall, the bootcamp positions itself as an extension of formal university education rather than as a substitute for it. In parallel, online social media campaigns are implemented to increase brand awareness and exposure.

Curriculum and Program

SE Factory curriculum focuses on technical skills (80 percent of the program content), and complements those with socioemotional skills necessary for web developers (20 percent of the content). The curriculum was developed in-house, by combining best practice from international bootcamps (for example, Dev Bootcamp, Hack Reactor) with local market demand. The team emphasized the need to adapt the curriculum to the local context rather than simply replicate the approach of U.S. or European bootcamps. The founders' familiarity with the key players in the Lebanese tech scene provides an intuitive demand assessment and curriculum structure. For example, SE Factory teaches PHP (server-side programming language for web development, which can also be used in general-purpose programming) rather than Ruby (object-oriented general-purpose programming language), since in Lebanon the demand for PHP programmers is much higher.

In general, SE Factory bootcamps teach full-stack web development, covering the following topics:

1. Infrastructure (HTTP and messaging patterns, networking, virtualization, operating systems cloud architecture), deployed on either Amazon Web Services, Heroku, VPS (DO), or Google Developer Console.
2. Back-End (Apache, MySQL, SQL, PHP, PHPUnit, Slim Framework), aimed at achieving proficiency in entire LAMP stack (Linux, Apache, MySQL, PHP), unit testing and web development within an MVC framework.
3. Front-End (HTML/CSS, XML, JavaScript, JSON, REST), aimed at building interactive and event-driven client-based applications with JavaScript.

In addition to actual programming languages, the bootcamp material covers the tools necessary in all web development tasks: source control (Git), integrated development environment, IDE (Sublime Text, Atom, or Vim). Best practice project management tools (Asana) and communication tools (Slack) are also an integral part of the curriculum.

SE Factory's bootcamp runs for 14 weeks, Monday to Friday, 10 am-7 pm. This intensive training schedule requires full commitment to the program, and typically students cannot pursue work or studies at the time of the bootcamp. Technical sessions are combined with presentations from industry insiders to illustrate career prospects. During the last two weeks of the bootcamp, students work on their own project, in which they develop a web application of their choice. Final projects typically require the skills learned throughout the program. The program ends with a Demo Day, during which students present their projects to potential employers.

The Demo Day works as part of the recruitment process, allowing students to showcase their work to potential employers. Partner companies, which are part of the SE Factory network of employers, are typically established corporations or well-funded start-ups. There is no obligation

from their side to hire SE Factory graduates, but they are invited to attend SE Factory events and are given an opportunity to assess students' projects. Students work throughout the program to develop their professional portfolio, including programming full web or mobile applications that serve as their final projects. The bootcamp aims to facilitate students' job search through introduction to potential employers, and partner companies have first-hand access.

Bootcamp Participants

SE Factory primarily targets computer science/engineering graduates from the larger Beirut area who are highly motivated to learn and become employed as web developers. Tuition fees are deliberately kept low ($100) in order to make the bootcamp affordable to people from all socioeconomic backgrounds. The motivation for this model emerged from the founders' background in NGOs (Bader Young Entrepreneurs Program, The Nawaya Network) that seek to empower young people. According to SE Factory cofounder Fadi Bizri, the bootcamp is especially attractive to students of below-average income who could not afford education at top-tier universities and hence are often left behind in the labor market. The bootcamp program can level the playing field for computer science graduates from second-tier universities, making them competitive in the labor market for web developers. While the program is still at an early stage, with the third cycle underway and 22 graduates as of March 2017, early impact is highly promising with 90 percent of graduates finding employment postbootcamp at market salaries. These are good signs for SE Factory's unique formulation of being able to successfully help lower-income youth to access good jobs in a short timeframe.

