

Quality Education for All: Colombia’s Partnership with the Republic of Korea to Expand Learning Opportunities through ICT, 2012–15



PROJECT DATA	
IMPLEMENTING AGENCY: Ministry of National Education of Colombia	REGION: South America
DEVELOPMENT CHALLENGE: Regional Education Gap; Low Quality of Public Education	IMPLEMENTATION YEARS: 2012–15
DELIVERY CHALLENGES: Bureaucratic Processes; Lack of Skilled Personnel; Stakeholder Coordination and Engagement; Language and Culture; Geographic Access; Lack of Basic ICT Infrastructure	AUTHOR: Christine H. Joo
SECTOR: Education, Information and Communication Technology (ICT)	LEAD PRACTITIONERS: Carlos Lugo Silva, Director of the Office of Educational Innovation with the Use of Technology, Ministry of National Education; Andres Lemus, Project Manager of the Office of Educational Innovation with the Use of Technology; Jeonghee Margarita Seo, Senior Research Fellow, Korea Education and Research Information Service (KERIS); Wou Seok Chris Yang, (former) Project Manager of LG CNS
COUNTRY: Colombia	

TABLE OF CONTENTS

Executive Summary 1
 Introduction 2
 Delivery Challenges..... 3
 Implementation Process..... 6
 Lessons Learned 11
 References 13
 Annex 14

Executive Summary

In Colombia, a country of vast geographic, ethnic, and cultural diversity, students’ place of residence and socioeconomic status heavily determine educational outcomes. Since the early 1990s, the Colombian government has sought to bridge the regional education gap and strengthen public education by harnessing the power of information and communication technology (ICT). In 2012, the Colombian Ministry of National Education partnered with the Republic of Korea to launch a project that aimed to improve the quality and equity of education through the use of ICT across Colombia.

From the outset, the education ministry faced significant capacity challenges because few teachers had strong ICT skills and the country lacked programmers and instructional designers, particularly outside of the capital, Bogotá. With the support of Korean experts in ICT in education, the ministry recruited and trained hundreds of content developers and teachers through five Regional Education Innovation Centers, which were equipped with ICT infrastructure for digital content development and teacher training. Given the large number of actors involved, all spread across the country, strong leadership and teamwork were key to ensuring smooth coordination and continued engagement of the education community.

Christine Joo authored this case study based on interviews conducted in Colombia and Korea in September–October 2019. This research was supported by the Korea Program for Operational Knowledge, a partnership between the Ministry of Economy and Finance of the Republic of Korea and the World Bank Group.

By 2015, the five regional centers had produced more than 33,000 pieces of digital education content that were freely available through an online portal called Colombia Aprende (Colombia Learns). The centers also trained more than 16,000 teachers on how to develop their own digital content and use it in their classrooms. However, as of 2019, sustainability challenges remained—in particular, in ensuring that the centers continued to function as hubs to drive innovation in education and reduce the regional education gap across Colombia.

Introduction

In 2012, poor students in Colombia were learning at levels far below their richest peers. In the 2012 Programme for International Student Assessment (PISA), a widely recognized global education study, 15-year-old students from the lowest income quartile scored on average 74 points (equivalent to about two years of schooling) below students from the highest income quartile in mathematics (Bos et al. 2014). The score gap between rural and urban students was also concerning: students in rural schools scored on average 50 points (equivalent to more than a year of schooling) lower than their urban peers in mathematics. Whereas Colombia had made strides in expanding access to education, reaching nearly universal primary school enrollment by 2008, Colombian students faced unequal learning opportunities depending on the schools they attended, and their academic performance was highly correlated with their socioeconomic background (OECD 2016).¹

To promote equitable, relevant, and quality education, the Colombian government advocated the strategic use of ICT in education beginning in the 1990s. The early policies and initiatives focused on providing basic ICT infrastructure, such as hardware and broadband, to create an enabling environment for using ICT in schools.² From the 2000s, the Colombian government focused on

incorporating ICT for pedagogical change and curricular development.

As part of these efforts, in 2004, the Ministry of National Education launched a national education e-portal, Colombia Aprende (Colombia Learns).³ The portal was to serve as a virtual meeting point for the educational community in Colombia, where all users could retrieve and share educational information. The portal generated a high level of interest from the Colombian learning community, with an average of 40,000 website visits per day. However, the content available in the portal varied greatly in quality and was suitable for only some grades and subjects. Some content did not even fit the Colombian cultural context and school curriculum because it was directly imported from other Spanish-speaking countries, limiting its use for teaching and learning.⁴ In addition, most teachers lacked the skills to create and share their own content. For the portal to serve as a useful educational tool, Colombia needed to build capacity to develop quality content, improve how the portal was managed, and train teachers to effectively use digital educational content to support student learning.⁵

In 2006, acknowledging the need for outside technical support, the education ministry began discussions with the Korean government to share knowledge and experience on how to effectively integrate ICT in education. Following the bilateral discussion, Korea's National IT Industry Promotion Agency, a government-affiliated institution for policy research and business support in the ICT industry, conducted a feasibility study for a potential project (KEXIM 2009b). The findings of the study further confirmed the need to build local capacity to produce high-quality digital educational content and to establish a system through which students, teachers, and the educational community could effectively use those contents to improve teaching and learning.

To develop a cooperation project with Korea and secure funding for the project, the Colombian government sought financial and technical assistance

1 The difference in students' academic achievement, as measured by the 2009 national academic assessment, Systems Approach for Better Education Results (SABER), was more pronounced between schools than within a school, also signaling a high degree of school segregation (Duarte, Bos, and Moreno 2012). Similarly, García et al. (2013) found that household socioeconomic level and parenting education explain nearly 70 percent of score differences in SABER 2011 results.

2 Agenda for Connectivity of 2000, the National ICT Plan of 2008, Vive Digital Plan of 2011, and social programs such as Compartel and Computers for Education (Computadores para Educar) were implemented to reduce the digital divide.

3 *Colombia Aprende*, described as the "knowledge network," offers various educational resources and customized services for each user group: primary and secondary teachers, students, family and community members, researchers, professors, and university students. To access customized contents, a user must create an account and log in.

4 Author interview with Roger Quirama, director of technology and information systems in the Colombian Ministry of National Education, October 24, 2019.

5 This is one of the findings of the Korea's Economic Development Cooperation Fund (EDCF) Evaluation Team's 2009 feasibility study (Export-Import Bank of Korea 2009b).

from Korea's Economic Development Cooperation Fund (EDCF), which provided concessional loans to support economic development in developing countries.⁶ Obtaining an international loan required a bureaucratic process that lasted several years. The Colombian Ministry of National Education worked with the National Planning Department, the Ministry of Finance and Public Credit, and the Ministry of Foreign Affairs to draft the loan document and receive congressional approval.⁷ The Colombian finance ministry submitted the loan proposal to the EDCF in late 2009, and the two countries signed the loan agreement in 2010 (KEXIM 2009a).

That same year, the education ministry restructured and created the Office of Educational Innovation with the Use of New Technology to manage the new project. By that time, the initial feasibility study conducted in 2006 was outdated, so the innovation office requested that EDCF update the study. The Korea Education and Research Information Service (KERIS), a public institution under the Korean Ministry of Education that specialized in the development of ICT in educational systems, was hired to update the study and, later, to design and manage the project. The innovation office and KERIS worked together to design a project that reflected international best practices in the use of ICT in education and to adapt the model to the Colombian context. After a series of long consultations on the components of the project, the Colombian education ministry finally launched the project, titled Building ICT Education Capacity in Colombia, in 2012.⁸

With the twofold goal of reducing the regional education gap and improving public education overall, the education ministry planned to strengthen teaching, content development, and administrative capacity

through the operation of regional hubs. The ministry selected five major cities where the Regional Education Innovation Centers (Centros de Innovación Educativa Regionales) would be established and planned to call for the selection of regional alliances in charge of the operation of the centers.

