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Bridging Skills and Employment: A Review of Advanced Digital Skills Training, Online Labor Market Programs, and Innovative Training Methodologies[†]

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Abstract

Digital transformation is reshaping labor markets, increasing demand for advanced digital skills, and creating new employment opportunities. This document provides a thematic review of robust impact evaluations of interventions aimed at improving labor market outcomes in the context of digital transformation. It focuses on three key areas: advanced digital skills programs, programs to improve online labor market outcomes, and emerging methodologies in training delivery.

Despite growing policy interest and global investment in these programs, robust causal evidence remains scarce. Available studies suggest that advanced digital skills programs can facilitate transitions into technology-related occupations and, in some settings, increase labor earnings. However, consistent effects on overall employment are not observed, and high costs and selective entry criteria may limit scalability. Similarly, programs designed to improve online labor market outcomes reveal both opportunities and constraints: while many participants gain initial access to digital platforms, success is often short-lived without strong technical skills and support. New training delivery models, including MOOCs and mobile-based or AI-driven approaches, offer potential for scale but face persistent challenges related to low completion rates, accessibility, and cost-effectiveness.

A consistent theme across the document is the need for more — and especially longer-term — rigorous impact evaluations to assess whether these interventions lead to sustained improvements in employment, earnings, and broader welfare outcomes.

Keywords: digital skills training, online labor market programs, innovative training

JEL codes: E24, J24, J48, M53

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1. Introduction

Digital technologies are reshaping labor markets, creating both new demands and possibilities for the design of active labor market policies (programs that support individuals' integration into the labor market). In many countries, a considerable proportion of firms are unable to find workers with the necessary digital skills to fill their job vacancies (e.g., Novella and Rosas-Shady, 2023a; 2023b; Baptista et al., 2023a). This has fueled growing interest in training programs aimed at equipping jobseekers with digital skills, as well as in training modalities that leverage emerging digital tools.¹ Yet, evidence on the effectiveness of these programs remains limited, particularly rigorous impact evaluations based on credible estimation strategies. This document reviews the evidence from 26 such evaluations,² 15 of which were published in 2024 or later.³ Despite the limited evidence base, policy recommendations are beginning to emerge regarding program design. These interventions show promise in achieving their intended outcomes, but also reveal important limitations that policymakers should address.

The present paper analyzes three types of interventions: (i) digital skills bootcamps and other advanced digital skills training programs; (ii) programs to improve online labor market outcomes; and (iii) Massive Open Online Courses (MOOCs) and other new methodologies of delivering training programs. Before turning to the systematic review of the literature, we first summarize some of the main findings on the effectiveness of these three types of programs:

Digital skills bootcamps and other advanced digital skills training programs. Only nine studies have evaluated these programs using robust empirical methods — a surprisingly small number for an industry that generated over USD \$800 million globally in training alone in 2024. Moreover, the limited evidence that does exist largely focuses on short-term impacts. Evidence suggests that these programs can support transitions into technology-related jobs and increase earnings in some contexts, particularly when they included direct employer linkages (such as internships), but overall labor market impacts and cost-effectiveness remain

¹ Digital skills are those that allow the use of electronic devices, applications, and networks to access and manage information (UNESCO, 2018). Within the framework of this paper, we understand basic digital skills as those necessary to be able to use computers or software at the user level, while advanced digital skills refer to those required to create or modify digital solutions or software. These advanced skills enable individuals to work in technical roles that demand a deep understanding of coding, design, and software functionality.

² To identify these studies, we broadly searched Google Scholar using terms such as “digital skills job training” and “online job training,” and applied forward and backward reference tracking of the citation lists in all included papers to identify other relevant studies. Interventions vary in aspects such as dose, duration, mode of delivery, and setting, with a focus on training programs outside traditional educational systems.

³ It is worth mentioning that a notable portion of the available evidence for Latin America and the Caribbean has been generated by the Inter-American Development Bank (IDB). Out of the 26 impact evaluations identified, 8 were funded by the IDB. See Table A.1 in the Appendix.

unclear. Some studies suggest that null results for overall employment may be due to participants holding out for tech jobs rather than accepting lower-skilled positions for which they are already qualified.

Programs to improve online labor market outcomes. Evaluations of these programs raise important questions about scalability, accessibility, and long-term effectiveness. While some programs — particularly those delivered online — offer potential for scale, low completion rates persist as a major challenge. Complementary interventions to boost completion, such as personalized tutoring, have raised costs (e.g., to over USD \$700 per person) without generating proportional improvements in completion or impact. Moreover, evidence suggests that while many participants gain initial access to digital platforms, their success is often short-lived without strong technical skills and job-matching support. In-person training appears to be more effective in improving completion rates.

MOOCs and other new methodologies of delivering training programs. Evidence of these programs offers valuable insights for scaling effective training interventions, though it also reveals key limitations. For example, while MOOCs have the potential to distribute content at scale, a significant downside is their low completion rates, often in the single digits — with males, wealthier individuals, and those with strong non-cognitive skills being more likely to complete them. This pattern of selective completion suggests that while providing free access to MOOCs theoretically offers high-quality training to all, economic constraints — such as the cost of sustained internet access or the opportunity cost of time — still likely affect course completion. As a result, MOOCs may primarily benefit those who already have the resources and skills to engage fully. Light-touch interventions, such as reminders, have proven insufficient to improve completion rates. Similarly, emerging evidence on generative AI-based training tools suggests that these technologies can effectively boost productivity, but evidence on who benefits the most is mixed.

In the following sections, we categorize studies based on the country of implementation, target population, intervention duration, take-up rate, delivery method, additional components, causal estimation methodology, primary outcome variables, and effect sizes. This classification aims to deepen understanding of overall program effects and to identify key design elements that may drive successful outcomes.

It is important to note that some programs in the reviewed literature address more than one focus area. For example, an advanced digital skills training program may also employ an innovative training methodology. In this paper, we categorize each study according to the area

we consider to be most relevant. Table A.1 in the Appendix provides an overview of the papers discussed in this report, along with the areas to which each paper applies.

After providing evidence on each type of intervention analyzed, we discuss a set of public policy recommendations. The report concludes with a general discussion of the available evidence, policy recommendations, and venues for future research to inform policy making.

2. Digital skills bootcamps and other advanced digital skills training programs

In light of growing digital skills gaps, a new form of advanced digital skills training has emerged: digital skills bootcamps (also known as coding bootcamps). These bootcamps are intensive, short-term training programs designed to equip participants with advanced digital and socio-emotional skills that make them immediately employable (Meng, 2013). They combine characteristics of traditional vocational training programs with the intensity of military bootcamps for recruits (World Bank, 2018a). They were developed to address gaps in formal education by offering young people without prior experience an accelerated pathway to acquiring in-demand advanced digital skills (World Bank 2018b). Unlike traditional classroom-based training programs, bootcamps integrate socio-emotional learning, technical skills, and job search support in a highly immersive and experiential format (Mulas et al., 2017).

Digital skills bootcamps typically exhibit four key characteristics. First, they are intensive and fast-paced, with a competitive selection process, often requiring minimum literacy and basic digital skills, and typically last no more than six months. Second, digital bootcamp classes generally have around 20 to 30 students, which allows for a more personalized learning experience and stronger interaction between students and instructors. Third, their teaching methodology follows a project-based, hands-on (learning-by-doing) approach. Fourth, their curricula are tailored to reflect current industry needs, with content adapted to local labor demand (World Bank, 2018a, 2018b).

Digital bootcamps are being implemented around the world, and their popularity has been growing over time. According to Course Report, over 600 coding bootcamps currently operate globally, offering training in various digital skills, such as web development, data science, and digital marketing (Eggleston, 2025). In 2023, approximately 66,000 students graduated from these programs — a more than 12% increase from the previous year — with an average cost of USD \$14,000 per student. Bootcamps are also gaining traction in Latin America and the Caribbean, where costs are relatively lower per student. Cathles et al. (2022) report that over 50 digital bootcamps are active across 17 countries in the region. The IDB has been actively

promoting and financing these programs in several countries, including Chile, Costa Rica, Peru, and Uruguay (Jaccoud, 2025).

However, rigorous evidence on the impact of digital bootcamps is limited, and there is no systematic thematic review of their effectiveness on employment outcomes. We have only identified the following five impact evaluations:

A pilot randomized control trial (RCT) by the World Bank evaluated the short-term (6 months) impact of a coding bootcamp in Medellín, whose regular tuition fee is USD \$2,000. The program provided labor market-relevant skills, such as programming, job readiness, and socio-emotional skills, and facilitated connections between graduates and employers. Of the 120 students who enrolled, 108 completed the program (a 90% completion rate). The evaluation found no significant effects on participants' employment status, job satisfaction, or business creation. However, the study's limited sample size constrained the ability to draw robust conclusions (World Bank, 2018). Descriptive qualitative results from pilots in Lebanon and Kenya suggested that similar bootcamps had important effects on tech skills, socio-emotional skills, and employment prospects; however, they also lacked sufficient sample for robust conclusions.

Building on this, Aramburu et al. (2021) evaluated the short-term effects of an intensive, part-time coding bootcamp program for women in Argentina and Colombia, where tuition costs were approximately USD \$1,215 and USD \$815, respectively.⁴ In the evaluation, places in the oversubscribed courses were randomly allocated to eligible applicants. Eligibility criteria included a minimum of a high school diploma, completion of a questionnaire and pre-assignment, and passing an exam. Successful applicants received scholarships covering most of the course fees. The bootcamp's curriculum focused on programming skills, such as JavaScript, HTML, CSS, and other platforms. Participants also completed several hands-on projects in a workshop setting. The program offered flexibility, allowing participants to choose their learning mode — either in-person or blended (a mix of in-person and online).

Out of the 402 applicants who were offered places, 283 (70%) enrolled in the course, and 241 of these (85%) successfully completed it. Using an RCT design, with follow-up data collected between two and five months after the bootcamps ended, the authors found that assignment to the program significantly improved participants' coding skills and increased their likelihood of securing jobs requiring coding tasks by 6.7 percentage points (pp), or 28%. However, no

⁴ Bootcamp costs were calculated from local currencies using the average 2020 exchange rates.

significant effects were observed on labor earnings or unemployment, and a negative effect of 7.2 pp was observed on the overall probability of employment. Moreover, the study was limited to women who were already mostly employed and college-educated, raising concerns about the generalizability of the findings. The authors also noted several methodological challenges.⁵

In Peru, Novella et al. (2024b) evaluated the effects of a cohort of the *Jóvenes Bicentenario* pilot program that offered an online bootcamp for advanced digital skills at a cost of approximately USD \$1,300 per student. Implemented by the Ministry of Labor and Employment Promotion (MTPE), selected participants in the program received approximately 400 hours of free digital technical skills training from local bootcamp providers. Training tracks included web development programming, mobile and game development, data analytics, and digital marketing, growth, and design. In addition, participants received training in employability skills, labor intermediation, and job search support.