To satisfy the minimum selection criteria, bootcamp applicants should: 1. have a university degree in computer science/engineering or have proven foundational knowledge in computer science fundamentals; 2. have basic English proficiency; 3. be able to commit to full-time attendance of the bootcamp; 4. be highly motivated to pursue the bootcamp education (as assessed through interviews). These criteria are tested through an online application, which covers educational and professional background, as well as asking for the personal assessment of various software development skills, socioemotional skills (for example, project management) and English language skills. The online application also includes a questionnaire on expectations from the program and ability to commit to attending the bootcamp on a full-time basis. Successful applicants who pass the online application round are invited for interview, which are conducted either by phone or face to face. The main purpose of interviews is to assess the level of motivation of the applicants and to verify claims of having acceptable tech/language proficiency.

Impact of the Bootcamp

As SE Factory is a new bootcamp, it is still too early to evaluate its impact. However, the bootcamp founders believe that high employment rates among graduates and improved earnings are two of the most important effects to achieve. According to Fadi Bizri, SE Factory trained graduates can earn about three times more postbootcamp compared to their initial salary. For those employed as junior web developers in Lebanon, the target salary is $1,500 per month. The rapid buildup of skills and the resulting salary improvement are two main reasons to apply for the bootcamp.

In SE Factory' experience, in order to do well during the bootcamp (as well as after), drive and motivation are important conditions, and knowing the basics of computer science (gauged during the selection process) is necessary as well. Based on the experience of the first cohort, the impact on students' lives can be tremendous: the bootcamp typically empowers people to pursue opportunities well beyond their initial range of options. For example, moving from short-term unskilled jobs outside of the computer science area, and tripling the salary is one way of improvement.

SE Factory currently targets the local demand for web developers and mobile developers. The ambition of the bootcamp is to scale nationwide and open new locations throughout Lebanon in order strengthen the knowledge economy, as well as strengthen the Lebanese middle class. While Beirut is a natural starting point, the effect of the program is currently reaching countrywide.

In terms of social spheres, the lower-middle class is the target segment on which the program has the most impact. However, the impact is not likely to extend to the poorest segments of the population, as the program focuses on relatively educated students with existing English language skills and computer science degrees.

The key positive effects of the bootcamp are not limited to building new skills, but also include the sense of community and engagement among the bootcamp participants and alumni. Going beyond the technical training, SE Factory aims to transform its students' lives by facilitating upward social mobility. Building a strong network of bootcamp alumni and participants is especially important in order to achieve this mission.

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WORLD TECH MAKERS

LOCATIONS & PARTNERSHIPS:

GENERAL INFORMATION:

Legal structure
For-profit corporation

Number of years in operation
3 years (May 2014)

Number of students trained (to date)
650+ students

BOOTCAMP PROGRAM:

Cost to participants
$2,000 in Colombia, $3,500 in Brazil, $499.99 per month for online programs

Bootcamp participants
Open to all participants. Primarily men between the ages of 18-35

Duration of the bootcamp
3 months for onsite programs, 1 week-2 years for online programs

Bootcamp curriculum
Different programs focused on Ruby on Rails, iOS, Android, JavaScript

World Tech Makers (WTM) is a technology education company offering onsite coding bootcamps and STEM eLearning solutions for individuals and/or organizations. The company has operations in four physical coding bootcamp locations across three different countries. With clients across the globe, World Tech Makers specializes in vocational training for young people and adults, along with K-12 STEM training for children and teenagers.

Regarding the onsite coding bootcamps, the organization focuses on emerging economies (mostly in Latin America) and trains students in web and mobile technologies, with programs ranging from 8 to 12 weeks in both part-time and full-time intensity levels. The programs are also offered online with remote connections (LIVE).

The company offers financial aid assistance for low-income students and the cost of the program ranges from $2,000 to $3,500 for the part-time onsite bootcamps.

Full-time and part-time courses exist for Ruby on Rails, iOS, Android, and JavaScript. Over 800 have completed the WTM program to date.

About the Bootcamp

The founding team of WTM had met online on Facebook. Ilya Brotsky was doing social impact work in Sao Paulo and Ilana Milkes was completing her second master's degree in Chicago. On a trip she made to Brazil, they finally met personally and decided to launch WTM. Prior to this, she had been working at a coding bootcamp in Chicago, where she had acquired a set of technical knowledge. During this time, she had attempted to convince more developed American bootcamps to expand to Latin America. Having grown up in Colombia, she saw the demand for high-quality technical talent in her home country. However, she received feedback that the margins in Latin America were too low to justify an expansion for a private, for-profit company.