The education ministry planned to equip the centers with ICT infrastructure, such as wireless networks; multimedia classrooms furnished with computers, e-boards, and e-podiums for teacher and center staff training; and multimedia studios for content production. With that equipment, the centers were to produce digital content for the renewed Colombia Aprende portal and train primary and secondary teachers on how to use ICT in the classroom and produce their own digital content. The education ministry also wanted the centers to support pilot lab schools, where ICT-trained teachers could apply their newly acquired skills and knowledge (see figure 1).

The regional centers were to act as change agents, fostering peer knowledge sharing and skills transfer, generating educational research, and driving innovation in education. After being trained by Korean experts on ICT in education, the center staff and teachers were expected to share knowledge and experience with other content developers, administrators, and most important, other teachers, thereby diffusing their learning back into their regions to ensure an impact at a countrywide scale.

Delivery Challenges

Bureaucratic Processes

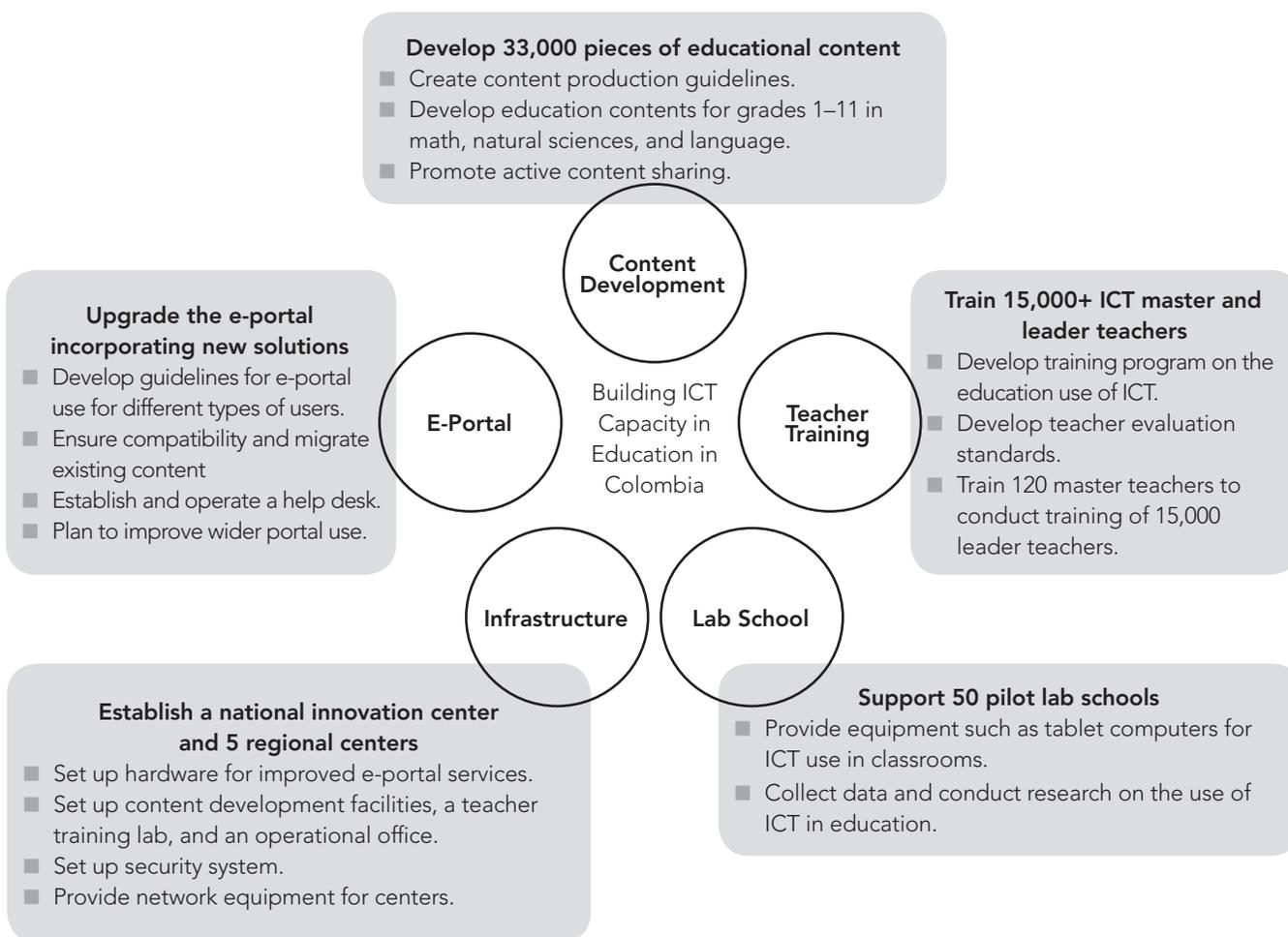
Similar to the long administrative process the education ministry faced during the project preparation phase (2006–10), the project team's work involved preparation for inflexible bureaucratic requirements and time-consuming paperwork that followed the procedures and guidelines of both the Colombian government and EDCF. The regional alliances that were applying to manage the Regional Education Innovation Centers and the Korean companies that were applying to become a project implementing agency had to strictly adhere to detailed evaluation guidelines and demonstrate their compliance with the criteria developed by KERIS and the education ministry in accordance with the general practices for EDCF loans. A disqualification and subsequent bidding

6 The EDCF was established by the Korean government with the aim of promoting economic cooperation between Korea and developing countries and supporting partner countries in their efforts to achieve industrial growth and economic stability. The Export-Import Bank of Korea is responsible for the administrative operation of the EDCF.

7 The project preparation team in the education ministry began by updating a 1970 cooperation agreement between Colombia and the Republic of Korea, and worked with the Colombian National Planning Department and Ministries of Finance and Public Credit and Foreign Affairs to draft the loan document. The loan document was approved by the National Council for Economic and Social Policy (Consejo Nacional de Política Económica y Social), Superior Council of Fiscal Policy (Consejo Superior de Política Fiscal), and Public Credit Inter-Parliamentary Commission. The National Planning Department is an administrative department directly under the executive branch of government, responsible for fostering the implementation of a strategic vision for the social, economic, and environmental development of the country as well as the design, guidance, and evaluation of public policy.

8 The Colombian and Korean governments signed a loan agreement in 2010, and in 2012, the first round of eight loan payments was executed.

FIGURE 1. THE FIVE COMPONENTS OF THE BUILDING CAPACITY FOR ICT IN EDUCATION PROJECT



failure would prolong the selection process and cut into the implementation time.

Lack of Skilled Personnel

The project team had to hire more than 150 content developers and staff members to support the operation of the centers, but finding Colombians with relevant education and experience was extremely challenging. Recruitment was particularly difficult in regions outside of Bogotá, where there were very few instructional designers, graphic designers, and programmers.

Stakeholder Coordination

With more than 300 ministry officials, Korean and Colombian consultants, and regional center staff members involved in implementing the project, stakeholder coordination was a fundamental challenge.