Among those offered a spot in the bootcamp, 60% completed the courses, meeting the minimum attendance requirements for all synchronous classes and graduating successfully. While there were relatively few differences between those who completed the program and those who did not, completers were significantly more likely to have prior experience with online courses. Using an RCT design and analyzing government administrative data on formal salaried employment up to nine months post-training, the authors found that the program significantly increased the likelihood of securing formal high-skilled jobs (1.5 pp) and entry-level technology positions (1.2 pp). Some bootcamp courses yielded positive impacts on formal employment and income, but others showed negative effects — resulting in null average impacts overall. Evidence suggests the negative impacts likely reflect limited labor market demand for certain advanced digital skills, underscoring the importance of aligning training programs with labor market needs.

In Chile, Neilson et al. (2024) evaluated the impacts of the *Digital Talent* bootcamp program, which provided advanced digital skills training across two levels: entry-level and specialty courses. Entry-level courses covered topics such as Full Stack Development, Mobile Application Development, and Digital Entrepreneurship, while specialty courses included Cloud Architecture, Data Science, Product Ownership, and DevOps Fundamentals. Although initially designed for in-person training sessions, the program shifted to online synchronous

⁵ For instance, roughly one third of the control group enrolled in another coding bootcamp after the treatment assignment.

instruction due to the COVID-19 pandemic. The training comprised both digital skill modules and a job-preparation component to support participants' labor market integration, with course durations ranging from 402 to 480 hours. The total program cost per student was approximately USD \$1,420.⁶

Among those shortlisted for a spot in the bootcamp, 45% enrolled, and approximately 50% of those that enrolled successfully completed the course. Using quasi-experimental methods (Regression Discontinuity Design and Difference-in-Differences), the authors found positive impacts on the probability of having a formal job (8 pp) and on formal earnings (113%) within six months of starting the course. However, these positive effects faded one year after the program, except in the Metropolitan Region.

Lastly, Baptista et al. (2024a) evaluated the effectiveness of a four-month data analytics bootcamp in Haiti, followed by an internship. The pilot program provided young Haitians with intensive training in advanced digital skills, such as Python, SQL, and PowerBI, as well as career guidance. The bootcamp was delivered in partnership with the well-known digital bootcamp provider Le Wagon and the Haitian Ministry of Social Affairs and Labor (MAST), using a hybrid teaching model that combined in-person instruction with online learning via Le Wagon's platform. All graduates also were placed in internships at formal companies.

The evaluation used a quasi-experimental design and found significant positive effects on labor market outcomes roughly one year after bootcamp completion. Despite the relatively small sample size, the study had sufficient statistical power due to the large effect sizes observed. Graduates were 34 pp more likely to be employed, 28 pp more likely to work as dependent employees, 27 pp more likely to hold permanent contracts, and 33 pp more likely to perform data analysis tasks in their roles. They also worked 17 more hours per week, earned 150% higher monthly incomes, and reported greater success in securing job offers. Additionally, bootcamp graduates were 39 pp less likely to remain enrolled in formal education, indicating that the bootcamp served as an alternative pathway to employment.

While the program's costs were high — approximately USD \$6,000 per participant — a cost-benefit analysis suggests it was cost-effective, with an internal rate of return of between 10% and 16%. Notably, 75% of employed graduates remained with their internship companies, suggesting the internship may have been a key factor in the program's success. Completion rates were exceptionally high, with all students successfully completing the program.

⁶ Using the average 2021 exchange rate.

Other advanced digital skills training programs

Countries around the world are also implementing more traditional training programs aimed at reducing the digital skills gaps — for example, programs that combine training courses with internships and typically last longer than digital bootcamps. However, rigorous evidence of their effectiveness is also limited. In the Netherlands, Vooren et al. (2022) evaluated the effects of the *Make IT Work* program, which offers full-time vocational IT training at the Amsterdam University of Applied Sciences. The program combines six months of classroom-based training in computer programming and software engineering with paid internships during the second semester.

Using an RCT design, the authors found significant negative lock-in effects on labor market outcomes during the training period, likely due to reduced job search efforts while in full-time training. However, after program completion, they observed significant positive impacts on participants' earnings (EUR €500 per month) and days worked (8 working days per month), with these effects persisting until the end of the three-year evaluation period. The cost of the program was EUR €7,000 per participant, with EUR €1,000 paid by the participant and EUR €6,000 by the hiring firm. A cost-benefit analysis based on earnings and participant contributions showed a modest but positive return of 2.5%. However, it is important to note that the program targeted a highly skilled population, as eligibility was limited to individuals with at least a bachelor's degree. Indeed, the program's focus was on retraining already skilled individuals in advanced digital skills rather than training a low-skilled population.

In the United States, Jabbari et al. (2023) evaluated the effects of a digital skills program offered by LaunchCode, one of the largest and longest-standing technology training providers in the country. The program includes 20 weeks of coursework in programming and Web application development, followed by 12 to 52 weeks of a paid apprenticeship with a local employer. Students also develop a portfolio project and receive job preparation support, including resume building and interview preparation. The program cost was around USD \$7,500 per participant.

Using a quasi-experimental design that instrumented program participation with entrance exam scores, the authors found that program acceptance significantly increased labor market earnings by USD \$9,296 and raised the likelihood of employment in science, technology, engineering, and math (STEM) fields by 21.7 pp after 12 months. Heterogeneity analysis suggests that these positive effects were primarily driven by those who completed the coursework and apprenticeship, rather than those who only finished the coursework.

In low- and middle-income countries (LMICs), where digital skills gaps are wider, governments and private sector partners are increasingly implementing policies and programs to prepare individuals for employment in the information and communications technology (ICT) sector. In Nigeria, Croke et al. (2023) investigated the effects of a job training program aimed at recent university graduates. The program lasted 85 hours over 10 weeks and trained participants in the ICT and business process outsourcing (BPO) sectors, providing technical skills in software and communication. The average cost was USD \$600 per trainee, and approximately 54% of the treatment group attended at least one training session.

Using an RCT design, the study found that participants were 26% more likely to work in the ICT sector two years after the training (compared to a base of 6.4%), although there were no significant effects on overall employment or income levels. The study also highlights how gender norms influenced outcomes, as women who overcame implicit biases about gender roles were twice as likely to switch to the ICT sector compared to those who did not hold such biases.

A different approach is illustrated by the *Digital Employability Pilot* (DEP), evaluated by Novella et al. (2024a) in Peru. Developed by the MTPE in partnership with the CISCO Networking Academy, the DEP targeted unemployed and low-income individuals with at least secondary education. The program provided 70 hours of online training in network administration, Python programming, and IT support, with participants completing the courses asynchronously.

Course completion rates were relatively high for an online program, with 66% of participants completing the program and receiving a certificate of completion. However, as is common with online courses, individuals who successfully completed the program were more likely to display certain socioeconomic characteristics. For example, completers were less likely to have young children in the household and more likely to have reliable access to a computer and internet at home. Using an RCT design and government administrative records on salaried formal employment up to three years after training, the authors found small but statistically significant positive effects on the probability of formal employment (0.5 pp), and increased likelihood of securing formal high-skilled jobs (1.2 pp), particularly in entry-level technology roles (0.2 pp).

In addition to the literature reviewed above, several papers examine advanced digital skills programs using weaker evaluations designs. These studies tend to have methodological limitations, such as insufficient collection of data or an over-reliance on small-scale qualitative

information. For instance, Chun et al. (2024) assessed the impact of an evening, part-time coding and apprenticeship program on participants' life satisfaction and optimism in the U.S. Despite relatively low completion rates (45% completed the course only, and 16% completed both the course and the apprenticeship), their findings suggest that participants who completed both components experience greater life satisfaction and optimism. Similarly, Hassan et al. (2020) analyzed the impact of ICT training on women's employability and entrepreneurial skills in Pakistan, finding positive outcomes.

Table 1 presents a summary of the literature discussed above, highlighting key aspects such as the target population, duration, delivery methods, and the significance of the results across various studies.

Table 1. Summary of advanced digital skills training literature

Authors	Country	Target Population	Level of skills	Duration	Delivery	Additional components	Metho dology	Outcome variables	Results (Size & Significance)
Coding bootcamps									
World Bank (2018a)	Colombia	Young adults with basic computer and internet skills	High	4 months, one class per day	In person	Training in job readiness and socioemotional skills, establishing linkages between graduates and employers	RCT	Employment, job satisfaction, job benefits, business creation, high-quality job	No significant results
Aramburu et al. (2021)	Argentina and Colombia	Women with at least a high school diploma	High	5 months, 210 hours (Argentina), 4 months, 170 hours (Colombia)	Either in person or hybrid of in person and online	Professional development and job readiness workshops, and personal mentoring	RCT	Coding skills, employment in tech, studying in tech, overall employment, monthly earnings	Coding skills: 1.1pp (+, ***) Employment in tech: 6.7 pp (+, **) Studying in tech: Null Overall employment: 7.2pp (-, **) Earnings: Null
Novella et al. (2024b)	Peru	Unemployed adults with at least secondary education, not enrolled in higher education	High	400 hours	Online	Training in skills for employability, labor intermediation, and job support	RCT	Formal job, formal monthly income, high skilled formal job, entry level formal tech job	Formal job: Null Formal income: Null High skilled formal job: 1.5pp (+, ***) Entry level formal tech job: 1.2pp (+, ***)
Nielson et al. (2024)	Chile	Vulnerable adults with at least secondary education	High	402-480 hours	Online	Job readiness module	Quasi-experi mental	Formal contract, formal income	<i>6 month:</i> Formal contract: 8.8 pp (+, ***) Formal income: 113% (+, ***) <i>12 month:</i> Formal contract: Null Formal income: Null