Both cofounders had a passion for education and from Ilana's experience with coding bootcamps, she understood the global shortage of programmers. The team felt that they could fill a need in the Latin American market, while working in a sector they were passionate about. WTM was started with a mission to destroy the mental archetype that coding is too difficult and complex to learn. They hope to teach people and have them stay in the region for years to come.

The bootcamp's first Brazil location was started by a cofounder who had been working with NGOs in the area at the time. After winning the Startup Chile competition, WTM opened up a bootcamp in Santiago as well (now closed). After announcing their first bootcamp cohort, to build an initial base of interested applicants, WTM created a Facebook page and website for the Sao Paulo and Bogota locations. Despite spending just $500 on social media advertising, the team has found that more than half of its applications now come online.

Business Model

WTM is a for-profit that charges a tuition fee to students of its training programs. Physical bootcamp fees depend on location, and online fees range from $14.99 to $499.99 per month. Location-specific fees were decided based on income levels within the cities as well as initial demand for coding bootcamps. Because WTM openly allows anybody to apply, they have seen wide variation in the income levels of applicants and students. Fee structures are flexible for less-affluent students, who are allowed to pay in smaller installments over a longer time period.

A major part of the WTM model is its emphasis on employment opportunities as a return on students' investment. The bootcamp has cultivated relationships with employers such as Microsoft, VanHack, and Imaginamos. Partner employers range from large corporations to small start-ups to public sector organizations. For both physical and online bootcamps, job matching is critical; WTM enables job matching through a standalone app that specifically helps their students find jobs where they can use their skills. WTM determines the skills most in demand by holding one-on-one meetings with employers

several times each year, as well as analyzing usage data of Remoto.online, WTM's online hiring portal. Moreover, curriculum programming includes networking sessions with local employers.

Curriculum and Program

WTM's curriculum is a workplace-oriented approach to teaching coding skills. While most bootcamp programs offer project-based learning, WTM is unique in that it teaches project and product management techniques that are used at top technology companies. Part of the curriculum is "agile" methodologies and techniques such as creating sprints, dividing tasks, and leveraging SCRUM. Agile software development is a set of principles that encourages collaboration, iteration, and self-organization within product teams; it is used in most technology companies such as Google, Apple, and Amazon.

Furthermore, to supplement mechanical knowledge of scripting languages (for example, Ruby on Rails, JavaScript, and so on), students are taught software product design and venture creation. Specific skills they learn include building empathy maps for potential users, applying design thinking to products, and creating user interface (UI) wireframes before building the product itself.

Overall, the WTM curriculum promotes an immersive learning experience where students learn concepts, apply them to projects, get assistance from industry mentors, and present their apps during a Demo Day. WTM hosts one-on-one discussions with mentors that include investors like Tim Draper (Draper Fisher Jurvetson), entrepreneurs like Ted Gonder (Moneythink), developers like Guillermo Iguaran (Ride.com), and designer entrepreneurs like Lisa Russell (Pitch Training Camp).

Onsite bootcamps last eight weeks for full-time programs and 12 weeks for part-time programs. Online bootcamps can extend any length of time as a monthly fee is charged and the LIVE content is paid on demand.

Bootcamps.online, WTM's online learning portal, acts as both an independent training program and a supplement to part-time onsite programs. Unlike typical online coding training, Bootcamps.online is essentially a virtualization of the in-class experience, with live and recorded lectures to watch, a challenge-based personalized learning path, and a global database of mentors. Online participants can still access free and paid WTM mentors; for paid mentors, WTM takes a commission on their fees. In addition, the team is implementing artificial intelligence to drive personalization of the online learning experience. Students struggling to grasp a certain concept can be given additional projects, mentorship, and foundational training modules.