Coordination was particularly important for the regional alliances, which were to be made up of at least one public or private university and the regional education authorities, called Secretariats of Education (Ministry of National Education 2012a).⁹ Close coordination with the secretariats was critical, because each municipality had the autonomy to design its own curricula, administer human resources, and manage schools.¹⁰ The project implementation team needed the cooperation and

⁹ For example, the regional alliance in the south was led by the University of Valle, a public university, in cooperation with the Autonomous University of the West; the University of Ibagué; the Secretariats of Education of Buga, Cali, Palmira, and Yumbo (cities in the southern region); and the Department of Education in Cauca. The southern center covered the departments of Amazonas, Caquetá, Cauca, Huila, Nariño, Putumayo, Tolima, and Valle del Cauca.

¹⁰ The General Education Law of 1994 gave the schools autonomy to develop their own curricula in accordance with community and regional needs. Although the Ministry of National Education outlines the learning objectives and subject areas for each grade level, the Secretariats of Education are in charge of administering education in their department, district, or municipality.

approval of each secretariat for the selection of lab schools and recruitment of teachers in their departments (a Colombian administration division similar to a state or province). The sheer number of teachers to train—a minimum of 15,000—presented another coordination challenge.

Language and Culture

Communication between the Colombian and Korean project members posed a challenge, mainly because of the language barrier. Meetings and training sessions were led by Korean experts, who needed interpretation from either Korean or English to Spanish and vice versa. Interpreting during meetings and translating documents was time consuming, and often the intended meaning was lost in translation. Compounding the Spanish-Korean language challenge, more than 65 indigenous and Afro-Colombian languages in Colombia are recognized as official languages within respective ethnic communities (Sánchez 2018). For teachers from those communities to participate in the training, the training sessions had to be interpreted and materials translated into their languages. Another language challenge, particularly for the e-portal and content development team, involved communicating technical terms in colloquial language to laypeople in the ministry.

In addition to the language barrier, the Colombian and Korean counterparts found that their work cultures were different: the Colombian team characterized the Korean work style as fast paced, efficiency driven, and accompanied by a sense of urgency to meet the deadlines, whereas Korean team members characterized their Colombian counterparts as prioritizing quality over quantity.

Geographic Access

Because Colombia is a country of extreme geographic diversity, encompassing parts of both the Andes mountains and the Amazon rainforest, geographic access posed a major challenge. Some of the proposed sites for innovation schools were located in peripheral regions that were difficult to reach, and teachers from remote regions faced difficulty traveling to the regional centers to participate in training. For example, it took teachers from Amazonas in the far south of Colombia days to travel to the southern center in Cali.

Lack of Basic Infrastructure

Schools in historically neglected, remote areas on the Pacific coast, the Caribbean coast, and the Amazon region had limited connectivity. “Some teachers were unable to access online educational content, not just because of poor internet connectivity, but because they lacked electricity,” said Yuli Ballesteros, a teacher trainer in Cundinamarca, highlighting the challenges faced by teachers in remote areas of Colombia in the early 2010s.¹¹ The lack of basic infrastructure was a challenge that needed to be addressed at the regional or national level, which was beyond what the project could offer. Despite the project goal to reduce the regional digital divide, it was much more difficult for students and teachers in schools with poor ICT infrastructure to access the educational content and information available on the e-portal.

Stakeholder Engagement

Because the project centered on building capacity by having teachers and programmers share knowledge and skills with their peers, stakeholder buy-in was critical. The project team had to build trust and motivate teachers to ensure their continued commitment to knowledge sharing. The training of the teachers was designed as a combination of self-administered virtual learning and face-to-face training administered in the regional centers. Participation in the self-administered virtual training session required teachers to have the self-discipline to complete the tasks within the given training period. For the face-to-face trainings, most teachers had to travel long distances, requiring an even higher level of engagement.

Tracing the Implementation Process

After the project launched in 2012, the first step was to form a team of Korean and Colombian experts in ICT in education and to select operating entities for the Regional Education Innovation Centers. After the project implementation team was established, all actors worked closely together to simultaneously carry forward the five components of the project: building ICT infrastructure,

¹¹ Author interview with Yuli Ballesteros, a teacher trainer who served as a master teacher for the central center in Cundinamarca, October 26, 2019.

FIGURE 2. THE FIVE REGIONAL EDUCATION INNOVATION CENTERS



renewing the e-portal, developing digital educational contents, training teachers, and supporting pilot lab schools.

Building a Team to Drive National Education Innovation

In 2012, the project implementation team in the education ministry’s Office of Innovation began surveying sites to establish the Regional Education Innovation Centers. The five regions were central, east, north, west, and south (figure 2).¹²

In May 2012, the education ministry opened a call for the selection of the alliances in these five regions to manage and operate the regional centers. Interested institutions needed to form an alliance of at least two Secretariats of Education and one public or private university (Ministry of National Education 2012a). Each alliance had to submit a proposal and supporting documents that demonstrated that the institutions met

the minimum legal, financial, and technical requirements published by the ministry.¹³ Each center had to train at least 3,000 teachers, produce at least 6,000 pieces of digital content, and develop six courseware products (educational programs containing subject-specific content and instructional strategies). The center in the central region was assigned more ambitious goals of 4,000 trained teachers, 8,000 digital content products, and eight courseware products, given the relative abundance of resources in Bogotá. Major selection criteria included experience executing projects related to integrating ICT in education, research and organizational capacity of the members of the alliance, number of teachers covered by the Secretariats of Education in the alliance, number of Secretariats of Education in the alliance, and a plan to ensure the sustainability of the center (Ministry of National Education 2012b).

To build interest and help institutions in the five regions navigate the criteria, the project implementation team in the ministry organized information sessions to raise awareness of the project, encourage institutions’ participation, and support proposal development. The ministry also created and disseminated a video explaining the project and its importance. Overall, the institutions in the regions demonstrated high interest but faced difficulties developing their proposals.

Although the institutions found the terms of reference clear, the complexity of the requirements led to a prolonged selection process of around 10 months. “The selection process was rigorous,” said Edgar Alarcon, director of the northern center. “The ministry declared our first proposal void because one of the members of our regional alliance submitted a supporting document just seven minutes late. [Because no other proposals were submitted in the northern region, the ministry opened a second call.] In the second round, we couldn’t become part of the alliance because our university didn’t have enough liquidity to meet the financial requirement specified in the terms of reference. The ministry suggested we instead

¹² Each center covered several departments, as follows: central center: Bogotá and Cundinamarca; west center: Antioquia, Risaralda, Caldas, Chocó, and Quindío; south center: Valle, Nariño, Cauca, Tolima, Huila, Caquetá, Putumayo, and Amazonas; north center: Bolívar, Córdoba, Atlántico, Magdalena, Cesar, Sucre, La Guajira, and San Andrés y Providencia; east center: Santander, Norte de Santander, Boyacá, Meta, Casanare, Arauca, Guaviare, Vichada, Guainía, and Vaupés.

¹³ Legal requirement: The proposal must contain a written document signed by all legal representatives of the partner institutions in the alliance stating that all institutions in the alliance participate in the alliance for a minimum period of 30 months and describing each partner institution’s role in the alliance. Financial requirement: All members of the alliance need to verify that they meet financial indicators and parameters (debt level ≤ 60 percent, liquidity index ≥ 1 or 2, depending on the entity) by submitting their financial documents, such as the balance sheet and income statement, for the past year. Technical requirement: The alliance must provide evidence that the proposed space for the center is unoccupied and suitable to equip ICT infrastructure provided through the project (Ministry of National Education 2012c).

offer the space for the center.”¹⁴ The project team in the innovation office maintained frequent communication with regional institutions to help them form alliances and develop their proposals. In early 2013, the ministry finally announced the selection of the alliances for the five regional centers.