Authors	Country	Target Population	Level of skills	Duration	Delivery	Additional components	Methodology	Outcome variables	Results (Size & Significance)
Baptista et al. (2024a)	Haiti	Young adults	High	16 weeks, 270 hours	Hybrid of in person and online	5-month internship after the training Career guidance, access to available tech jobs, daily stipend for food and transportation	Quasi-experimental	Employment, dependent worker, perform data analysis tasks, hours per week, monthly income	Employment: 33.6 pp (+, **) Dependent worker: 27.7pp (+, *) Perform data analysis: 32.9pp (+, **) Hours per week: 16.7 (+, ***) Monthly income: USD \$170.75 (+, **)
Other digital skills training programs									
Vooren et al. (2022)	Netherlands	Anyone with at least a bachelor's degree	High	6 months full-time and 6 months one day a week	In person	Six-month internship after training	RCT	Monthly income and working days per month	Earnings: EUR 500 per month (+, **) Working days: 8 working days per month (+, **)
Jabbari et al. (2023)	United States	Anyone, priority given to diverse sample	High	20 weeks, typically 15 hours/week	Either in person or online	12-to-52-week apprenticeship after training, up to 4 weeks training in job preparation	Quasi-experimental	Earnings and STEM employment	Earnings: USD\$ 9,296 (+, *) STEM employment: 21.7 pp (+, **)
Croke et al. (2023)	Nigeria	Recent university graduates	Medium	10 weeks, 85 hours	In person	Communication training	RCT	Employment in the ICT sector, overall employment, and earnings	Employment in ICT: 1.7 pp (+, *) Overall employment: Null Earnings: Null

Authors	Country	Target Population	Level of skills	Duration	Delivery	Additional components	Metho dology	Outcome variables	Results (Size & Significance)
Novella et al. (2024a)	Peru	Unemployed and low-income adults with at least secondary education, not enrolled in higher education	High	70 hours	Online	Training in skills for employability, labor intermediation, and job support	RCT	Formal job, formal monthly income, high skilled formal job, entry level formal tech job	Formal job: 0.5 pp (+, **) Formal income: Null High skilled formal job: 1.2pp (+, ***) Entry level formal tech job: 0.2pp (+, ***)

Notes: Level of skills refers to whether the digital skills taught are at medium or high technical level. 'pp' refers to percentage points. RCT refers to randomized controlled trial. Brackets after the results refers to the sign and significance of the estimated effects. * p < 0.10, ** p < 0.05, *** p < 0.01.

Recommendations for public policy

Based on the review of available evidence, several recommendations are starting to emerge for policymakers. However, given the scarcity of rigorous evidence, these recommendations should be considered highly suggestive rather than definitive:

- 1. Carefully select the target population.** Advanced digital skills programs generally require participants to have at least secondary education and often include rigorous entry requirements (e.g., competency tests, interviews). Policymakers should carefully consider whether these programs are likely to be effective for their intended beneficiaries. For example, evidence from Aramburu et al. (2021) suggests that bootcamps may be less effective in raising overall employment among individuals who are already employed and highly educated, though they may facilitate important occupational shifts towards technology-related roles.
- 2. Incorporate internships or demand-linked components.** Some of the largest employment and earnings gains have been observed in programs that combined training with structured internships or apprenticeships. Moreover, negative effects have been observed when the skills taught are not well aligned with current industry needs. Strengthening connections with employers — starting from identifying in-demand skills through to job placement — can help ensure that program graduates meet actual labor market needs and secure employment opportunities.
- 3. Include employability and soft-skills training.** A common feature across most programs is the emphasis on combining technical training with modules on soft skills, employability or job-readiness, such as communication skills, labor intermediation, and socioemotional training. Incorporating these elements improves not only technical competencies but also participants' ability to integrate and succeed in the labor market.
- 4. Consider scalability and sustainability.** Digital bootcamps typically serve small, highly-selected cohorts of individuals at relatively high per-student costs. Scaling these models to reach a larger number of beneficiaries may strain provider capacity and compromise quality.⁷ Additionally, local demand for specific digital skills (e.g., coding) may be limited in certain contexts. Given the magnitude of the digital divide — particularly in developing countries — alternative training models should be explored.

⁷ The programs included in this review include bootcamps of different types, structures, and likely varying levels of quality. However, none of the existing impact evaluations collect comparable measures of provider quality or analyse whether employment and earnings impacts differ across bootcamps of different quality. As a result, the current evidence base cannot speak to whether high-quality providers generate larger or more sustained labor-market gains than lower-quality ones.

Despite these insights, one of the clearest findings is the scarcity of rigorous evidence on the effectiveness of advanced digital skills training programs. As highlighted above, only nine studies have evaluated these programs using robust empirical methods — a surprisingly small number for an industry that generated over USD \$800 million globally in training alone in 2024.

Moreover, the limited available evidence largely focuses on short-term impacts. Some studies suggest that null effects on overall employment may be due to participants holding out for tech jobs rather than accepting lower-skilled positions for which they are already qualified. Since tech positions often offer higher pay and better career progression, long-term evaluations are needed to determine whether participants eventually secure these roles and experience sustained labor market and welfare gains.

The programs evaluated typically target individuals who have completed secondary education, with a few interventions targeting participants with tertiary qualifications. However, demographic trends — such as the growing number of tertiary-educated youth who are unemployed or underemployed — are becoming increasingly relevant for the design of ICT retraining policies. None of the available studies analyze whether program impacts differ between individuals with only secondary education versus those with tertiary education, and therefore it remains unclear whether advanced digital-skills training is relatively more effective for one group than the other. This represents an area for future research.

There is also a lack of evidence on the cost-effectiveness of these programs. Many programs, particularly bootcamps, are relatively expensive compared to more traditional training programs, requiring significant and sustained economic gains to justify their cost.⁸ However, research on this aspect is limited.⁹

Finally, more evidence is needed on the broader labor market effects of such programs, as well as the mechanisms underlying their success or failure — particularly for programs that receive public financial support. While some studies rely on administrative data to assess program outcomes, these sources only capture formal indicators, often limited to salaried workers, and thus provide little insight into the mechanisms driving program impacts or the

⁸ We acknowledge that while bootcamps are far more expensive than online modalities such as MOOCs, their cost is not necessarily high relative to traditional university programs.

⁹ The bootcamps included in this review vary widely in their costs. These differences largely reflect structural variations across programmes, including delivery model (e.g., online vs. in-person), the use of local versus international training providers, the intensity and duration of instruction, instructor profiles, and the level of employer engagement or placement support offered. However, none of the impact evaluations in this review analyse whether more expensive programs generate larger employment or income impacts than cheaper ones. As a result, the existing evidence does not allow for conclusions about the relationship between program cost and program effectiveness.

extent of independent work.¹⁰ Given the high levels of informality in labor markets in Latin America and the Caribbean, as well as in other LMICs, more detailed survey data is necessary to understand the full impact on livelihoods and the pathways through which these programs achieve, or fail to achieve, their intended outcomes.

These considerations become even more relevant in light of rapid technological change. Looking ahead, the rise of generative AI raises questions about future demand for entry-level IT occupations, including whether roles such as junior programmers may decline. However, the proliferation of generative AI does not necessarily eliminate the relevance of digital skills bootcamps but rather may shift the competencies that these programs need to prioritize. Indeed, as companies become increasingly digitized, a greater number of technical profiles with digital skills will likely be needed, even if their skills will need to be transformed to encompass new fields such as AI or big data. Many tasks within entry-level IT occupations are likely to be augmented—rather than fully replaced—by AI, increasing the premium on adaptive digital capabilities such as data literacy, problem-solving, and the ability to work effectively with AI-enabled systems. Consequently, even if the number of traditional programming roles declines, demand is expected to grow in closely related fields, including Big Data, AI and Machine Learning, and Software and Application Development.

Bootcamp models, by design, are modular and can update curricula more rapidly than traditional education systems, supporting faster adoption of new technologies and tools. Policymakers should therefore view such programs not as fixed pipelines into a narrow set of digital occupations, but as flexible models capable of incorporating emerging technologies and preparing individuals for an evolving digital labor market.

3. Programs to improve online labor market outcomes

In this section, we review the literature on the effectiveness of programs designed to improve individuals' outcomes in online labor markets. Online gig work, where workers are paid for specific tasks or for a defined period, now constitutes a significant share of the global labor force, with an estimated 154 to 435 million people engaged in such jobs (Datta et al., 2023). Upwork, one of the largest online gig work platforms, reported revenues of approximately USD \$3.8 billion in 2022 (Kempton, 2024). On these platforms, clients — primarily from developed countries — post job listings and hire independent workers from around the world for tasks

¹⁰ Moreover, in many countries, if these programs generate success in promoting high-quality self-employment, social security records would not pick up these effects as social security is voluntary for the self-employed.

that can be completed remotely. Moreover, the adoption of technology has fueled the growth of e-commerce, providing new opportunities for local sellers to connect with international buyers. However, as with advanced digital skills training programs, rigorous evidence on the effectiveness of these programs is very limited.

Online gig work comes in two forms: online freelancing and microwork. Online freelancing tends to involve projects that are performed over longer durations and include complex tasks targeting skilled individuals with intermediate to high expertise. Examples include software development, graphic design, and e-marketing. Microwork, in contrast, is characterized by smaller projects and tasks that are dissected into bite-sized subtasks achievable within seconds or minutes by remote workers through online platforms. Despite its potential, most registered users never manage to successfully obtain online work, particularly in developing countries. In Latin America, for example, it is estimated that only 10% of registered online freelancers have ever obtained a job through an online platform (Hilbert and Lu, 2020).

Online labor marketplaces differ from their traditional counterparts in several key aspects. Employers in online labor platforms typically evaluate applicants based on their profile information (for example, ratings, reviews, and self-declared credentials) and initial interactions via the platform (for instance, written proposals and interviews). This can influence how employers interpret candidate information, leading to hiring decisions that differ from those made in traditional settings.

In response, some programs aim to improve individuals' online labor outcomes by helping them better navigate the platforms and engage more effectively with online marketplaces. Baptista et al. (2023b) conducted an RCT to evaluate a program in Haiti designed to improve online freelancing outcomes through entrepreneurial skills training. The program, run by the "Ministere des Affaires Sociales et du Travail" (MAST) of Haiti with the support of the startup Wisar and the IDB, targeted Haitians over 20 years old who were recent higher education graduates or had relevant work experience. The goal was to help 50 treated participants engage more effectively with online marketplaces by focusing on key tasks such as creating profiles, preparing proposals, and interacting with clients.

The program lasted four weeks, requiring 3-4 hours of daily engagement. It was delivered entirely online via Wisar's platform, and course completion was asynchronous. The training was split into two phases: a theoretical phase in the first two weeks covering eight core modules, followed by a practical phase in which participants increased their activity in online project searches and proposals submissions, supported by personalized tutoring.

Despite a relatively low completion rate (58% finished the theoretical phase and only 18% completed the entire program), the evaluation found significant positive impacts on online freelancing outcomes roughly one year after program completion. Treated participants showed increased activity in submitting proposals and receiving client contacts, leading to more contracts signed. However, the program had no effect on broader labor market outcomes such as overall employment or income — suggesting that the initial success in online freelancing did not translate into sustained labor market improvement.