Every course begins with foundational programming knowledge, moving toward language mastery and later, skills with development platforms and tools. The stages of learning are as follows:

1. Basics: Fundamentals of programming (for example, variables, loops, methods), command line, Git (version control), user interface/user experience (UI/UX), lean methodologies (start-up venture creation).
2. Software Engineering: Object-oriented skills, smart software architecture, design patterns, system dynamics.
3. Core Language: Ruby on Rails, JavaScript, iOS, or Android. Fundamentals, syntax, design, and project work.
4. Database and Integrations: Databases and tables, connections, external libraries, and APIs.
5. Projects: Synthesizing information to develop and demo a live project.

During the development of this curriculum, the team had a chance to discuss with Pearson, the world's largest textbook publisher. They helped in defining specific evidence and learning outcomes for each individual class, helping students take steps toward an end-learning objective.

WTM has pivoted multiple times to iterate its curriculum. Initially, only full-time programs were offered, where students would work eight hours a day for 12 weeks. Feedback from students and applicants indicated that less intensive courses would be preferred. They have since shortened

the length of full-time courses to eight weeks from 12 and have created part-time programs as well. In addition, Bootcamps.online itself was a pivot as the onsite bootcamp was greatly oversubscribed with over 18,000 applications and this presented an opportunity to participate in the training in alternative ways.

Bootcamp Participants

Applications for WTM are open to everyone. About 80 percent of students are male and students range from 14 to 59 years of age, although most are between 18 and 35 years of age. Most applicants and students live in the surrounding urban areas where each bootcamp is located. However, WTM has received some applications from Europe as well. The earliest adopters of the WTM bootcamps were engineers who had received a formal education, but wanted to develop more applied skills for the workforce. The professional mix has changed since then, with more students who want to switch careers or start a technology company.

The selection process begins with a short online application, after which a subset of candidates is given 20-minute interviews. Interviews consist of personal questions to assess program commitment and technical questions to see whether an applicant has taken enough of an interest in coding to learn some foundations on their own. 10-20 percent of applicants are accepted, depending on seasonality – the team has noticed that they receive fewer applications in later months of the year, because of the holiday season. Online bootcamps are open to anyone, without any application process, except for LIVE content, where students go through the same selection process as in the onsite programs.

Impact of the Bootcamp

WTM reports that 75 percent of onsite participants were employed within four months of graduating from the program. Most program graduates get jobs as junior developers and many early students are now in roles where they lead junior development teams.

Still, the bootcamp's impact is not only in attracting employment for the previously unemployed. Participants may have had a job prior to the bootcamp, but software development may offer them a higher quality of life and salary. On the other hand, from their work and discussions with formal education institutions (for example, University of Los Andes), they have found that many middle and upper-class students do not apply for computer science programs because they are not as well paid as business programs. With the supply and demand situation of technical talent in Latin America, the WTM team believes that it is possible that average salaries will increase for programming jobs.

The team believes that project-based training is a better approach than theoretical learning to fix the huge deficit of technically skilled workers. Most companies are interested in what a developer can build rather than in the concepts they learned at university. This stems from the fact that bootcamps often ask partner employers for feedback on their curriculum, whereas this happens to a much lesser extent in traditional education. To add, WTM instructors are professionals who have built technology in the field.

The main negative effect that they have discovered is that many people come in with an unrealistic expectation of being taught a deep understanding of programming and computer science within an 8 to 12 week program. WTM emphasizes that they teach the skills necessary to begin work as a junior developer, but that bootcamp graduates need to continue learning to improve their skills to further progress in their respective workplace.

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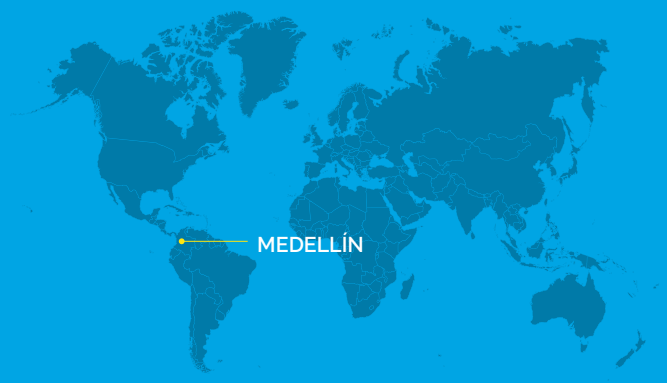
CODERISE