Following the selection of the regional alliances, the ministry opened a competitive bidding process to contract a project implementing agency. As was the norm for EDCF projects, any Korean company with the requisite technical capabilities was eligible to submit a bid. The implementing agency was to be responsible for installation of ICT infrastructure, e-portal development and enhancement, content development and standardization, teacher training, and creation of the five Regional Education Innovation Centers.

The bidding process was rigorous and time consuming, closely following guidelines set out in a 330-page document and specified in the loan agreement. The participating companies said it was difficult to develop comprehensive proposals, including detailed plans and résumés of potential hires, in accordance with the guidelines. After a series of dilemmas that nearly derailed the bidding process, LG CNS, a subsidiary of the multinational conglomerate LG Corporation that had extensive experience implementing large-scale public ICT projects, was finally selected as the implementing agency in December 2013.¹⁵ One evaluator called the evaluation process “overly stringent, stressful, and time consuming.”¹⁶ The director of LG CNS who prepared the bidding proposals said that the evaluation process was meticulous and required a lot of work: “Failure to check the work history of potential hires led to a disqualification due to a conflict of interest, since one of the candidates had been hired by the education ministry as one of the evaluators.”¹⁷

The process of selecting the regional alliance and contracting the implementation agency took 18 months longer than originally planned. By that time, the project team realized that the objectives outlined in the project were overambitious and that insufficient time had been allocated to complete the tasks. To facilitate implementation, the ministry contracted support teams to work alongside LG CNS. A team of experts in ICT in education from KERIS, in close cooperation with the innovation office, was responsible for developing and refining the structure and components of the project and for managing implementation (Seo 2015). The ministry also contracted a team of experts in ICT in education from EAFIT University, a private Colombian university, and another team from CINTEL (Centro de Investigación de las Telecomunicaciones), a Colombian research institute.

As the ministry was contracting support teams, LG CNS began sending Korean experts to Colombia and recruiting local talent, including engineers, programmers, graphic designers, and Spanish-Korean interpreters. However, because of the lengthy selection process, many of the planned local hires listed by LG CNS in its proposal were no longer available to join the project. The management team at LG CNS encountered difficulties hiring personnel with relevant education and experience and relied on LG Corporation’s local office and the ministry for referrals.¹⁸ LG CNS eventually hired around 100 local staff members and contracted Korean software developers to train local programmers and update the e-portal. A few months later, two Korean firms that had been subcontracted by LG CNS unexpectedly filed for bankruptcy. Both firms were subsidiaries of Korea’s largest telecom provider, and their bankruptcy took the project team by surprise. To make up for the time lost in searching and contracting, LG CNS allocated more of its own employees to the project and eventually contracted another Korean software developer.

In the meantime, the regional alliances began recruiting staff, from the center director and managers to instructional designers, programmers, and graphic designers. All centers had difficulty hiring experts with the requisite technical qualifications. To speed up the hiring process, the project team reduced the qualifications

14 Author interview with Edgar Alarcon, current director of the northern Regional Education Innovation Center, October 29, 2019.

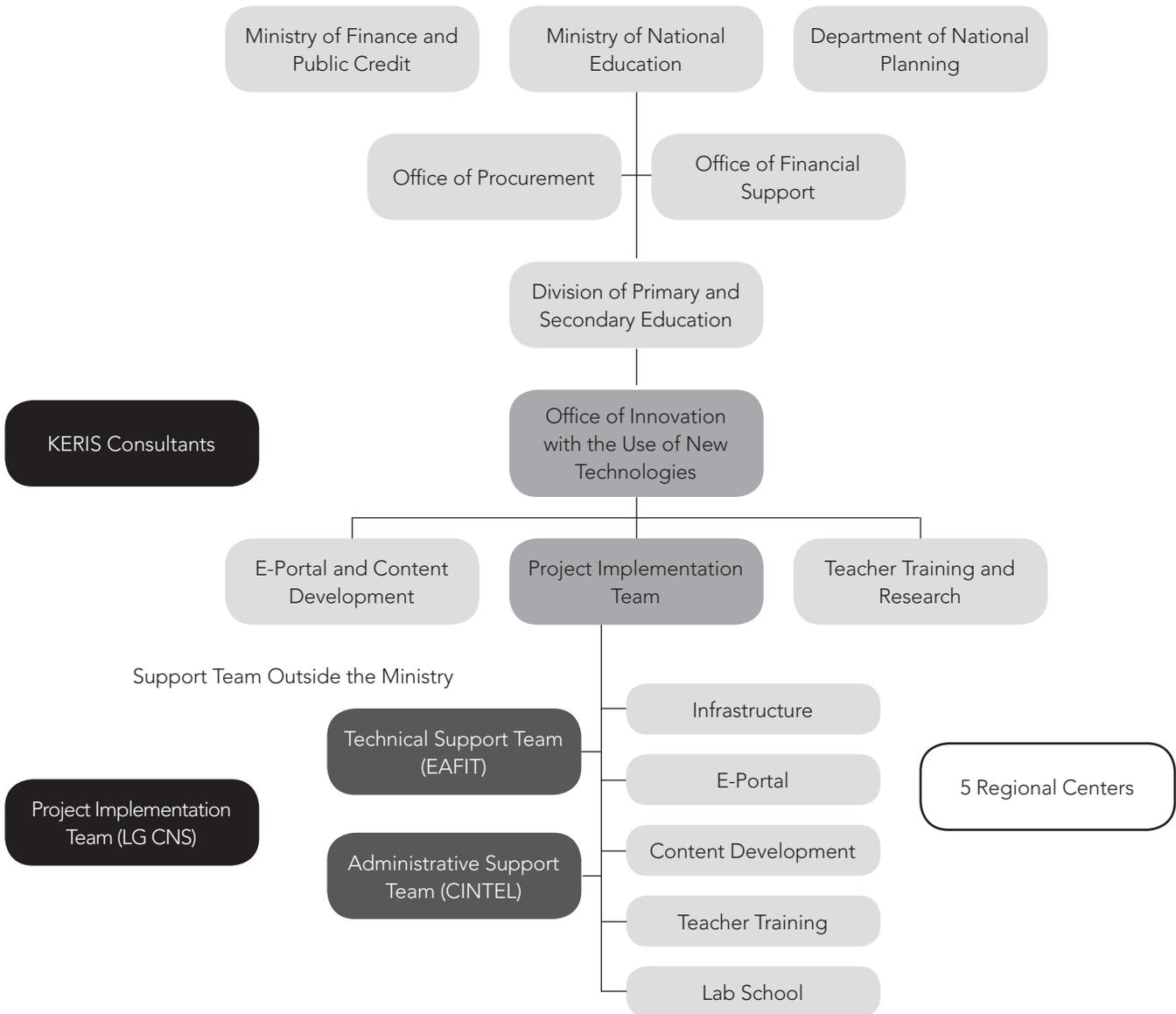
15 After the initial evaluation by the EDCF, the two selected companies, LG CNS and Korea Telecom (KT), submitted proposals for review by a committee of evaluators. The first bidding process was declared void; both companies were disqualified because of a conflict of interest. The competition for the bid became heated after the first round, and another Korean company that wanted to participate in the bid shared defamatory information about LG CNS and KT with the Colombian education ministry, raising concerns about a potential lawsuit.