Building on this, Fazio et al. (2025) report on a scaled-up version of a similar online freelancing training program implemented in El Salvador, in which 350 individuals were trained. The program was implemented through a collaboration between the Ministry of the Economy of El Salvador and Wisar, with support from the IDB. The target group included Salvadorans over 18 with relevant higher education degrees or work experience, English proficiency, and access to a computer and the internet. While the content was similar to the Haiti pilot, the El Salvador program extended over 12 weeks, with a required engagement of 5 hours per week. Participants also had access to an ‘English for freelancers’ course to improve their communication skills for online work. As in Haiti, the program was delivered entirely online via Wisar’s platform, with asynchronous course completion and personalized tutor support throughout. The program’s cost per beneficiary was approximately USD \$700, with USD \$550 allocated to the tutoring alone.

Despite self-selection into the course and tutor support, completion rates were low. Only 39% of participants completed the theoretical phase, 16% completed the full program, and while 45% started the English course, only 16% finished it. Those who completed the program came from significantly wealthier households and were less likely to be married, suggesting that economic and household constraints may affect one’s ability to complete the training. Nevertheless, using an RCT design, the authors found positive impacts on online freelancing outcomes roughly one year after program completion. Participants were 53% more likely to create freelancing profiles, submitted 300% more proposals, and were 54% more likely to secure at least one online freelancing contract. However, similar to the Haiti pilot, these initial improvements did not lead to sustained success, with no significant effects on the number of job offers, contracts, or broader labor market outcomes. Socioemotional skills, particularly self-efficacy, improved, but the program did not result in lasting changes to participants’ livelihoods. Further analysis suggests that poor initial online job ratings may have hindered sustained success in online freelancing.

The previous studies focused on trying to improve online freelancing outcomes by training individuals on how to be self-employed and better engage with online platforms. A different approach focuses not only on platform engagement but also on equipping individuals with the technical skills needed to offer high-demand services in the digital marketplace. In Bangladesh, Das et al. (2024) evaluated a freelancing training program aimed at increasing women's participation in online work by providing technical training in graphic design, digital marketing, and web research. The program ran for four months, comprising 50 classes of four hours each. Initially delivered in-person, it transitioned to online delivery due to the COVID-19 pandemic. Sessions included both theoretical and practical training, followed by two months of mentorship to help participants in establishing freelancing profiles and securing work. Mentorship included personalized guidance on developing profiles and completing initial assignments on major freelancing platforms.

Approximately 34% of participants attended all the training sessions, and 72% attended at least half. Interestingly, the average number of sessions for those who participated online was higher than for those attending in-person, possibly reflecting changes in the opportunity cost of time during the pandemic. Using an RCT design, the authors found that one year after the intervention, women in the treatment group were 10 pp more likely to be employed, with a corresponding increase in monthly income (USD \$26.8) and hours worked. This increase came from freelancing work, which more than doubled. Household food expenditure also significantly increased. The average cost of training was approximately USD \$410,¹¹ and the benefit-cost ratio of the intervention was estimated at 6.55, suggesting considerable benefits compared to costs.

While the previous studies have focused on improving online freelancing outcomes, a different set of interventions aims to enhance individuals' success in microwork. The rise of artificial intelligence (AI) has driven a global surge in demand for microworkers. Due to its more complex nature, online freelancing typically requires higher education and prior work experience, making it accessible only to individuals with a certain level of skill and expertise. Microwork, in contrast, only requires basic numeracy and literacy skills, resulting in much lower barriers to entry than online freelancing. This makes it a potentially attractive income-generating opportunity for unemployed individuals with few or no specialized skills (Meyers et al., 2017), and a large proportion of workers in LMICs.

¹¹ Using the average 2021 exchange rate.

Baptista et al. (2024b) evaluated the effects of a microwork job training and search assistance program in Haiti. The program covered the entire microworking process, from creating accounts on online platforms up to the processes of conclusion and collection of payment. It was run by MAST and Wisar, targeting adults without higher education and requiring no minimum educational qualifications. Prior work experience was not necessary, but participants needed to be literate in French, have basic arithmetic and geometric skills, and possess basic computer skills.

The five-week program required approximately eight and a half hours of daily engagement. All training took place in-person at facilities equipped with internet-connected computers. Participants worked through modules hosted on Wisar's online learning platform, while tutors provided feedback and corrected activities. The training was split into two phases: a three-week theoretical phase covering six core modules on microworking, followed by a practical phase where participants engaged in platform activity with tutor support.

Attendance was exceptionally high, at 96%. Using an RCT design, the authors found that the program significantly increased the likelihood of having a microwork profile (76 pp), the number of tasks completed (47.6 tasks), and hours worked (12.8 hours per week) six months after the program concluded. These improvements led to higher microwork earnings (USD \$28.3) and a greater percentage of total monthly income from microwork (7.8 pp). The program also improved socio-emotional skills and English ability. However, no effects were observed on current employment, possibly as participants viewed microwork as a supplementary income source rather than a form of employment.

In Kenya, Atkin et al. (2021) conducted an RCT to evaluate the effects of two microwork programs. The first, Artificial Intelligence 101 (AI 101), taught young workers technical skills needed for digital microwork. The curriculum included occupational skills relevant to microwork, the BPO industry, and job search preparation. The second program built on AI 101 by adding information about job opportunities at Sama DC, a local firm that hires young workers to complete digital projects for clients like Google and Walmart. Participants in the second program were informed that their candidacy would be forwarded to Sama DC. Both programs targeted low-income youth with little to no formal work experience, requiring only that participants be aged 18 to 35, hold a secondary school certificate, and be proficient in English.

AI 101 is a classroom-based vocational training program, with trainees attending five hours of class per day over ten days. Completion rates were 74% for the AI 101 group and 86% for the

group offered both training and a job referral to Sama DC, showing that the job referral increased the incentive to complete the training. Additionally, 51% of the training plus job group eventually became employees of Sama DC. Participants who received both training and a job referral experienced a significant increase in monthly earnings (USD \$44.8) and a reduction in unemployment (10.4 pp), with particularly strong effects for women, both at midline (16 months) and endline (2.5 years) follow-ups. However, those who received only the AI 101 training struggled to find digital work in the initial years after training, resulting in slightly negative impacts on their earnings at midline, likely due to holding out for ICT jobs that did not materialize. By endline, many had adjusted expectations and found alternative work outside of ICT, leading to a recovery in earnings — though impacts remained statistically insignificant from the control group and far weaker than those observed for the training-plus-job group.

Lastly, as technology continues to advance, new avenues have emerged for local retail sellers to connect with global markets. The expansion of e-commerce offers a valuable opportunity for sellers in developing countries to enter broader markets at lower costs. However, much like online gig work, new entrants face substantial barriers to entry, as success in e-commerce marketplaces demands a different set of entrepreneurial skills compared to traditional retail.

Jin and Sun (2021) use an RCT to evaluate a training program offered on a leading e-commerce platform in China that helps new entrants overcome these skill barriers to selling on online marketplaces. The program focused on the specific challenges of running e-commerce businesses, covering three key areas: setting up online stores, marketing, and customer service. The goal was to equip new sellers to navigate the complexities of the online business environment. Training was accessible via the platform's seller portal, where the training module is easily available as a front-page widget. Each training task combined tutorials, Q&A forums and webinars to deliver recommendations.

Among sellers in the treatment group, 45% explored the training during their first month on the platform. However, within the first nine months, only 24% of sellers completed at least one task, and just 13% fully completed a task. Despite low completion rates, using an RCT design, the authors found that treated new sellers with access to the training earn higher revenues (1.7%) and attract more consumers to their sites. These sellers also became more engaged in marketing and improve their customer service practices.

Table 2 presents a summary of the programs discussed above, highlighting key aspects such as the target population, duration, delivery methods, and the significance of the results across various studies.

Table 2. Summary of programs to improve online labor market outcomes

Authors	Country	Target Population	Type of online labor	Duration	Delivery	Additional components	Method	Outcome variables	Results (Size & Significance)
Baptista et al. (2023b)	Haiti	Recent higher education graduates; those with relevant experience (2+ years)	Online freelancing	1 month, 3-4 hours daily (60-80 hours total)	Online	Personalized tutor support during training	RCT	# of proposals, # of contracts, employment, formal job, satisfaction index	# of proposals: 2.8 (+, **) # of contracts: 0.4 (+, ***) Employment: Null Formal job: Null Satisfaction: 0.5sd (+, *)
Fazio et al. (2025)	El Salvador	Recent higher education graduates; those with relevant experience (2+ years)	Online freelancing	3 months, 5 hours per week (60 hours total)	Online	Personalized tutor support during training; English for Freelancers course	RCT	# of proposals, at least one contract, # of contracts, employment, earnings, self-efficacy	# of proposals: 16.3 (+, ***) # of contracts: 5.8pp (+, **) Employment: Null Earnings: Null Self-efficacy: 1pp (+, ***)
Das et al. (2024)	Bangladesh	Women with at least secondary schooling	Online freelancing	4 months, 50 classes each lasting 4 hours (200 hours total)	In person	Mentored for 2 months after training; provided on-the-job guidance in first few assignments	RCT	Employed, freelancing employment, hours worked per day, total monthly income, freelancing income, household food expenditure	Employment: 10pp (+, **) Freelancing employment: 15.8pp (+, ***) Hours per day: 0.88 (+, **) Income: USD \$26.8 (+, ***) Freelancing income: USD \$10.5 (+, **) Food expenditure: USD \$26.4 (+, ***)

Authors	Country	Target Population	Type of online labor	Duration	Delivery	Additional components	Method	Outcome variables	Results (Size & Significance)
Baptista et al. (2024b)	Haiti	Adults without higher education, literate in French, basic arithmetic, geometric skills, and computer skills	Microwork	5 weeks, 8 ½ hours per day (212 hours in total)	Hybrid	Financial assistance; tutor support during training; insurance	RCT	# of tasks, platform earnings, hours worked on platforms, % of income from microwork, employment, satisfaction index, self-efficacy	# of tasks: 47.6 (+, ***) Platform earnings: USD \$ 28.3 (+, *) Hours worked on platforms: 12.8 (+, ***) % of income from microwork: 7.8pp (+, ***) Employment: Null Satisfaction: 0.6sd (+, ***) Self-efficacy: 1.9pp (+, ***)
Atkin et al. (2021)	Kenya	Individuals with secondary school and proficiency in English	Microwork	10 days, 5 hours per day (50 hours total)	In person	Some referred to microwork firm	RCT	Monthly earnings, unemployment, hours worked	No significant effects for training only <i>Training + Job:</i> Earnings: USD \$44.8 (+, ***) Unemployment: 10.4pp (-, ***) Hours worked: 6.0 (+, ***)
Jun and Sun (2021)	China	Sellers on a leading e-commerce platform	E-commerce	Not specified, but at least 10+ tasks	Online	None	RCT	Log revenues, any revenues,	Log revenues: 1.7% (+, ***) Any revenues: 5% (+, ***)