LOCATIONS & PARTNERSHIPS:



GENERAL INFORMATION:

Legal structure
Nonprofit organization registered in the United States

Number of years in operation
4 years (since September 2012)

Number of students trained (to date)
120 students

BOOTCAMP PROGRAM:

Cost to participants
Free of charge

Duration of the bootcamp
9 weeks, once a year

Bootcamp participants
High-school students, 13-17 years of age

Bootcamp curriculum
CSS, HTML, JavaScript

Coderise is a Colombia-based bootcamp that seeks to empower high-school students by teaching them how to build web applications. A nonprofit organization operating in Medellín, Coderise teaches web development to promote upward social mobility in developing countries. According to Andrea Cornejo, the bootcamp founder, the program was a response to the lack of opportunities available for young people. Coderise teaches not only web development, but also critical thinking and the ability to solve complex problems.

Medellín was chosen as the location for the bootcamp since the city is committed to leading technological innovation in the Latin American region and in the world. As such, it has a growing and active ecosystem of both tech start-up entrepreneurs and software developers that are indispensable to Coderise's successful implementation. Beyond this, the Coderise founding team had close connections and support from the tech community in Medellín from the outset.

The technical curriculum includes CSS, HTML, and JavaScript, and is complemented with mentoring sessions by IT professionals from the region. The bootcamp had graduated 120 students by 2016, and is aiming to expand to countries such as Honduras and El Salvador in the near future.

About the Bootcamp

Coderise was founded in September 2012 by Andrea Cornejo, a developmental economist from Peru and a U.S. citizen, and backed by U.S. engineers and entrepreneurs with Latin American origins. Since then, the bootcamp has been in operation every year for nine weeks, accepting 20 students in each batch. Coderise also trained 17 students in Peru as part of a one-off, all-female bootcamp in 2014.

Business Model

As a nonprofit organization, Coderise is sponsored by donations from Socialatom Ventures, which cover basic operational expenses, such as stationery, food, and transportation costs. Coderise offers transportation grants to students travelling from remote regions of the Medellín metropolitan area, as well as reimbursing travel costs for mentors who hold weekend industry insight sessions. Students are also provided with snacks during breaks in-between sessions. The program itself is completely free of charge to participants.

Coderise estimates the cost to run each bootcamp (nine weeks' training for 20 students) is between $15,000 and $20,000. This includes the cost of hiring premises and equipment, labor costs, and operational expenses (stationery, food, and transportation). Premises and equipment are currently provided through its partnership with Ruta N, the business and innovation center in Medellín. Regarding labor costs, instructors and tutors who run the technical sessions work on a pro bono basis. Coderise also maintains strong relationships with its network of mentors from the local community of tech entrepreneurs and developers.

Curriculum and Program

Coderise's vision does not end with teaching the basics of web development – it also endeavors to stimulate the intellectual curiosity of students and equip them with learning skills that would allow them to master new knowledge quickly and efficiently. Thus, technical sessions are combined with inspirational talks from successful web developers, start-up founders, and chief technology officers in the region. Additionally, its mentorship system helps students discover their interests and understand how they can best employ their newly learned skills in the future.

The Coderise curricula is semiformal, that is, there is a list of minimum programming concepts for HTML5, JavaScript, and CSS that students cover during the course. However, instructors have some flexibility to expand on certain topics, so that they can react organically to students' response to the material. The guidelines for the curriculum were developed in-house, and are quite similar to the curricula of other regional bootcamp providers. Bootcamp participants are encouraged to make use of, and contribute to, open-source code. Since the bootcamp does not focus on employment for its graduates (it is aimed at high school students), the curriculum

reflects overall trends in programming rather than specific industry demands prevalent at a certain point in time. The founders' vision of the purpose of the bootcamp is to make young people curious about technology and increase their educational attainment rather than turn them into professional web developers.

The Coderise bootcamp runs for nine weeks, of which the first four weeks are dedicated to technical modules, while weeks 5-8 cover practical applications of the theory; the last week is dedicated to Demo Day presentations.