16 Author interview with Patricia Toro, a professor of EAFIT University in Bogotá who served as an evaluator in the regional alliance and implementing agency selection process, October 25, 2019.

17 Author interview with Dae Yeung Um, director of Latin America New Business Development at LG CNS, October 25, 2019.

18 Author interview with Chris Yang, project manager at LG CNS, September 25, 2019.

FIGURE 3. ORGANIZATIONAL CHART



required and provided successful candidates with more on-the-job training.

The project implementation team of the ministry’s Office of Innovation, LG CNS, and the technical support teams were organized into five subteams for the five project components (see figure 3). Because the tasks were interrelated and executed simultaneously, it was crucial for the five subteams to collaborate and maintain frequent communication. The project implementation team in the innovation office monitored the project’s progress and checked the quality of the deliverables.

Building ICT Infrastructure and Developing Standard Curricula

After the regional alliances were finally selected, the innovation office team visited each of the proposed project sites. Despite the ministry’s strict requirements for proposals, the team still encountered several major issues at the proposed sites. In February 2014, the infrastructure team of LG CNS began remodeling the selected sites to address the center-specific concerns. In the western center, the team agreed to install lighter

equipment than initially planned to avoid exceeding a building weight limit. The eastern center faced security issues from theft and civil unrest, so the team made scheduling accommodations and used additional resources to better guard the equipment.

In accordance with EDCF procurement guidelines, the LG CNS team ordered equipment and furniture from Korea, transported it to Colombia, and installed it in each center. At this time, the National Education Innovation Center was established within the education ministry to coordinate with the five regional centers and serve as the operational center of Colombia Aprende.

While the infrastructure team was establishing the centers, other teams developed curricula and guidelines. The content development team conducted curricular analyses and developed a national standard curriculum with clearly defined learning objectives to create content linked to the curriculum. The team also produced manuals for courseware and content development. The teacher training team analyzed and designed teacher training curriculum and materials, while the e-portal team benchmarked best practices to design an upgraded e-portal and conducted migration analysis for the existing contents.

Training Teachers

In March, the newly recruited e-portal team created and launched a portal for teachers called CREA-TIC. The CREA-TIC platform offered self-directed virtual training programs to help teachers develop their pedagogical, technical, management, communication, design, and research competencies. In addition to training, the platform offered a variety of educational resources, including interactive classroom activities, homework samples, and a “Community of Practice” where educators could share their experiences and educational information with their peers (Ministry of National Education 2016).

In the same month, the ministry opened a call to recruit 120 ICT master teachers. Public school teachers who taught language, math, or natural sciences; demonstrated a high level of interest; and scored high on a virtual ICT skills assessment developed by the project team were selected as master teachers for each center. The selected master teachers were to participate in an intensive training on the use of ICT in education by Korean experts and were to serve as trainers of 16,000 peer teachers who were to be called ICT leader

teachers. These leader teachers were then expected to apply and share their knowledge and skills in their school communities and with other educators online.

From June through July 2014, the selected master teachers participated in virtual and face-to-face training in Bogotá. Eighty-eight participants completed the training and became master teachers. The number of master teachers was reduced from the originally intended 120 teachers, because the northern center was able to send only 8 people to participate in the training (KEXIM 2018). Having to travel to Bogotá for the training was one of the main barriers to participation for teachers in the northern region. Some Secretariats of Education in the north did not provide subsidies to cover travel costs. Another barrier was language. Indigenous and Afro-Colombian communities (highly concentrated in the northern Pacific and the Caribbean regions) primarily spoke languages other than Spanish, and interpretation during the training was available only in Spanish.¹⁹

Language was a barrier to developing teacher training materials as well. Team members identified frequent Spanish language errors, insufficient translation, unhelpful graphics, and other problems in the teacher training materials. Some Colombian team members raised concerns about the lack of team members with expertise in pedagogy. “LG CNS had the technical capacity but seemed to lack pedagogical approaches, particularly in teacher training and educational content development,” said Betty Buitrago, coordinator of the lab school team in the innovation office.²⁰ After hearing such concerns, LG CNS hired additional skilled translators. The team also invited other participants to Colombia, including educational content developers and Korean professors with expertise in developing educational software and ICT teacher training programs.

As the new experts arrived from Korea, the centers continued to recruit ICT leader teachers. Public school teachers who taught language, math, or natural sciences and who reached an intermediate level in the virtual ICT skills assessment offered on the CREA-TIC platform were eligible to apply to become leader teachers. Because the number of teachers with intermediate-level ICT skills was insufficient, the ministry changed the criteria to accept those with just a basic level. Beginning in August

19 Author interview with Jorge Castro, official in the Secretariat of Education of Cartagena, October 29, 2019.

20 Author interview with Betty Buitrago, former coordinator of the lab school team in the innovation office, October 24, 2019.

2014, master teachers began conducting weeklong, face-to-face training sessions in each regional center on how to develop and use digital educational content. The ministry provided a certificate to each leader teacher who completed both the virtual and face-to-face training and also submitted digital educational content that they had created and that had been approved by a master teacher. Each center selected 10 pilot lab schools in its region, and the infrastructure team provided these schools with tablet computers, projectors, and other equipment so that leader teachers could apply what they had learned in the classroom.

By that time, the Colombian and Korean teams had built mutual trust and had begun to understand how best to overcome language and cultural barriers. The Korean team respected the meticulous attention and passion the Colombian team members put into the project, despite the delays that sometimes caused. The Colombian team began to see how much effort the Korean team was putting into the project, frequently working beyond business hours and always responding quickly to requests. “I was 95 percent happy with working with the Korean team because they had two things that the Colombian team needed to learn—the quality of products and responding promptly to requests,” said Martha Rodríguez, coordinator of the teacher training team in the Office of Innovation. “Were it not for the language barrier, I would have been completely satisfied.”²¹ The hiring of additional Spanish-Korean interpreters and frequent formal and informal interactions between the Colombian and Korean teams helped to facilitate understanding and communication as the project progressed.

Developing Digital Educational Content and Launching the Renewed E-Portal

As the teachers received training, the content development team organized an intensive training session in Bogotá for 150 content developers from each regional center. The training covered the process and tools needed to create quality digital educational content. The content production process began with a Colombian subject expert, usually a teacher, proposing a manuscript. Building on the manuscript, the

instructional designer developed classroom activities and created a storyboard—a graphic organizer to help visualize the lesson in a step-by-step sequence—in collaboration with graphic designers and video producers. Then the storyboard was submitted to the content development team of LG CNS and the innovation office for review and approval. Once approved, the graphic designers and programmers worked together to create digital content.

Content development began when the centers became operational in mid-2014. By July 2014, four of the five centers had opened; the western center did not open until late September because of construction delays. Each regional center was assigned two grades that it was to develop content for, while the central center was assigned three grades. Each center aimed to create a total of 3,000 pieces of digital content for each of their assigned grades for language, math, and science to deliver the joint target of 33,000 pieces of digital content.

As the centers produced the content, the e-portal team uploaded it to Colombia Aprende and worked closely with the ministry to enhance the portal’s user friendliness. The team needed the ministry’s approval in designing the user interface of the portal. In September 2014, the project team in the Office of Innovation changed when the president appointed a new minister of education. The project team members outside the ministry had to explain the project to the new innovation office and discuss their progress. “When the administration changes, the people in the ministry change, which means the preferences change—from the color scheme to the communication method,” said Margarita Gómez, one of the local contractors of the e-portal team.²² Despite some alterations, such as to the design of the portal, the administrative change did not greatly affect the project schedule or components because the project team closely followed the original implementation plan. In December 2014, the renewed Colombia Aprende went live.

