EdTech Hub

Clear evidence, better decisions, more learning.

Low-Tech Devices and Connectivity for Learning in Lebanon

Date   **March 2021**

Authors   **Rachel Chuang**
            Abdullah Khalayeh

THE WORLD BANK

UKaid
from the British people

About this document

About the EdTech Hub Helpdesk

The Helpdesk is the Hub's rapid response service, available to Foreign and Commonwealth Development Office (FCDO) advisers and World Bank staff in 70 low- and lower-middle-income countries (LMICs). It delivers just-in-time services to support education technology planning and decision-making. We respond to most requests in 1–15 business days. Given the rapid nature of requests, we aim to produce comprehensive and evidence-based quality outputs, while acknowledging that our work is by no means exhaustive. For more information, please visit https://edtechhub.org/helpdesk/.

Contents

Abbreviations and acronyms

FCDO   Foreign and Commonwealth Development Office

CERD   Center for Educational Research and Development

CMDI   Coder-Maker Digital Innovations

DLI   Digital Learning Initiative

FFTx   Fibre to the *x*

IAI   Internet-assisted instruction

IEA   International Education Association

IoT   Internet of things

IRI   Interactive radio instruction

ISP   Internet Service Provider

ITU   International Telecommunications Union

LAYW   Learn-As-You-Work

LMC   Last-mile connectivity

LMICs   Low- and middle-income countries

LMS   Learning management system

MEHE   Ministry of Education and Higher Education

MoT   Ministry of Telecommunications

RAI   Radio-assisted instruction

TAI   Television-assisted instruction

TVWS   Television whitespace

Purpose of this document

This document was produced in response to a request from the FCDO Lebanon team that was submitted to the EdTech Hub Helpdesk in August 2020. The FCDO team requested guidance on leveraging low-tech devices and enabling connectivity to support learners in Lebanon, aligning with school reopenings in late September. This document compiles effective initiatives across Lebanon and other countries.

The authors acknowledge the intricacies of the current state of Lebanon, encompassing the Covid-19 pandemic, economic crisis, ongoing refugee situation, the August 2020 explosion in Beirut, and resignation of the government. In this topic brief, we have emphasised global contexts with limited ICT infrastructure to underline how relevant initiatives might be implemented and scaled in light of existing complexities. We recognise that any educational initiative must be tailored carefully to the local context.

1. ICT infrastructure in Lebanon

A significant portion of the Lebanese population has access to both low-tech and high-tech devices. (⬆Silver, et al., 2019) found that 57% of adults in Lebanon have access to a computer, laptop, or tablet in their household and 89% own a mobile phone. Table 1 summarises access to various education technologies in Lebanon, additionally demonstrating high penetration rates for radio and television.

Table 1. *ICT access in Lebanon. Sources: ⬆World Bank (2018); ⬆World Bank (2017); ⬆Silver, et al. (2019); ⬆Trombetta (2018); ⬆ITU (2017).*

	Percentage
Radio penetration rate (2018)	85%
Television penetration rate (2018)	97%
Mobile cellular subscriptions (2018)	64%
Individuals using the internet (2017)	78%
Households with a computer, laptop, or tablet (2018)	57%

However, several caveats to the data emerge when examining recent surveys conducted on the ICT infrastructure and education technology in Lebanon. Based on the Ministry of Education and Higher Education (MEHE) Distance Learning report shared by FCDO Lebanon, only 21% of learners used the Microsoft Teams online learning platform that was developed by the government in response to Covid-19. Reported reasons spanned from unstable internet connections to shared hardware within families to data costs (Ministry of Education and Higher Education, 2020). Despite more than half of the households in Lebanon having access to a computer, laptop, or tablet, learners may still encounter difficulties with device ownership and usage.

Variations in ICT access and usage may also exist between rural and urban populations and for the 1.1 million Syrian refugees in the country (⬆UNESCO, 2019). Smartphones and mobile phones feature heavily in the lives of refugees in Lebanon. In 2017, 86% of refugees owned mobile phones, while an additional 6% had access to one (⬆UNHCR, et al., 2017). Mobile devices are being used to connect or reconnect with others, find and maintain work, and

receive important information from sources like the UNHCR. However, ownership does not mean continuous access for everyone. Low bandwidth, no credit, and having to share with others limits how often refugees are able to use their mobile devices (↑Göransson, 2018).