Technical modules are led by two instructors who explain the concepts for 20-30 minutes, with the remaining time allocated to practice. In order to progress to the next module, students are required to complete a predefined set of exercises of various levels of difficulty. To help them with practical assignments, there are 3-4 tutors per class of 20 students in order to provide guidance and facilitate the learning process. Each technical module lasts three hours, with a 30-40 min break in between modules. In general, there are no mandatory homework assignments, but students should complete the required set of exercises in the time allocated for practice during the technical session. Instructors also provide optional materials from Code Academy and Khan Academy, which students could use to deepen their knowledge of the topics covered.

During the second half of the bootcamp, students work on their own projects, putting into practice the theory learned during the technical sessions. There are no strict guidelines as to the topics of students' projects, but they are encouraged to work on socially focused applications that could help local communities. In the last week, students showcase their projects during the Demo Day, which is typically attended by mentors, partner companies, and students' relatives and friends. Coderise does not use the Demo Day as a career fair matching students to prospective employers. Rather, it serves as an exercise, aimed at training skills such as public speaking, critical thinking, and networking.

Bootcamp Participants

Coderise bootcamps are open to high-school students from the Medellín metropolitan area. Prior to each application round, the Coderise team targets local schools through a massive media campaign. Online applications are open for two months, after which the selected applicants are invited for a telephone or Skype interview. The number of applications for 20 places in each batch increased from 40 in 2012 to about 100 in the most recent application round in 2016.

The online application form is simple, only requesting self-reported grades, a list of extracurricular activities, and details of three referees (typically school teachers). The online application is designed to identify students with above average grades who are actively engaged in their local communities, student clubs, and other extracurricular activities. Critical thinking, intellectual curiosity, and strong motivation to learn are the desired characteristics of those invited for interview. Interestingly, having high grades is seen as relatively less important than demonstrated social engagement.

Interviews are usually conducted via phone or Skype, and only in rare cases – when an applicant has neither a mobile phone nor Internet connection – in person. The interview focuses on the student's motivation to participate in a Coderise bootcamp, and to learn programming in general. Interviewers also seek to understand the student's interests and aspirations. The selection criteria favor those with the strongest motivation to learn coding, and with the proven ability to commit to extracurricular activities. Because Coderise bootcamps are scheduled at weekends and after school on weekdays, commitment to the program is crucial. In fact, no certificate of completion is issued to students who miss more than three sessions.

Among the 20 selected bootcamp participants are students from 13 to 17 years of age, with the majority being 15-16 years old. Over the years, the gender distribution has been close to 50 percent male/50 percent female. Importantly, students come from diverse socioeconomic backgrounds, and different areas of Medellín. Frequently, students who would not otherwise mix in social settings are placed in the same classroom, which makes socioeconomic status secondary

compared to the acquisition of knowledge and skills.

Prior knowledge of coding is not necessary to apply for the Coderise program. Some bootcamp participants share the ambition of pursuing programming as a professional career, while others are simply curious about coding.

Impact of the Bootcamp

The Coderise bootcamps' impact on the local economy and society has been to increase the number of young people with critical thinking skills who truly understand how technology and programming serve as tools to tackle the world's problems across all sectors. Coderise is not meant to necessarily increase the number of students that become software developers (this is merely a plus), however the growing economy in Latin America needs young people with the technical and critical thinking skills to fill high-skill jobs in the IT sector across the board in the coming decades.

In terms of geographical impact of the bootcamp program, initially effects at the community level are likely to dominate. Young people with a higher level of skill and motivation can make the local economy more dynamic by creating new job opportunities or increasing local supply of capable programmers. As the program is scaled up, the bootcamp program is more likely to structurally change a country's long-term direction.

As to the impact on bootcamp graduates, currently Coderise does not collect data on graduates' education or employment status. One reason for this is that it would require long-term tracking of graduates, since the gap between high school and employment could extend for five to ten years. However, short-term (that is, after six months) follow-up surveys from 2012-2014 suggest that 40 percent of bootcamp graduates were still engaged in coding six months after the program ended, and half of graduates were active in the coding community, attending local tech meet-ups and events. According to Andrea Cornejo, the main positive effect has been to graduate students who believe they can tackle the most important problems in their social medium or community through technology. On the opposite side of the spectrum, a significant challenge that the evolving bootcamp model faces is to better understand and conceptualize the final desired outcome. The bootcamp needs to stress that the most important result of a program is empowered young people that have developed the ability for effective and continuous learning. After all, programming languages will come and go, but the ability and dedication to master new knowledge remains.