Scaling Up Teacher Training and Content Production

In late 2014, all regional centers were far from achieving the project targets of training 16,000 leader teachers and

²¹ Author interview with Martha Rodríguez, current Ministry of National Education official who served as the coordinator of the teacher training team in the Office of Innovation, October 23, 2019.

²² Author interview with Margarita Gómez, a former e-portal team contractor, October 26, 2019.

producing 33,000 pieces of digital content. The regional centers had trained only 3,434 teachers by 2014.²³ The center directors strategized with the project team on how to speed up content production and teacher training to reach the targets before the project's closing date.

The regional centers and the innovation office increased their efforts to promote the ICT leader teacher training program through various media, including news channels; ministry, secretariat, and school websites and bulletin boards; and information sessions. Master teachers directly reached out to peer teachers to encourage their participation and convey the importance of completing the virtual training module. The most effective strategy to increase teacher participation was organizing training sessions in locations other than the regional centers, because traveling to the centers was one of the main barriers to participation. The centers sent master teachers to different communities within their regions to provide face-to-face training. When visiting areas with limited connectivity, master teachers used contents stored on USBs or CDs. Master teachers from the western and central centers trained additional teachers to make up for the shortfall in the number of trained teachers in other regions. Following the new approach, the number of leader teachers trained in 2015 nearly quadrupled the total from 2014.

Similarly, the centers combined efforts to expedite content production under the common goal of achieving the targets before the project closing date. "There was pressure at the end to produce a certain number of content modules," said William Delgado, manager of the Office of Development at the central center.²⁴ Although the centers were under pressure to accelerate content production, they aimed to not sacrifice quality in pursuit of quantity. "We did not create content for the sake of producing content but wanted to create content that was fun, innovative, and useful," said Gloria Toro, director of the southern center. "Because we took time to develop learning objectives, consult with relevant university departments to check the accuracy of content, and

invite the Art Department to design graphics, we were extremely slow in production."²⁵

Because the central center was the first of the regional centers to produce its allocated number of pieces of content, the central content development team helped other centers create content on the basis of the storyboards developed by the other centers. The central team also reviewed content produced by other centers before sending it for approval to the content teams of LG CNS and the innovation office in an effort to expedite the content approval process.

Through these collaborative efforts, by mid-2015, more than 16,000 teachers learned effective teaching methods using ICT and 150 content developers received training and produced more than 33,000 pieces of educational content that became available to the educational community on Colombia Aprende. The content was also distributed on CDs and DVDs so that schools without internet access could use them.

Outcomes

The renewed Colombia Aprende portal expanded access to educational resources. As of 2019, more than 100,000 digital products were available through the portal, including 9,000 educational videos, 3,000 interactive learning exercises, 79 books, and 30 courses for teachers (Noticias RPTV 2016). The Central, Southern, and Western Regional Education Innovation Centers continued to actively produce multimedia content and educational research and expanded the scope of contents beyond math, science, and language. The centers created contents on other academic subjects and social issues, such as drug use, violence, and gender equality. The number of annual portal visitors more than doubled, from about 16.9 million in 2014 to more than 42.6 million in 2016. Data revealed that private schools also used the content developed through the project (KEXIM 2018).

Although the increase in portal visitors did not necessarily signify increased content use in classrooms nor improved teaching, anecdotal evidence was encouraging. "The new teaching method using ICT helped us learn not only inside but outside the classroom,"

²³ The central center had completed training of 1,018 leader teachers, the southern center 778, the northern center 613, the western center 601, and the eastern center only 424 (Export-Import Bank of Korea EDCF Evaluation Team 2018).

²⁴ Author interview with William Delgado, a former content developer and current manager of the Office of Development of the Central Education Innovation Center, October 21, 2019.

²⁵ Author interview with Gloria Toro and Juan Francisco Diaz, director and former director of the Southern Regional Education Innovation Center, respectively, October 28, 2019.

said Julieth Cortez, an 11th grader who took a class taught by a teacher who participated in the training (LG CNS 2016). Many of the teachers said the subject-oriented training with detailed subject-specific examples helped them apply ICT and new teaching methods in their classrooms.²⁶ According to a post-training questionnaire of 2,000 teachers administered by the education ministry, a large majority of teachers were highly satisfied with the resources made available through the portal. Emerson Osorio, a leader teacher who said he used the resources on the CREA-TIC platform to complement his teaching, said his students were “now more actively engaged” (LG CNS 2016).

Benefits of the teacher training were not evenly spread across the country, however. Of the more than 16,000 teachers who completed training on ICT use in education, teachers who resided or taught near the regional centers were disproportionately represented. Many teachers in remote, rural areas were unable to participate in or complete the training because they had difficulty accessing both the virtual and the face-to-face trainings. For example, of the teachers who participated in the leader teacher training offered by the southern center, about 65 percent came from Valle del Cauca, the department where the center was located, while the remaining 35 percent were distributed among the other seven departments covering the vast south. Only eight teachers from Caquetá, the third-largest department in Colombia in terms of area, located in the Amazon region, participated in the training, representing less than 0.3 percent of the teacher population in that department (Uribe 2019). Although these teachers could have shared their knowledge with their peers, creating ripple effects, such low participation of teachers from certain regions raised concerns. “The training program benefited mostly the teachers who already had access to various professional development opportunities and rather exacerbated inequality between the regions,” said Carlos Uribe, a professor and researcher in the southern center.²⁷

Findings from national and international assessments suggested that, as of 2020, much more work had to be done to improve the quality and equity in education and

bridge the regional education gap in Colombia. Although the direct impact of the teacher ICT training and use of digital educational content on student learning was difficult to measure and its potential longer-term effects were not fully documented, Colombian students’ performance on standardized assessments showed little improvement in the years following the project’s completion. In fact, according to the results of PISA 2018, students’ average reading scores declined by more than 10 points from 2015 to 2018. Students’ math and science performance improved slightly, though the change was not statistically significant.²⁸

Socioeconomically disadvantaged students were still less likely to succeed at school than were their more advantaged peers, and regional gaps in student performance were still pronounced.²⁹ In analyses of results of the national standardized assessment, SABER indicated that in 2017, 80 percent of 9th graders from the lowest socioeconomic quartile did not reach the minimum level of achievement, compared with 15 percent of students in the highest quartile (Sánchez 2018). Studies also found that regional gaps persisted over time.³⁰ PISA 2018 results indicated that students in Bogotá scored more than 30 points higher than the national average in language, math, and science (OECD 2019).³¹

Although it was still too early to assess the project’s impact on improving student learning outcomes, by 2019 Colombia had largely achieved its goal of building ICT capacity of key actors in the education community, though more could be done. “The project laid the groundwork for developing ICT talent,” said Andres Lemus, the project manager in the Office of Innovation during the last phase of the project. “The project created jobs in the regions, built infrastructure, and developed the capacity necessary for Colombia to become a more equal and prosperous country.”³² As of 2019, the education

26 Author interview with Giovanni Serrato, staff member at the Central Education Innovation Center, October 21, 2019.

27 Author interview with Carlos Uribe, a professor at the University of Valle and researcher in the evaluation team of the Southern Regional Education Innovation Center, October 28, 2019.

28 See the Organisation for Economic Co-operation and Development’s PISA 2018 Database, tables I.B1.10, I.B1.11 and I.B1.12.