Notes: We have excluded Atarodi et al. (2024) from the table as the evaluation is more descriptive than causal. 'pp' refers to percentage points. RCT refers to randomized controlled trial. Bangladeshi Taka converted to USD using average 2021 exchange rate of 0.0118 BDT/USD. Kenyan Shillings converted to USD using average 2020 exchange rate of 0.009 KSH/USD. Brackets after the results refers to the sign and significance of the estimated effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Recommendations for Public Policy

The studies summarized above reveal common trends and highlight several important considerations for policymakers designing programs aimed at improving online labor market outcomes:

- 1. Address underlying barriers to low participation and completion.** Online programs often suffer from low completion rates, particularly among women and participants from disadvantaged households. Promoting higher completion rates may require complementary, substantive support — such as providing devices, internet access, childcare services, or stipends— to address underlying structural barriers. While interventions like personalized tutoring have increased costs (e.g., over USD \$700 per person), they have not consistently generated proportional gains in completion or impact. Evidence from Baptista et al. (2024b), where daily financial assistance boosted completion rates, suggests that targeted financial support might be effective for vulnerable groups.
- 2. Pair platform access with technical skills development.** Simply facilitating access to online work platforms is unlikely to generate meaningful, sustained labor market outcomes. While participants need to engage effectively with these platforms, they may also need technical and soft skills to be globally competitive. Programs should focus on building the skills that allow workers in developing countries to compete effectively in international digital markets.
- 3. Ensure sufficient online work opportunities and reduce competition barriers.** Programs that connect participants directly with established firms offering steady online work have shown more promising results than those leaving trainees to compete for tasks on saturated platforms. Partnerships with reputable organizations or structured task-allocation mechanisms can help mitigate intense competition and improve reliable job access for vulnerable populations.
- 4. Recognize microwork as supplemental income.** Given its low pay and limited career advancement opportunities, microwork may be better suited as a secondary activity to smooth income volatility rather than a primary employment pathway. Program objectives and success metrics should be adapted to reflect this reality.

The review also highlights several important evidence gaps. Given that women are often expected to take responsibility for household chores, online jobs that allow them to work from home, manage childcare, and choose their working hours hold promise for increasing female labor force participation (Ho et al., 2024). In developing countries, where commuting and childcare infrastructure may be limited, and societal norms may discourage work outside the

home, the impact could be even more substantial. Similarly, gig work offers opportunities for young people who are still in education or individuals with disabilities to engage in part-time or flexible work, making it an attractive option for those with constraints affecting their offline labor market options. However, more evidence is needed to determine which training programs best support these groups — such as women and individuals with disabilities — in achieving sustained success on online platforms, and whether these opportunities enable meaningfully labor force participation.

These evaluations also raise important questions about the scalability, accessibility, and long-term effectiveness of programs designed to improve outcomes in online labor markets. While some programs — particularly those delivered online — offer potential for scale, low completion rates remain a persistent challenge. In contrast, in-person training has shown promise in improving completion rates and has not been overly expensive. However, the cost is still not negligible (e.g., over USD \$400) and comes with capacity constraints (e.g., limited space, instructors, and infrastructure) that may hinder scalability.

It is also important to note that, given its more complex nature, most online freelancing programs require beneficiaries to meet certain prerequisites, such as higher education, relevant work experience, and English proficiency — potentially excluding individuals from more disadvantaged backgrounds. Even in programs targeting less-skilled participants, such as microwork interventions, a basic level of digital literacy, language ability, and access to digital devices and internet is typically required.

Finally, nearly all existing evaluations focus on short-term impacts. As these programs continue to expand across developing countries, there is a clear need for more rigorous evidence — particularly on long-term outcomes — to inform future program design and investment.

4. MOOCs and other new methodologies of delivering training programs

In this section, we review the literature on the effectiveness of new methodologies for delivering training programs. Here, we expand our scope beyond programs focused solely on advanced digital skills or online labor markets, drawing insights from the broader training literature. However, we maintain our focus on training programs designed for individuals outside the formal education system.

MOOCs

One emerging methodology is the use of MOOCs to deliver training content. MOOCs are short online courses on a specific subject with virtually unlimited enrolment capacity and minimal enrolment requirements beyond internet access. MOOCs are often discussed as an instrument for scaling-up not only education, but also the provision of job training. Indeed, the OECD (2016) asserts that integrating MOOCs into professional development is the most promising use for these instruments in the future. In addition to imparting technical skills, one plausible mechanism in which MOOCs may enhance career trajectories is through the issuance of microcredentials from recognized education institutions.¹²

MOOCs have become increasingly important in recent years. In early 2016, there were just over 4,000 MOOCs available; by 2020, there were more than 19,000 courses on offer that reached 220 million people globally (Shah, 2021). However, despite their significant expansion, rigorous research on the labor market returns to MOOCs is also limited. Castano-Muñoz and Rodrigues (2021) used a quasi-experimental approach to study the labor market effects in Spain of participation in Coursera MOOCs in ‘Business Intelligence’ and ‘Communication and Marketing.’ These MOOCs typically lasted 15 hours over 2-5 weeks. Their sample consisted of adult (average age 45) employed individuals, most of whom had higher education and had completed an average of six MOOCs prior to the one studied. Using a differences-in-differences approach and follow-up data collected approximately two years after MOOC enrolment, the authors found that while MOOCs increased the probability of maintaining employment, they had no effect on wages.

This study suggests that MOOCs may have positive effects on some labor market outcomes. However, it is important to note that these studies surveyed only those who successfully completed a MOOC. A major critique of MOOCs is their low completion rates, often as low as between 2% and 10%. As such, the broader labor market implications of MOOCs as a method of delivering effective job training, particularly in LMICs and among less educated populations, remain unclear.

Addressing this gap, Novella et al. (2024c) implemented an RCT to evaluate the impact of a job training program offered by the Costa Rican Investment Promotion Agency (CINDE), in collaboration with the Ministry of Labor and Social Security in 2020. The program aimed to

¹² There is a growing body of literature highlighting the potential labor market benefits of online microcredentials. For example, Athey and Palikot (2024) find that encouraging individuals to share their MOOC credentials increases the probability of new employment. Additionally, Kässä and Lehdonvirta (2022) found that obtaining a voluntary online freelancing microcredential increased workers’ freelance earnings. While we note these findings, we have not included these papers in the main review as they focus on the potential value of certificates only rather than new methodologies for delivering training.

reduce the labor market effects of the COVID-19 pandemic on vulnerable workers. It provided participants with cost-free access to Coursera MOOCs and certificates, carefully selected by CINDE in consultation with large firms to ensure alignment with skills in high demand in the formal labor market. The MOOCs were organized into various 'learning paths,' designed to facilitate mastery of the skills required for specific occupations. A behavioral experiment was also integrated within the training offer, where some individuals received a light-touch email reminder, while others received both an email and a personalized call to encourage course completion.

The program targeted individuals with at least secondary education whose labor market outcomes were affected by the COVID-19 pandemic. All courses were relatively short (averaging 14 hours). Despite the provision of free, curated learning paths, completion rates were low.

The evaluation found that while 42% of the treatment group enrolled in a MOOC, only 10% completed at least one course. Males, individuals from wealthier households, and those with stronger digital and non-cognitive skills were significantly more likely to complete a MOOC. The personalized reminder had no additional effect compared to the simple email reminder. This suggests that light-touch behavioral nudges may have limited effectiveness in improving MOOC completion rates.

Regarding labor market outcomes, neither assignment to nor completion of the training had any significant effect on employment or earnings approximately two years after the program. The authors suggest that this may be because alternative credentials, such as MOOC certificates, are not highly valued in the Costa Rican labor market. However, the program did increase post-secondary education enrolment by 11%, particularly among those who completed at least one MOOC and those without prior tertiary education. Evidence suggests that this may be operating partially through the program motivating individuals who lacked sufficient skills to pursue further specialization.

Similar to the intervention in Costa Rica, Majerowicz and Zárate (2024) implemented an RCT design to evaluate a job training program in Colombia that provided access to free MOOC certificates. The program was also implemented during the COVID-19 pandemic and aimed to offer vulnerable workers opportunities to acquire new skills. The initiative was led by the Ministry of Information Technologies and Communications of Colombia, in partnership with Icetex, the Colombian Institute for Educational Credit and Technical Studies. The program

targeted individuals who had previously received educational loans or scholarships from Icetex.

Despite offering free certificates, enrolment and completion rates were low, echoing the findings in Novella et al. (2024c). While 54% enrolled in at least one course, only 6% successfully completed a MOOC. When examining labor market outcomes one year after the courses were concluded, the results of the program were mixed. Treatment effects on formal employment among the full treatment group were positive but statistically insignificant; however, an event study shows a significant increase in formal employment (3.3 pp) among those who managed to complete at least one MOOC, especially for low-income beneficiaries.

Other new methodologies of delivering training programs

An alternative to online, self-paced asynchronous courses without any human interaction is to hold video-based synchronous courses that mimic the format of in-person training, while allowing for remote delivery. This online synchronous format has been used in several studies. For example, in the online bootcamp evaluated by Novella et al. (2024b), participants attended synchronous sessions at pre-scheduled times, but they were also expected to engage with the content independently to support their learning.

Davies et al. (2024) conducted an RCT to evaluate the feasibility, cost-savings, and impact of delivering live training sessions over Zoom in Mexico and Guatemala. The training was delivered by a Mexican NGO to female microentrepreneurs, with an average age of 40, nearly half having attended university, and typically operating very small firms (1–2 employees on average) in the food or services sectors. The treatment group were provided with a business training program taught live in small groups over Zoom in a total of nine 2-hour sessions over 4 weeks, while the control group were provided with four asynchronous online modules. The estimated cost per participant was USD \$50 in Mexico and USD \$56 in Guatemala, which covered the cost of personnel for recruitment and training, technology costs such as Zoom license fees, data plans, paid Facebook advertising, and other recruitment costs. The costs of personnel, especially the trainer, were the main cost.

The authors found that 80% of those assigned to training started at least one session, and 61% completed all sessions. This is in line with the average take-up rate for in-person training classes of 65% (McKenzie and Woodruff, 2014). In contrast, take-up from the control group for the asynchronous materials was low: only 7% completed all modules. The remote training improved business practices and performance in the period immediately after training, but these impacts did not last. Moreover, the authors found that the cost savings from switching

from in-person to online training were not that large (USD \$50 versus USD \$62 per participant), reflecting that the main costs of instructor time, recruitment, and material development are similar for online and offline synchronous training.