Based on the existing technology landscape and government initiatives such as the Reaching All Children with Education (RACE) II platform, a scoping study by ↑Gaible (2018) indicates high potential for EdTech in Lebanon:

> *"The government's proactive and well-informed approaches to date, in combination with activity by NGOs (e.g. Little Thinking Minds) and the private sector (e.g. Microsoft) suggest that government personnel will have clear and actionable ideas regarding high-impact EdTech investments and activities in Lebanon." (p.v)*

The Ministry of Telecommunications (MoT) has made substantial progress in building overarching ICT infrastructure and internet connectivity from 2010 and on. Developed in 2016, the Digital Telecommunications Vision 2020 (DTV2020) outlined two strategic initiatives to improve connectivity over the fixed network and via mobile cellular services. Between 2013 and 2015, the number of broadband internet subscribers increased significantly with over 750,000 new subscribers. This increase was largely due to a reduction in internet costs and an increase in data consumption quotas (↑Ministry Of Telecommunications (Lebanon), 2016).

In 2018, the MoT and OGERO, the fixed infrastructure operator in Lebanon, began a last-mile connectivity project to deliver 'Fiber to the *x*' (FFTx), broadband network architecture that utilises fibre optic cables (see Section 3.1 for more information on last-mile connectivity). Three companies, SERTA Channels, BMB, and Powertech, were awarded tenders to carry out the project, in partnership with Huawei, Calix, and Nokia (↑anon. FTTX to be distributed by three companies: Ogero head, 2018). The FTTx project scope included both urban and rural locations, and its goal was for users to be able to access faster internet connection, video-on-demand, and Internet Protocol TV (↑Telecommunications Regulatory Authority (Lebanon), no date). OGERO projected that 467,000 users would be connected through the FTTx network by the end of 2018 (↑Rasbey, 2018). The FTTx deployment status and future plans for 2021–2022 are available online.[1] In 2019, the MoT announced plans to set up a third new internet submarine cable to link Lebanon to Europe. The

---

[1] You can learn more about OGERO's FTTx deployment plan here: https://www.ogero.gov.lb/dep.php?id=4

cable would turn Lebanon into an access point for other countries in the region to access internet services (↑Nakhoul, 2019).

Despite such innovative efforts, ↑Huawei (2019) reports that 3G coverage is still poor in certain areas and less than 10% of mobile users are able to use 4G / LTE connections in Lebanon. The August 2020 explosion in Beirut further impacted internet connectivity in surrounding areas, due to damage to local infrastructure and power outages (↑anon. Internet connectivity in Lebanon impacted following blast, 2020). On September 1, 2020, members of UNESCO's Global Education Coalition pledged to support the rehabilitation of damaged schools, professional development for teachers, and access to distance learning platforms and content in response to the explosion (↑UNESCO, 2020).

2. Low-tech education initiatives

The MEHE Distance Learning report highlighted three pathways for distance learning during Covid-19:

1. Television broadcasting on TeleLiban.

2. E-learning platforms via Microsoft Teams with pre-recorded video content and digital resources.

3. Low-tech options including worksheets distributed in hard copy and through WhatsApp.[2]

The Digital Learning Initiative (DLI),[3] launched by the MEHE, the Center for Educational Research and Development (CERD), and school administrators and teachers, encompasses multiple ways of learning, some overlapping with those listed in the MEHE report. The various channels include: recorded television lessons, assignments created by teachers on the learning management system (LMS) mCourser,[4] a digital library, live classes through Microsoft Teams, and collaboration with teachers and classmates through Google Workspace applications.

The MEHE report also covered potential actions to introduce radio-based programming into a blended learning initiative and to collect data on device ownership and usage. A multi-modal and data-driven approach is well aligned with effective distance learning approaches that EdTech Hub recommends.[5]

2.1. Radio and television

In countries with limited infrastructure for internet-assisted instruction (IAI), radio-assisted instruction (RAI) and television-assisted instruction (TAI) are commonly implemented. In Palestine, RAI has been integrated across almost all primary and secondary schools and TAI has been integrated across 76% and 94% of primary and secondary schools, respectively (↑UNESCO, 2013). During the Covid pandemic, applications of radio and television aiming to reach all learners have continued to expand.