29 According to the results of the 2015 PISA, about 14 percent of the variation in students’ performance could be attributed to students’ socioeconomic status (Radinger et al. 2018).

30 Analyses of results of SABER for grade 11 indicate that regional gaps still persist (Loaiza Quintero and Hincapié Vélez 2016), and educational inequalities have increased over time in six metropolitan areas: Bogotá, Medellín, Cali, Barranquilla, Armenia, and Bucaramanga (Gamboa and Londoño 2015).

31 According to the results of PISA 2018, students in Bogotá scored, on average, 455 on reading, 430 on math, and 451 on science, compared with the national average of 412, 391, 413, respectively. See the Organisation for Economic Co-operation and Development’s PISA 2018 Database.

32 Author interview with Andres Lemus, former project manager in the Office of Innovation and current adviser in of the Office of Cooperation and International Affairs of the Ministry of National Education, October 22, 2019.

ministry was working to revitalize Colombia Aprende and the five regional centers. The ministry, through the national innovation center, which was operated by the same university that managed the central center, planned to update Colombia Aprende and the CREA-TIC portal to enhance user experience.

With the support of the education ministry, the central center led the coordination with the other four centers, including the eastern and northern centers, which ceased operations in 2015. After the project period ended in mid-2015, the eastern center and its equipment became part of a graduate school, which used the center for purposes other than producing educational content for Colombian public schools. In the north, the private university that operated the center abandoned it shortly before the project ended when funding from the education ministry stopped. Each center had to develop its own research or content development projects to secure funding for its operation. Although some centers were ready to take on the challenge and develop their own projects, others struggled to secure funding. The operation of centers depended highly on the competence and the degree of willingness and involvement of each center's operating entity.

As of 2019, the education ministry hoped to leverage the resources available through the centers—which included a trained team of content developers and project managers, researchers and practitioners of ICT in education, and ICT equipment provided through the project—and revamp the centers so that they could serve as education innovation hubs and take on a spectrum of roles beyond promoting effective integration of ICT in classrooms.

Lessons Learned

Several lessons were learned from the project.

Support from the Highest Levels of Government Was Critical

In the initial stage of the project, communicating the government's full support and the national importance of the project through multiple channels was key to motivating the project team members. For example, President Juan Manuel Santos stressed in several public events the strategic importance of the initiative to integrate ICT into education. He specifically endorsed

the project, stating that “it will contribute to Colombia rising as a leader in Latin America for the production of educational content, teacher training, and research development” (DNP 2013). Similarly, the ministry created and disseminated a promotional video that highlighted the potential of ICT in improving the quality of education, describing ICT as the most powerful instrument to pave the pathway toward prosperity. “I had goosebumps when I first saw the video,” said Juan Bernal, a content development coordinator in the innovation office, describing how excited he was to be involved in a project of national importance³³. “Everyone in our team understood the significance of the project. It was evident in the huge amount of money Colombia invested in it to introduce high-quality digital education,” added William Delgado, manager of the central center's content development team.³⁴

Flexible Decision-Making and Strong Teamwork Helped Overcome Capacity Constraints

The project's initial design was to develop contents for four grades covering eight subjects, but given the goal to improve education equity, the team decided to instead target all primary and secondary students (grades 1–11). The broader focus meant there was not enough time and not enough resources to create content for eight subjects, so the team decided to concentrate on language, math, and science. Throughout the project period, the team maintained constant communication to better adapt the original design, using international best practices, to the diversities of the local Colombian context. For instance, when the centers faced difficulty hiring content developers and recruiting teachers who met the identified qualifications, the team decided to reduce the qualifications and provide more on-the-job training. When the regional centers realized they were far from achieving the project's targets, the center directors, the ministry, KERIS, and the LG CNS team discussed alternative ways of teacher recruiting, and they combined their efforts to promote teacher participation in training and to deliver the promised content. A focus on evolving practices and necessary midcourse adjustments

³³ Author interview with Juan Bernal, coordinator of the content development team of the Ministry of National Education, October 26, 2019.

³⁴ Author interview with William Delgado, a former content developer and current manager of the Office of Development of the Central Education Innovation Center, October 21, 2019.

enabled the team to scale up teacher training and content production. “Instead of sticking to the original design, we worked together to modify the project on the way to create the best results,” said Sandra Barragan, the first director of the central center.³⁵

Better Preparation Might Have Made the Delivery Challenges Easier to Overcome

A deeper understanding of the educational, cultural, and geographic context might have resulted in more realistic project targets and helped the implementation team foresee some of the delivery challenges. For example, had the Korean project designers known how meticulous and thorough the Colombian bid evaluation process was, they could have allocated more time or simplified procedures so that the selection process did not cut into the implementation time. Furthermore, with the knowledge of the difficulty of traveling across departments and the need for each secretariat to support teachers’ participation in training, the project team might have foreseen and prepared for the challenge of recruiting 16,000 leader teachers. Organizing teacher training in multiple locations, as the project team did to scale up training, could have resulted in a more even representation of teachers throughout the country.

The project could have benefited from testing the teacher training and content development program in a smaller-scale pilot project. “If I could go back and design the project again, I would do a pilot first,” said Juan Bernal, a content development team coordinator in the Office of Innovation. “It was like designing a car then immediately producing 10,000 of them without testing how it works.”³⁶ Most members of the implementation team were learning new skills as they were carrying out the different components of the project. Some had to familiarize themselves with new technology; others had to learn to address various challenges that unexpectedly emerged during implementation. “The project was of unprecedented scope, encompassing infrastructure and multi-stakeholder capacity building,” said Margarita Seo, project manager of KERIS.³⁷ “We were all learning together

about the disparate cultural and educational contexts.” An up-to-date feasibility study and a pilot project could have helped to mitigate some of these challenges and prepare key stakeholders for a seamless nationwide implementation.

Trainings Should Be Teacher Focused and Easy to Access

The success of building teacher ICT capacity depended on teacher buy-in. Many teachers and project team members found that having master teachers train other teachers was very effective.³⁸ Participating teachers were able to relate to each other, and they looked up to the master teacher to develop content. Teachers appreciated the constructivist approach of training during which teachers participated in the full process of analysis, planning, design, and development of content and, ultimately, applied the content in their classrooms. Teachers also found the subject-oriented training material with detailed subject-specific examples useful, as opposed to a general training independent of the teaching subject.

The centers pointed out that providing a seven-week program to all teachers at once was not the best approach, however. Improving access to training by organizing sessions at multiple times and in different locations proved to be effective in increasing teacher participation. Providing attractive incentives could have induced greater teacher participation and ensured continued commitment. The program “offered value in terms of learning and self-improvement but did not translate into economic value,” said Angélica del Pilar Osorio, a teacher training expert on the technical support team. “Providing certification from an accredited teacher training institution from either Colombia or abroad, or linking the ICT skills assessment with teachers’ evaluations for promotion, will generate more teacher interest.”³⁹

Strong Management and Long-Term Operational Planning Were Crucial to Sustainability

With rapid technological advancement, the digital educational contents and ICT knowledge developed through the project can quickly become old-fashioned

³⁵ Author interview with Sandra Barragan, first director of the Central Regional Education Innovation Center, October 27, 2019.

³⁶ Author interview with Juan Bernal, coordinator of the content development team of the Ministry of National Education, October 26, 2019.

³⁷ Author interview with Jeong Hee Margarita Seo, project manager from KERIS, September 23, 2019.

³⁸ Author interview with Gloria Toro, director of the Southern Regional Education Innovation Center, October 28, 2019.