Another approach to training combines in-person instruction with distance learning in a hybrid format. For example, the digital bootcamps in Aramburu et al. (2021) offered a “blended learning mode”, which integrated face-to-face and online classes. A similar innovative approach is seen in Janzen et al. (2025), who evaluated a hybrid distance-learning program to train community animal health workers (CAHW) in Nepal. Traditionally, training to become a CAHW involves a 35-day stay at a training center, which can be challenging for women with household responsibilities. To address this barrier, the authors modified the CAHW course, creating a hybrid system with both in-person and remote learning components. The program began with a five-day orientation at a training center, after which trainees returned home to complete digitized content over 30 days. This content was primarily delivered through short, engaging videos and interactive materials. Although trainees completed the content asynchronously, they had various ways to engage with instructors and peers through an app or by phone. After the 30-day remote period, trainees returned to the training center for a final ten-day practical module with livestock. Ignoring the fixed cost of platform development (approximately USD \$40,000), the cost per trainee was USD \$430, including the cost of the tablet.

Using an RCT design, the authors compared completion rates, knowledge acquisition, skills development, and job performance indicators between groups. They found that 51% of women assigned to distance learning completed the training, compared to only 30% in the traditional program. Moreover, 18 months after the program concluded, distance learning participants demonstrated equivalent levels of knowledge and skill, with comparable job performance to their traditionally trained peers. One factor contributing to these differences appears to be women’s preference for flexibility, allowing them to balance training with household responsibilities. For example, no women with very young children enrolled in traditional training, while 45% of those offered the distance-learning option completed the course.

A different approach to delivering training, which takes advantage of the high mobile phone penetration in many developing countries,¹³ is through mobile applications. Estefan et al. (2024) implemented an RCT to evaluate the impact of business training among franchise store owners in Guatemala, predominantly women from low-income households. The seven-week

¹³ In Latin America, around 65% of the population used mobile internet in 2023 (GSMA, 2024).

program combined a mobile app offering access to 28 short video capsules, a workbook with additional training exercises, and three personalized video meetings with professional business consultants. Training topics covered branding, operations, marketing, and financial management.

The evaluation found a 50% completion rate, defined as participants attending all three consulting meetings and watching at least 70% of the video capsules. This completion rate is notably higher than MOOCs, despite the training being largely asynchronous. However, to encourage participation, the program provided tablets to participants without smartphones, sent standardized WhatsApp reminders for new video releases, and personalized reminders for upcoming one-on-one sessions. Additionally, participants received weekly text messages comparing their training progress with peers and were rewarded with digital money for completing each module.

The evaluation also found significant positive effects on business knowledge, practices, monthly sales (USD \$159), and monthly profits (USD \$102) approximately six months after the end of the program. The cost of the program was approximately USD \$537 per beneficiary, and the authors calculated a cost-effectiveness ratio of 2.3, highlighting its efficiency in delivering these outcomes.¹⁴

Building on the potential of high mobile penetration, Cole et al. (2024) implemented an RCT to evaluate the impacts of a light-touch, mobile-based business-training service in India and the Philippines. Partnering with microfinance institutions, the program delivered financial-heuristics training to micro-entrepreneurs via weekly audio messages on their mobile phones. Participants were predominantly adult women running small businesses, with an average age of 38 in India and 45 in the Philippines, and with varying levels of education (35% in India vs. 72% in the Philippines had at least a high school diploma). Each week, participants received 3- to 4-minute interactive voice response calls with training content, presented in an engaging soap-opera format, over 21 weeks in the Philippines and 22 weeks in India. The per participant cost of training delivery (airtime only) was very low — just over USD \$2 in India and approximately USD \$15 in the Philippines.

¹⁴ Athey and Palikot (2022) evaluate a program designed to help women transition into technology jobs by developing portfolio items through job-relevant projects, with an emphasis on peer interactions and online collaboration. The program demonstrated a positive increase on the likelihood of finding a tech job. While we mention this, we do not include it in the review as is not a training program but rather a skill-signaling intervention that utilizes technology to connect participants with industry professionals for project feedback.

The evaluation found high engagement, with around three-quarters of calls picked up and listenership rates above 60% in the Philippines and 48% in India. Endline data was collected approximately 3 to 6 months after participants completed the training. The training had a significant positive impact on the adoption of improved business practices. However, no significant impacts were found on business sales or profits.

The final innovative approach to delivering training leverages the rapid advancements in generative AI.¹⁵ Many economists expect generative AI to transform the structure and dynamics of economic activity (Frank et al., 2019). From a job training perspective, generative AI holds potential for augmenting worker productivity.

Peng et al. (2023) provided early evidence from a controlled lab experiment designed to measure the productivity effects of GitHub Copilot, an AI-based coding assistant, in a standardized programming task. As developers work on software code or plain text comments, Copilot analyzes the context and generates relevant code snippets, comments, and documentation.

In their study, 95 professional programmers recruited via Upwork — mostly from India and Pakistan — were asked to implement an HTTP server in JavaScript as quickly as possible. The treatment group was granted access to GitHub Copilot, while the control group completed the task without the tool but could use standard resources like internet search and Stack Overflow.¹⁶ Results showed that access to Copilot helped developers to complete the task 55.8% faster than the control group, although it did not significantly affect task success rates (measured as the percentage of participants that adequately completed the task). Developers with less programming experience, older programmers, and those who programmed more hours per day experienced the greatest productivity gains.

Building on these findings, Cui et al. (2024) evaluated the impact of generative AI on software developer productivity through three randomized controlled trials conducted at Microsoft, Accenture, and a Fortune 100 electronics manufacturing company. These experiments, which were run by the companies as part of their ordinary course of business, provided a randomly selected group of developers with access to GitHub Copilot. The adoption rate of Copilot was relatively high, with approximately 50% of Microsoft developers and 60% of Accenture

¹⁵ We acknowledge that research on generative AI for skills development is rapidly evolving; this review covers studies available up to the end of 2024.

¹⁶ Stack Overflow is an online question-and-answer platform where programmers and developers share knowledge, ask technical questions, and provide solutions to coding problems.

developers using the tool during the experiment. Results from the experiments revealed that Copilot adoption resulted in a significant increase in the number of completed tasks among developers. Notably, similar to Peng et al. (2023), less experienced developers showed higher adoption rates and greater productivity gains.

Another way generative AI may enhance worker productivity is through conversations with large language models. Such interactions could help individuals learn new skills and receive personalized advice. Noy and Zhang (2023) conducted an experiment to test the effects of generative AI on midlevel professional writing tasks. The authors recruited 453 experienced, college-educated professionals via Prolific, an online survey platform widely used in social science research, and randomly assigned half to a treatment group that was instructed to register for ChatGPT between the first and second writing task, given guidance on using it, and explicitly told they could use it on the second task if they found it useful. Among treated participants, 92% successfully registered for ChatGPT and 80% chose to use it on the second task.

The treatment significantly increased productivity: the time taken to complete tasks decreased by 0.75 standard deviations, and evaluator-assessed output quality rose by 0.45 standard deviations. The productivity gains were particularly pronounced among lower-ability workers, reducing performance inequality between participants. In a follow-up survey two months later, 42% of treated participants reported continued use of ChatGPT in their real jobs.

Otis et al. (2024) further tested the potential of generative AI in a field experiment with Kenyan entrepreneurs, who were typically young (average age of 26), male, college-educated, and had been running their business for one year. Participants in the treatment group received access to a custom GPT-powered AI business assistant via WhatsApp, while the control group received business guides designed for entrepreneurs. Engagement with the AI assistant was high; 85% of treated entrepreneurs used the assistant at least once, and on average, they sent 17 messages over five months. Using data collected six months after the AI assistant was deployed, the experimental design showed that, on average, access to the assistant had no impact on business performance. However, analyzing heterogeneity, the authors found that the AI assistant significantly improved performance among high-performing entrepreneurs (those with above-median baseline performance). In contrast, low-performing entrepreneurs saw a significant decline in performance compared to the control group.

In a similar exercise in a different context, Brynjolfsson et al. (2023) implemented a difference-in-differences approach to evaluate the impacts of adopting a generative AI tool that provided

conversational guidance for customer support agents. This tool was implemented among agents, primarily based in the Philippines, who worked for a Fortune 500 software firm. The agents were granted access to a customized generative AI assistant, which combined a recent version of GPT with additional algorithms specifically fine-tuned for customer service interactions.

The evaluation found that five months after AI deployment, access to the AI tool significantly boosted agents' productivity, as measured by the number of customer issues resolved per hour (14%). Notably, consistent with Noy and Zhang (2023) but in contrast to Otis et al. (2024) and findings from previous waves of computerization, these productivity gains were most pronounced among less-experienced and lower-skill workers.

Table 3 presents a summary of the programs discussed above, highlighting key aspects such as the target population, duration, delivery methods, and the significance of the results across various studies.

Table 3. Summary of new methodologies to deliver training programs

Authors	Country	Target Population	Training method	Duration	Delivery	Additional components	Method	Outcome variables	Results (Size & Significance)
Novella et al. (2024c)	Costa Rica	Individuals with at least secondary education whose labor market outcomes were affected by the pandemic	MOOCs	Average MOOC duration of 14 hours	Online, asynchronous	Free certification; specialization paths; bi-weekly reminders	RCT	Employment, formal employment, monthly income, education enrolment	Employment: Null Formal employment: Null Income: Null Education enrolment: 0.05 (+, *)
Majerowicz and Zárate (2024)	Colombia	Individuals who had previously received a higher-education loan or scholarship	MOOCs	Not specified, but likely around 14 hours per MOOC	Online, asynchronous	Free certification; specialization paths	RCT	Formal work; daily wages	<i>Full treatment group:</i> Formal work: Null Wages: Null <i>Event study:</i> Formal work: 3.3pp (+, **) Wages: Null
Davies et al. (2024)	Mexico and Guatemala	Women entrepreneurs in economically marginalized areas	Zoom classes	Nine 2-hour sessions over 4 weeks (18 hours)	Online, synchronous	Several take-home exercises	RCT	Index of business practices, monthly sales, monthly profits	Business practices: 5.4pp (+, ***) at 2-month; Null at 6-month Sales: USD\$240 (+, ***) at 2-month; null at 6-month Profits: Null