---

[2] Ministry of Education and Higher Education, 2020

[3] You can learn more about the Digital Learning Initiative (DLI) here: https://dl.crdp.org/?fbclid=IwAR1pC1BY2YrWrp2pFUM9e2OAqL7l12QThpW1A601O8aQkmG8saDwx156wwY

[4] You can learn more about mCourser here: https://www.mcourserlb.com/

[5] You can read EdTech Hub's brief on a five-part education response to the Covid-19 pandemic here: http://docs.edtechhub.org/lib/JLEWADHF

A rapid evidence review of 66 research papers related to radio programmes by ↑Damani, Kalifa & Mitchell, Joel (2020) highlighted the use of radio to promote problem-solving and learner engagement during disruptions to schooling. Radio can have advantages in rural areas of Lebanon with limited electrical infrastructure since these devices can be operated using batteries and distributed at a low cost (↑UNESCO, 2013). However, the disadvantages of radio include a lack of access to coverage in rural regions (lessons broadcast on a national station will not reach children in communities that cannot access the signal); this use case varies widely based on country and is crucial to consider for the Lebanese context. On the question of cost-effectiveness, ↑Damani, Kalifa & Mitchell, Joel (2020) noted that "[r]adio is cost-effective when compared with most other EdTech, but it still entails significant upfront implementation and maintenance costs" (p.18).

For both radio and television, cost-effectiveness depends greatly on the number of learners reached by the programmes (↑Damani, Kalifa & Mitchell, Joel, 2020; ↑Watson, 2019). Given the 97% penetration rate of television in Lebanon, educational television on TeleLiban is an important building block for a multi-modal approach to reach all learners. Throughout Covid and school closures, recorded lessons were broadcast on television in Lebanon. The MEHE is working to collect feedback from learners on the effectiveness of lessons shared through television programming. Other countries in the MENA region, including Jordan, Saudi Arabia, and Morocco, are broadcasting daily lessons through local channels (↑World Bank, 2020). However, many low-income families may not have access to television at home. learners additionally may not be able to watch programming in other locations outside of their homes due to continued social distancing measures (↑Watson, 2020).

A study on Ubongo Kids, a Tanzanian television show, demonstrated positive learning outcomes for mathematics among children aged 7–16. Calculations indicated that Ubongo Kids was highly cost-effective due to low costs per viewer and a large viewer base (↑Watson, 2019). The learning gains per USD 100 spent on Ubongo Kids were reported to be higher than interventions in any other published study focused on cost-effectiveness (↑Watson, 2020). Moreover, educational television can support stigma reduction. Across various studies, educational television has the ability to promote positive attitudes in children towards others with different backgrounds and cultures (↑Watson, 2020). Television programmes could be used to counter prejudice against certain groups in Lebanon, such as refugees.

For more information on what makes effective educational radio and television programming, please refer to EdTech Hub's curated list of interactive radio instruction (IRI), EdTech Hub's rapid evidence review of

television, and the World Bank's note on educational television during Covid-19.

2.2. Other low-tech initiatives for education

Other low-tech initiatives to reach learners can include the use of SMS messaging and game-based applications. During the Covid pandemic, many teachers in Lebanon are using mobile devices and WhatsApp to communicate with their learners albeit in varied ways, such as through photographs of handwritten notes, voice memos, and / or links to Youtube videos. This points to the value of mobile devices in education across Lebanon (↑Chopra & Talhouk, 2020).

↑Angrist, et al. (2020) conducted a preliminary study on the effects of mobile-based interventions on learning outcomes for learners in Botswana, in the context of Covid-19 and minimising learning loss. The two-pronged intervention consisted of one-way weekly SMS messages containing numeracy problems, and supplemental 15-minute phone calls with a facilitator to talk through the problems. The facilitators asked parents to put the call on speakerphone, enabling them to engage both learners and parents in learning. Early evidence indicated that the SMS text messages and phone calls were linked with learning gains of 0.16 to 0.29 standard deviations.

A game-based learning initiative, Can't Wait to Learn can be accessed on tablets and is active in Lebanon, Jordan, Sudan, Uganda, Chad, and Bangladesh (↑War Child, no date). In Lebanon, the Can't Wait to Learn model is based on MEHE maths and reading curricula. An evaluation of the Mathematics Can't Wait to Learn programme showed that maths mastery scores improved by 7% within 12 weeks in the country. There were also positive changes in self-esteem scores and psychological symptoms. By the end of 2023, War Child aims to scale up Can't Wait to Learn to reach 135,000 children in Lebanon, in close partnership with MEHE (↑War Child, 2019).