³⁹ Author interview with Angélica del Pilar Osorio, a former consultant of the EAFIT technical support team for the teacher training part, October 23, 2019.

or too basic. To ensure continued production of up-to-date, high-quality digital content and training of teachers on relevant ICT skills for education, the centers needed to stay in operation to coordinate projects and training and conduct quality checks. The centers would have benefited from a long-term operation plan that clearly defined the operating entity, purpose of operation, and sources of funding to ensure sustainable operation beyond the project period. The northern center, which ceased operation after the project ended, did not have a clear operating entity. The private university that initially managed the center abandoned it shortly before the project ended in 2015, and although a public university was interested in operating the center, it did not have the legal authority to do so. Conversely, centers that were active as of 2019 continued to develop projects, under a strong management team, and to secure diverse funding sources. For example, after the project period, the central center submitted project proposals and procured various projects—mainly public projects, such as researching ICT competencies of teachers commissioned by the education ministry and developing police officer training content commissioned by the police department. For the centers to continue to serve as an education innovation

hub, they would need a management entity with a strong capacity to pool resources and a demonstrated commitment to education. “The center had to work like a company to actively search and compete to win projects in order to survive,” said Fredy Olarte, director of the central center.⁴⁰

Lessons learned from the centers that were active as of 2019 showed that, in addition to strong management capacity, a competent, passionate team was key to a center’s successful operation. Center directors strived to form a team passionate about innovation and social impact. “I tried to find people who not only had technical skills, but were interested in creating social impact,” explained Sandra Barragan, who personally interviewed all candidates. She added, “All the center staff felt ownership of the project and knew how helpful the project would be for the students.”⁴¹ In addition to communicating the national importance of the project, center directors tried to create a culture of collaboration. “We needed to understand that the project was not ‘my’ project but a collective effort of an interdisciplinary team,” said Juan Francisco Diaz, the first director of the southern center.⁴²

40 Author interview with Fredy Olarte, director of the Central Regional Education Innovation Center, October 21, 2019.

41 Author interview with Sandra Barragan, first director of the Central Regional Education Innovation Center, October 27, 2019.

42 Author interview with Juan Francisco Diaz, first director of the Southern Regional Education Innovation Center, October 28, 2019.

References

- Bos, María Soledad, Alejandro Ganimian, Emiliana Vegas, and Horatio Álvarez Marinelli. 2014. *América Latina en PISA 2012: Colombia en PISA 2012: Logros y Desafíos Pendientes*. Washington, DC: Inter-American Development Bank. <https://publications.iadb.org/es/publicacion/13787/america-latina-en-pisa-2012-colombia-en-pisa-2012-logros-y-desafios-pendientes>.
- DNP (Departamento Nacional de Planeación). 2013. “Importancia Estratégica del Proyecto de Inversión ‘Crédito de Transferencia de Tecnología para Producción y Distribución de Contenidos en Educación Básica y Superior en Colombia.’” Conpes Documento 3768, Consejo Nacional de Política Económica y Social, Bogotá.
- Duarte, Jesús, María Soledad Bos, and José Martín Moreno. 2012. *Quality, Equality and Equity in Colombian Education*. Washington, DC: Inter-American Development Bank.
- KEXIM (Export-Import Bank of Korea). 2009a. *ICT Education Capacity Building Project Evaluation Report*. Seoul: KEXIM.
- . 2009b. *ICT Education Capacity Building Project Feasibility Study*. Seoul: KEXIM.
- . 2015. *ICT Education Capacity Building Project Completion Report*. Seoul: KEXIM.
- . 2018. *Evaluation Report 2018-7: Ex-post Evaluation of ICT Education Capability Building in Colombia Project*. Seoul: KEXIM.
- Gamboa, Luis, and Erika Londoño. 2015. “Assessing Educational Unfair Inequalities at a Regional Level in Colombia.” *Lecturas de Economía (Readings in Economics)* 86: 97–133.
- García Villegas, Mauricio, Jose Rafael Espinosa, Felipe Jiménez Ángel, and Juan David Parra Heredia. 2013. *Separados y Desiguales: Educación y Clases Sociales en Colombia* [Separate and Unequal: Education and Social Classes in Colombia]. Bogotá: Dejusticia.
- LG CNS. 2016. “ICT Education Capacity Building in Colombia.” Project results video. Seoul: LG CNS. Provided to author by Dr. Seo in 2019.
- Loaiza Quintero, Osmar, and David Hincapié Vélez. 2016. “Un Estudio de las Brechas Municipales en Calidad Educativa en Colombia: 2000–2012.” *Ensayos sobre Política Económica (Essays about Political Economy)* 34 (79): 3–20. <http://dx.doi.org/10.1016/j.espe.2016.01.001>.
- Ministerio de Educación Nacional. 2012a. “Convocatoria para la selección de las alianzas encargadas de la operación, administración y gestión de los Centros de Innovación Educativa Regional.” Bogotá: Ministerio de Educación Nacional. <https://www.mineducacion.gov.co/portal/secciones/Convocatorias-y-concursos/299410:Convocatoria-para-la-seleccion-de-las-alianzas-encargadas-de-la-operacion-administracion-y-gestion-de-los-Centros-de-Innovacion-Educativa-Regional>.
- . 2012b. *Términos de Referencia Definitivos, Convocatoria para: Selección de las Alianzas Encargadas de la Operación, Administración y Gestión de los Centros de Innovación Educativa Regional*. Bogotá: Ministerio de Educación Nacional.
- . 2013. Bidding Documents for “*ICT Education Capacity Building in Colombia*.” Bogotá: Ministerio de Educación Nacional.
- . 2016. *La Innovación Educativa en Colombia: Buenas Prácticas para la Innovación y las TIC en Educación*. Bogotá, Colombia: Ministerio de Educación Nacional.

- Noticias RPTV. 2016. "Con Colombia aprende.com Hacer Tareas ya no Es Dolor de Cabeza." Noticias RPTV, March 18. <http://noticiasrptv.com/carlos-lugo-colombias-aprende/>.
- OECD (Organisation for Economic Co-operation and Development). 2016. *Education in Colombia*. Paris: OECD Publishing.
- . 2019. *PISA 2018 Results. Vol. I: What Students Know and Can Do*. Paris: OECD Publishing. <https://doi.org/10.1787/5f07c754-en>.
- Radinger, Thomas, Alfonso Echazarra, Gabriela Guerrero, and Juan Pablo Valenzuela. 2018. *OECD Reviews of School Resources: Colombia 2018*. Paris, France: OECD Publishing.
- Sánchez, J. L. 2018. *OECD Review of Policies to Improve the Effectiveness of Resource Use in Schools: Country Background Report for Colombia*. Bogotá: Ministerio de Educación Nacional.
- Seo, Jeong Hee. 2015. "Case Studies of Education Informatization: ODA Projects and Their Areas of Improvement." PowerPoint presentation. Provided to author by Dr. Seo in 2019.
- Uribe, Carlos. 2019. "Eval-IETIC: Evaluación de la Innovación Educativa Mediada por TIC." Universidad del Valle, Cali, Colombia.



WORLD BANK GROUP

© 2020 International Bank for Reconstruction and Development/The World Bank. Some rights reserved. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of The World Bank, its Board of Executive Directors, or the governments they represent. The World Bank does not guarantee the accuracy of the data included in this work. This work is subject to a CC BY 3.0 IGO license (<https://creativecommons.org/licenses/by/3.0/igo>).