Another important impact, yet hard to quantify through surveys, is the social and emotional learning acquired through the bootcamp experience. It is likely that the program has a positive effect on grades and performance in academia and at the workplace; however, no formal studies were conducted in this respect.

While Coderise does not build formal links with educational institutions, a certain degree of cooperation with schools is part of its promotions strategy, whereby school teachers can encourage students to apply. In general, the founders think that private and innovative initiatives usually overtake and lead advances in a sector, and formal education institutions on technology and computer programming fields are no exception. Bootcamps have an intentionally disruptive design and, as such, have made traditional training providers and the IT sector rethink and reevaluate their strategies and the importance of generating a highly capable and motivated labor supply.

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DECODING BOOTCAMPS PROJECT

Funded under the Jobs Umbrella Multi-Donor Trust Fund , the World Bank is conducting an activity to assess the key success factors for rapid technology skills training programs (that is, coding bootcamps) and measure their impact on employment and employability of young people.

This initiative is specifically focused on addressing the youth unemployment problem in urban settings with traditionally large and growing young populations in developing countries.

The activity will test whether coding bootcamps are applicable to an emerging economy context by creating employment for low-entry tech skills and reducing the skills mismatch. The Rapid Technology Skills Training Program is being piloted in three cities: Beirut, Lebanon; Medellín, Colombia; and Nairobi, Kenya. All three cities have been selected because of the presence of vibrant local tech innovation ecosystems, relevant size of the low-income youth population (which helps extrapolate findings to other cities and even countries), and high youth unemployment.

The impact of these bootcamps is being measured through a randomized controlled trial (RCT) in Medellín and qualitative studies (surveys and focus group discussions) in Beirut and Nairobi, in collaboration with key players from the local tech innovation ecosystems (see Appendix A).

The initiative relies on four main components:

1. Assessing the impact of coding bootcamps on local, young jobseekers to secure quick employment and income generation opportunities thanks to the coding bootcamp;
2. Comparing employment patterns of bootcamp participants to those in a control group who have not received the training;
3. Identifying key success factors of coding bootcamps and devising a methodological toolkit for designing a coding bootcamp from scratch based on an overview of existing tools and best-practice methods;
4. Informing policy makers in emerging markets on how to support the establishment, implementation, and growth of demand-driven rapid tech skills training to combat youth unemployment.

Through these components, the activity seeks to lay the foundation for a swift response to boost demand-driven labor market training that is necessary to tackle youth unemployment in today's fast-changing world. The ultimate goal of this initiative is to establish best practices for rapid tech skills programs (coding bootcamps) that result in employability and employment to inform policies in the emerging world.

The activity has developed an online website to make available the contents of the program and its results: http://www.decodingbootcamps.org.

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NOTES

1. http://www.decodingbootcamps.org/about/.

2. There are diverse definitions that refer to the broad concept of socioemotional skills. Heckman and Kautz (2013) suggest that all of them refer to the same concept and that they are often used interchangeably. The authors have used the term socioemotional skills to refer to all the terms within the same conceptual space (such as noncognitive skills, soft skills or life skills).

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4. http://www.c4q.nyc.

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6. https://www.andela.com.

7. http://www.hackreactor.com.
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9. See, for instance, Advanced Manufacturing Bootcamp at DevryBootcamp, http://manufacturing.devry.edu/ ; or manufacturing bootcamp at the Foundery in Baltimore: http://baltimore.cbslocal.com/2017/02/20/baltimore-boot-camp-teaches-valuable-manufacturing-skills/.
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11. http://www.ruralsourcing.com/.

12. http://www.hackreactor.com.

13. Occupation rate takes into account both employment and continuing education.

14. http://www.rutanmedellin.org/es.

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