Authors	Country	Target Population	Training method	Duration	Delivery	Additional components	Method	Outcome variables	Results (Size & Significance)
Janzen et al (2025)	Nepal	Members of women's livestock marketing cooperatives who have at least 8 th grade education	Hybrid of in person and tablet application	45 days (15 in person and 30 distance learning)	Hybrid of in person, synchronous, and tablet-based, asynchronous	Given a tablet; communication through the app or phone calls	RCT	Livestock knowledge score, adoption of health practices, CAHW services provided	<i>Difference between hybrid and in-person:</i> Knowledge score: Null Adoption of animal health practices: 35 pp (+, **) CAHW services provided: Null
Estefan et al. (2024)	Guatemala	Franchise store owners of a food corporation	Mobile application and virtual meetings	67 minutes of videos, 90 minutes of meetings, 6.5 hours of workbook exercises	Asynchronous mobile application and online synchronous	Lent tablet if don't own smartphone; digital money for completion, reminders; social comparisons	RCT	Knowledge and Business practices index; monthly sales, monthly profiles	Knowledge and business practices index: 5pp (+, ***) Sales: USD\$159 (+, *) Profiles: USD\$102 (+, **)
Cole et al. (2024)	India and Philippines	Microentrepreneurs of microfinance institutes	Audio messages delivered by calls	Weekly 3-to 4-minute audio messages, for 21-22 weeks	Audio message, asynchronous	30 minute in-person orientation; service to access training content at any time	RCT	Business practice index, weekly sales, weekly profits	Business practice index: 0.12 sd in Philippines (+, **); 0.06 sd in India (+, *) Sales: Null Profits: Null

Authors	Country	Target Population	Training method	Duration	Delivery	Additional components	Method	Outcome variables	Results (Size & Significance)
Peng et al. (2023)	Online platform, mostly from India and Pakistan	Professional programmers registered on Upwork	GitHub Copilot	Continuous access	Online, downloadable extension	Brief video explaining how to use the tool and email with installation instructions	RCT	Task completion time, task success rate	Task completion time: 55.8% (-, ***) Task success rate: Null
Cui et al. (2024)	United States and Southeast Asia	Software developers at various large companies	GitHub Copilot	Continuous access	Online, downloadable extension	None	RCT	Pull requests (unit of work)	Pull requests: 26.1% (+, **)
Noy and Zhang (2023)	Online platform	Experienced, college-educated professionals registered on Prolific	ChatGPT	Continuous access	Online	Instructed to register for ChatGPT and received guidance on using it	RCT	Time taken on task, evaluator grade	Time on task: 0.75sd (-, ***) Evaluator grade: 0.45sd (+, ***)
Otis et al. (2024)	Kenya	Kenyan entrepreneurs	WhatsApp AI-assistant	Continuous access	Asynchronous WhatsApp messages	Regular reminders to use the tool	RCT	Business performance index	Business performance index: Null
Brynjolfsson et al. (2023)	Philippines (majority)	Customer service agents at software company	Computer AI-assistant	Continuous access	Asynchronous messages	None	Quasi-experimental	Resolutions per hour	Resolution per hour: 14% (+, ***)

Notes: We have excluded Castano-Muñoz and Rodrigues (2021) from the table as it is not a training program. 'pp' refers to percentage points. RCT refers to randomized controlled trial. Brackets after the results refers to the sign and significance of the estimated effects. * p < 0.10, ** p < 0.05, *** p < 0.01.

Recommendations for public policy

The evidence on MOOCs and other innovative training delivery methods highlights several considerations for policymakers seeking scalable and cost-effective approaches to skills development:

- 1. Address underlying barriers to low participation and completion.** MOOCs and other asynchronous online programs typically have relatively low completion rates, with participation skewed toward men, wealthier individuals, and those with stronger digital and non-cognitive skills. Complementary substantive support — such as targeted financial assistance, provision of digital devices, improved internet access, personalized and intensive monitoring or childcare support — may be necessary to improve engagement and completion, particularly among disadvantaged groups. Without such support, MOOCs and other online training may primarily benefit those who already have the resources and skills to engage fully. Light-touch interventions (e.g., reminders) have proven insufficient to boost completion rates.
- 2. Clarify the labor market value of alternative credentials.** Evidence shows limited or mixed labor market returns from MOOC and bootcamp certificates, suggesting that their value is not universally recognized by employers. Policymakers should engage with employers to ensure training is demand-linked and, where necessary, develop mechanisms to strengthen recognition of alternative credentials within national continuing education and employment systems.
- 3. Leverage synchronous and hybrid delivery models to boost engagement.** Live, online training sessions and hybrid models that combine in-person and remote learning have shown higher completion rates and, in some cases, improved outcomes relative to asynchronous training. However, such models raise questions about cost-effectiveness since the primary cost drivers remain. Sustainably scaling these approaches cost-effectively may involve strategies such as larger class sizes on platforms like Zoom (e.g., increasing from 15–20 to 30–40 participants) and incorporating structured networking opportunities (e.g., WhatsApp groups) to foster peer support and collaboration.
- 4. Harness mobile-based delivery for broader reach.** Mobile training programs, particularly those with interactive elements and financial incentives, have shown promise in increasing completion and improving knowledge and business outcomes. Policymakers can leverage high mobile phone penetration in many developing countries to reach a broader demographic more effectively.

5. Monitor equity impacts of generative AI tools. Emerging evidence shows that generative AI can enhance worker productivity and support personalized skill development. However, in developing countries, these tools may disproportionately benefit relatively advantaged individuals with higher baseline skills and access to technology. Policymakers should carefully monitor distributional impacts and consider pairing AI-based tools with traditional training programs or targeted support to ensure benefits extend to disadvantaged groups. This concern is particularly relevant in Latin America, where, according to the OECD's Survey of Adult Skills (PIAAC), much of the workforce lacks the minimum technological skills needed to benefit from digital learning tools (OECD, 2023).

There are also several important evidence gaps. First and foremost, more rigorous evaluations of new training delivery methodologies are needed — particularly those assessing longer-term horizons. This is essential to determine whether these approaches can produce sustained improvements in labor market outcomes and to identify which complementary interventions most effectively enhance completion rates for MOOCs and other online asynchronous training, especially among economically disadvantaged individuals.

Hybrid learning models, as explored in Janzen et al. (2024), present a promising approach to training. The in-person aspects of these programs act to boost comprehension and engagement, while the distance-learning components provide flexibility and accessibility, especially for individuals with specific needs, such as women. However, further research is needed to determine how hybrid approaches can be adapted and scaled across different sectors and to identify which combinations of in-person and remote elements yield the best results for diverse demographic groups.

Mobile-based programs also hold potential for extending access to training. The flexibility of such programs aligns well with participants' schedules, and regular progress updates or financial rewards appear to effectively motivate continued participation. However, given the asynchronous nature of mobile-based content, these programs may face similar completion challenges as MOOCs. Further research could help refine mobile applications for training delivery, particularly in determining whether such programs can sustain effectiveness without financial incentives for disadvantaged learners.

Finally, emerging evidence on generative AI suggests that its distributional effects might depend on factors such as the sector of implementation, the complexity of tasks, and the target population. It is possible that generative AI tools designed to address complex and dynamic issues (like entrepreneurial challenges) could exacerbate inequality, whereas tools for more stable tasks (such as customer service) might help reduce it. Further research is needed to better understand the distributional effects of generative AI tools, whether pairing them with more traditional training programs could broaden their benefits to disadvantaged groups, and the potential longer-term impacts of generative AI on skill demand, job design, and wages.

A related gap in the literature concerns the career implications of AI-based tools and training. While the emerging studies highlight that generative AI may increase short-run productivity, they do not shed light on whether these gains translate into sustained improvements in career progression or occupational mobility, including for tertiary-educated workers, many of whom face job-quality challenges in many Latin American labor markets. At present, no studies evaluate the impact of AI-assisted training or augmentation tools on labor-market and career trajectories, making this a further area for future research.

5. Conclusion

Digital transformation is reshaping the global labor market, creating new job opportunities and increasing the demand for advanced digital skills across industries and countries. This shift offers potential for economic growth and labor market inclusion, especially as new technologies create flexible work opportunities that extend beyond traditional employment. However, realizing this potential depends on equipping individuals, especially those in developing countries, with the skills needed to participate meaningfully in the digital economy.

This study offers a thematic review of the robust evidence on the effectiveness of interventions aimed at improving labor market outcomes in the context of digital transformation. It focuses on three key areas: advanced digital skills programs, programs to improve online labor outcomes, and innovative training delivery methodologies. Each approach offers distinct advantages and challenges, underscoring the need for adaptable, context-sensitive solutions.

Overall, the review highlights that despite growing interest, rigorous evidence on the effectiveness of such interventions remains limited, pointing to the need for greater efforts to build a stronger evidence base.

That said, the existing evidence suggests that advanced digital skills programs have demonstrated significant impacts on placements in technology-related jobs, income growth, and workforce inclusion. However, the high costs and selective entry requirements of these programs often limit access to already skilled individuals, leaving behind those who may benefit most. Furthermore, while positive labor market outcomes are observed, more evidence is needed on the mechanisms behind these programs, the long-term impacts, and their cost-effectiveness — especially as the digital skills gap continues to grow.

Online labor market improvement programs illustrate the potential of remote work opportunities but also underscore the importance of complementary skills development and labor intermediation support in making these roles accessible and sustainable. Findings indicate that while many participants can gain initial access to gig platforms, their success is often short-lived without competitive technical skills and job-matching support. This highlights the value of demand-linked training and partnerships with established firms, which may create more stable employment pathways in an otherwise highly competitive online labor market. Additionally, more research on tailored support for women, individuals with disabilities, and young people could help ensure that the benefits of online work extend to underrepresented groups.

New training delivery methodologies, such as MOOCs, synchronous online courses, hybrid approaches, mobile-based programs, and generative AI present scalable solutions to deliver training for bridging the skills gap, but they also face limitations. MOOCs provide scalable, flexible, low-cost learning, but suffer from low completion rates, particularly for disadvantaged populations. Synchronous classes, hybrid approaches, and mobile-based applications show promise in achieving higher engagement, but questions remain regarding their cost-effectiveness, scalability, and sustainability. Generative AI also holds potential for personalized training and continuous support, though its efficacy, particularly for the most disadvantaged, warrants further exploration. Future research should further explore how complementary interventions can enhance engagement across these delivery methods and improve outcomes for disadvantaged learners.

A consistent finding throughout the paper is the need for more long-term evidence on the impacts of such training programs. Current evaluations largely capture short-run effects, which may not fully reflect their welfare implications. For example, some digital skills bootcamps have encouraged participants to enter the labor market earlier rather than pursuing additional education, while lighter-touch interventions such as MOOCs have, in contrast, motivated further education with little immediate improvement in labor market outcomes. Similarly, several advanced digital skills programs have facilitated occupational shifts into more technology-related roles without changing overall employment levels. The net welfare effects of these shifts, including potential longer-term earnings gains, career progression, or foregone educational opportunities, are not clear — particularly in the short term. Robust longer-term evaluations are needed to understand whether these training approaches ultimately enhance participants' labor market trajectories and well-being.

References:

- Aramburu, J., Goicoechea, A. and Mobarak, A.M. (2021). Coding Bootcamps for Female Digital Employment: Evidence from an RCT in Argentina and Colombia. World Bank Policy Research Working Paper No. 9721.
- Athey, S. and Palikot, E. (2024). The value of non-traditional credentials in the labor market. Mimeo.
- Atkin, D., Schoar, A. and Wahnschafft, K. (2021). Evaluating Sama's Training and Job Programs in Nairobi, Kenya. Mimeo.
- Baptista, D., Haro, E. and Novella, R. (2023a). Resultados de la Encuesta de Talento Digital en Ecuador. Mimeo.
- Baptista, D., Freund, R. and Novella, R. (2023b). Entrepreneurial skills training for online freelancing: Experimental evidence from Haiti. *Economics Letters* 232, 111371.
- Baptista, D., Freund, R. and Novella, R. (2024a). Digital Skills for Employment: Evidence from a Bootcamp Program in Haiti. Mimeo.
- Baptista, D., Freund, R. and Novella, R. (2024b). Job training and search assistance for microwork: Evidence from Haiti. *Economics Letters* 244, 111948.
- Brynjolfsson, E., Li, D. and Raymond, L.R. (2023). Generative AI at Work. NBER Working Paper No. 31161.
- Cathles, A., Suaznabar, C., & Vargas, F. (2022). The 360 on Digital Transformation in Firms in Latin America and the Caribbean. <https://doi.org/10.18235/0004635>.
- Chun, Y., Jabbari, J., Huang, W. and Graham C. (2024). Can training and apprentice programs in STEM increase worker life satisfaction and optimism? *International Journal of STEM Education* 11, 6.
- Cole, S., Joshi, M. and Schoar, A. (2024). Heuristics on Call: The Impact of Mobile-Phone-Based Business-Management Advice. *World Bank Economic Review* 38(3), 580–597.
- Croke, K., Goldstein, M. and Holla, A. (2023). The Role of Skills and Gender Norms in Sector Switches: Experimental Evidence from a Job Training Program in Nigeria. *Journals of African Economies* 32(3), 237-268.
- Cui, K.Z., Demirer, M., Jaffe, S., Musolff, L., Peng, S. and Salz, T. (2024). The Effects of Generative AI on High Skilled Work: Evidence from Three Field Experiments with Software Developers. Mimeo.
- Das, N., Arman, M.R., Bhattacharjee, A, Gomes, M. and Mahmood, S. (2024). Tackling Women's Unemployment: Evidence from an Online Freelancing Experiment in Bangladesh. Mimeo.

- Datta, N., Rong, C., Singh, S., Stinshoff, C., Iacob, N., Simachew, N., Nxumalo, M. and Klimaviciute, L. (2023). Working without Borders: the Promise and Peril of Online Gig Work. World Bank, Washington, DC.
- Davies, E., Deffebach, P., Iacovone, L. and McKenzie, D. (2024). Training microentrepreneurs over Zoom: Experimental evidence from Mexico. *Journal of Development Economics* 167, 103244.
- Eggleston, L. (2025). The Ultimate Guide to Coding Bootcamps in 2025. Course Report, 1st January.
- Estefan, A., Improta, M., Ordoñez, R. and Winters, P. (2024). Digital Training for Micro-Entrepreneurs: Experimental Evidence from Guatemala. *World Bank Economic Review* 38(2), 394–421.
- Fazio, M.V., Freund, R. and Novella, R. (2025). Do entrepreneurial skills unlock opportunities for online freelancing? Experimental evidence from El Salvador. *Journal of Development Economics* 172, 103363.
- Frank, M.R, Autor, D., Bessen, E.B., Brynjolfsson, E., Cebrian, M., Deming, D.J., Feldman, M., Groh, M., Lobo, J., Moro, E. et al. (2019). Toward understanding the impact of artificial intelligence on labor. *Proceedings of the National Academy of Sciences* 116(14), 6531–6539.
- GSMA. (2024). The Mobile Economy Latin America 2024.
- Hassan, M.U., Iqbal, Z. and Shakir, K. (2020). Impact of ICT training and education on women's employability and entrepreneurial skills: achieving the sustainable development goals. *International Journal of Business Forecasting and Marketing Intelligence* 6(2), 157-166.
- Hilbert, M. and Lu, K. (2020). The online job market trace in Latin America and the Caribbean. Project Documents (LC/TS.2020/83). Economic Commission for Latin America and the Caribbean, Santiago.
- Ho, L., Jalota, S. and Karandikar, A. (2024). Bringing Work Home: Flexible Work Arrangements as Gateway Jobs for Women in West Bengal. Mimeo.
- Jaccoud, F. (2025). International Review of Evidence and Systematic Review of Program Results Evaluations for (A) Stem Graduate Programs and (B) Digital Skills Programs. Mimeo.
- Janzen, S., Magnan, N., Mullally, C., Sharma, S. and Shrestha, S. (2025). Going the Distance: Hybrid Vocational Training for Women in Nepal. *Journal of Development Economics* 174, 103414.

- Jabbari, J., Chun, Y., Huang, W. and Roll, S. (2023). Disaggregating the Effects of STEM Education and Apprenticeships on Economic Mobility: Evidence from the LaunchCode Program. *Educational Evaluation and Policy Analysis*, 0(0).
- Jin, Y. and Sun, Z. (2021). Lifting Growth Barriers for New Firms Evidence from an Entrepreneurship Training Experiment with Two Million Online Businesses. Mimeo.
- Kässi, O. and Lehdonvirta, V. (2022). Do Microcredentials Help New Workers Enter the Market? Evidence from an Online Labor Platform. *Journal of Human Resources*, 0519–10226R3.
- Kempton, B. (2024). Gig Economy Statistics and Market Takeaways for 2025. Upwork, 07 November 2024.
- Majerowicz, S. and Zárate, R.A. (2024). Massive Open Online Courses and Labor Market Outcomes: Experimental Evidence from Colombia. Mimeo.
- McKenzie, D. and Woodruff, C. (2014). What are we learning from business training evaluations around the developing world? *World Bank Research Observer* 29, 48–82.
- Meng, V. (2013). The Ultimate Guide to Coding Bootcamps: The Most Selective Bootcamps. SkilledUp. <http://archive.fo/YCwEA#selection-145.0-145.68>.
- Meyers, L., Minic, B., Raftree, L. and Hurst, T. (2017). The Nexus of Microwork and Impact Sourcing: Implications for Youth Employment. Global Center for Youth Employment and Banyan Global Research Paper.
- Mulas, V., C. Paradi-Guilford, E. Allende Letona, and Z.V. Dalphond. (2017). Coding Bootcamps: Building Future-Proof Skills through Rapid Skills Training. Washington, DC: World Bank.
- Neilson, C., Egana, P. and Humphries, J.E. (2024). Final Report: Impact Evaluation of the Digital Talent Program for Chile. Mimeo.
- Novella, R., Freund, R., Rosas-Shady, D. and Haro, E. (2024a). Digital skills and demand-driven training programs for vulnerable jobseekers in Peru. Mimeo.
- Novella, R., Freund, R. and Rosas-Shady, D. (2024b). Tackling Youth Employment through Digital Skills Bootcamps: Experimental Evidence from Peru. Mimeo.
- Novella, R., Rosas-Shady, D. and Freund, R. (2024c). Is online job training for all? Experimental evidence on the effects of a Coursera program in Costa Rica. *Journal of Development Economics* 169, 103285.
- Novella, R. and Rosas-Shady, D. (2023a). Demanda y Brechas de Talento Digital en Costa Rica. Inter-American Development Bank.
- Novella, R. and Rosas-Shady, D. (2023b). La demanda insatisfecha de Talento Digital en el Perú. Inter-American Development Bank.

- Noy, S. and Zhang, W. (2023). Experimental evidence on the productivity effects of generative artificial intelligence. *Science* 381, 187–192.
- OECD. (2016). Massive open online courses (MOOCs): Trends and future perspectives. In Background paper for the international seminar “opening higher education: What the future might bright”. Berlin, 8–9 December.
- OECD. (2023). Skills in Latin America: Insights from the Survey of Adult Skills (PIAAC), OECD Skills Studies, OECD Publishing, Paris, <https://doi.org/10.1787/5ab893f0-en>.
- Otis, N., Clarke, R., Delecourt, S., Holtz, D. and Koning, R. (2024). The Uneven Impact of Generative AI on Entrepreneurial Performance. Mimeo.
- Peng, S., Kalliamvakou, E., Cihon, P. and Demirer, M. (2023). The Impact of AI on Developer Productivity: Evidence from GitHub Copilot. Mimeo.
- Shah, D. (2021). By the Numbers: MOOCs in 2021. The Report. 1st December, 2021.
- UNESCO (2018). Digital skills critical for jobs and social inclusion. <https://www.unesco.org/en/articles/digital-skills-critical-jobs-and-social-inclusion>.
- Vooren, M., Haelermans, C., Groot, W. and van den Brink, H.M. (2022). Make IT Work: The Labor Market Effects of Information Technology Retraining in the Netherlands. *De Economist* 170, 323-342.
- World Bank. (2018a). Coding Bootcamps for Youth Employment: Evidence from Colombia, Lebanon, and Kenya. Technical Report 1. Washington, DC: World Bank
- World Bank. (2018b). Coding Bootcamps: Guide for Practitioners (English). Washington, DC: World Bank Group.
- World Economic Forum. (2025): Future of Jobs Report 2025: Insight Report.

Appendix

Table A.1 Overview of primary papers and categorizations

Study	Digital skills training	Online marketplaces	New methodology	IDB financed the evaluation
Vooren et al. (2022)	x			
Croke et al. (2023)	x			
Novella et al. (2024a)	x		x	x
World Bank (2018a)	x		x	
Aramburu et al. (2021)	x		x	
Novella et al. (2024b)	x		x	x
Baptista et al. (2024a)	x		x	x
Jabbari et al. (2023)	x		x	
Neilson et al. (2024)	x		x	x
Baptista et al. (2023)		x	x	x
Fazio et al. (2025)		x	x	x
Das et al. (2024)	x	x		
Baptista et al. (2024a)		x	x	x
Atkin et al. (2021)	x	x		
Jin and Sun (2021)		x	x	
Novella et al. (2024c)	x		x	x
Majerowicz and Zarate (2024)	x		x	
Davies et al. (2024)			x	
Estefan et al. (2024)			x	
Janzen et al (2025)			x	
Cole et al. (2024)			x	
Peng et al. (2023)			x	
Cui et al. (2024)			x	
Noy and Zhang (2023)			x	
Otis et al. (2024)			x	
Brynjolfsson et al. (2023)			x	