A 2019 International Education Association (IEA) study examined the impact of Coder-Maker Digital Innovations Kits (CMDI Kits) across 41 schools in Lebanon, with a focus on refugee children. The CMDI Kit encompassed Raspberry Pi stations, SD memory cards and other digital equipment, open-source software packages, and pedagogical content. The pedagogical aspect of the initiative was informed by IEA's teacher professional development methodology, Learn-As-You-Work (LAYW), and encompassed training resources, teacher workshops, and digital support tools for schools and teachers (↑Metni, 2019). The intervention was found to increase learner metacognition, problem-solving, and critical thinking skills, and was estimated to cost USD $2 per learner per month at a programme scale of 200,000 learners (↑Metni,

2019). In the aftermath of the Beirut explosion and in an attempt to reach unconnected learners during Covid-19, IEA has begun developing a platform to map out areas of low-connectivity in Lebanon and to connect learners living in those areas with their network of volunteers.

Also focused on reaching refugees, Jusoor is an NGO based in Lebanon that provides educational programmes and is working to adapt its services in light of social distancing guidelines. They have been working with learners, teachers, and parents to provide WhatsApp-based education. While limited in its scale, this intervention stands out as one that:

- focuses on engagement between teachers, learners and the wider community, rather than simple content provision;

- has developed remote learning activities for learners to complete at home;

- has adapted to the needs of its learners and boosted engagement through the provision of food hampers and devices for select families.[6]

Jusoor is currently working with the EdTech Hub to enhance their offering through conducting a Sandbox.

When implementing WhatsApp-based or other tech-based initiatives, it is key to focus on pedagogy and ensure that teachers are sufficiently prepared to teach using relevant resources. For additional information on supporting teachers, please refer to EdTech Hub's curated list on effective teacher education in low-connectivity settings.

2.3. Recommendations on low-tech education initiatives

2.3.1. Data collection

Collecting a baseline set of statistics on device ownership and usage is a vital first step in developing a multi-modal approach. To reach all learners, including those in marginalised groups, the most technologically advanced initiatives often are not the most effective. As stated by ↑Trucano (2013):

> **"The best technology is the one you already have, know how to use, and can afford."**

Additionally, even if ownership rates of a device are high, educational usage rates do not necessarily follow. For example, data from Kenya shows that while 62% of Kenyan households own a radio, only about 19% of Kenyan learners

---

[6] (anon. About Our Organization)

tune into radio lessons. Alternatively, 45% of Kenyan households own a television, but 42% of Kenyan learners are tuning into educational TV (↑Uwezo, 2020). Based on the high penetration rates of radio and TV in Lebanon, both present viable options for a blended learning model once schools reopen. The FCDO team can support the collection of additional data across learner segments (such as marginalised learners, including refugees and girls) to inform the blended learning model.

2.3.2. Device costs

Policymakers can engage in various efforts to reduce overall costs of devices suitable for blended learning, especially for learners from low-income backgrounds. The associated costs of digital tools, such as the cost of regularly charging and maintaining such devices, should not be overlooked. The ↑Alliance for Affordable Internet (2020) recommends that governments and partner organisations work to reduce taxes on low-cost devices. Policies must be designed cautiously to ensure that lower taxes result in lower prices for users.

The government of Lebanon and its partners can also consider supporting projects to help spread the cost of devices over a period of time. For example, ↑GSMA (2017) outlines three business models to address affordability of mobile devices: direct payment, asset financing, and third party payment. Whereas in the direct payment model, customers use their own income to purchase devices, asset financing enables access to credit from banks, mobile network operators, or microfinance institutions so that a customer can make monthly payments. Third party payment helps to subsidise costs, and is often implemented by governments as part of a larger ICT strategy (↑GSMA, 2017).

3. Connectivity initiatives

Reasons for limited connectivity in countries may include: lack of local infrastructure, lack of affordable internet, gaps in ICT-related skills, and limited availability and high cost of devices (↑Garba, 2019). This section covers several initiatives related to providing connectivity, including: last-mile connectivity, Giga, and television whitespace. We also discuss zero-rating, which has potential to address data costs, a related barrier to accessing educational content when internet and mobile networks are already available. The majority of these initiatives are not specific to education, but have overlaps with the education sector.

3.1. Last-mile connectivity

A national main backbone network exists in many countries, but connectivity frequently does not reach populations in rural and remote areas. Last-mile connectivity (LMC) is the connectivity between the main backbone network and user devices such as phones, laptops, and tablets (↑ITU, 2020). It encompasses both wired and wireless technologies with different signal penetration, frequency use, cost, market size, and options for integration (↑Garba, 2019). In many cases, LMC is the most expensive and difficult stage of building ICT infrastructure (↑ITU, 2019).

While LMC can be a cornerstone initiative to foster the digital economy pursued by many countries, including Lebanon, there are several risks, as outlined by ↑USAID (2020):

1. **Sector risk.** LMC is a complex space with many external dependencies (for example, hardware, customers, funding for growth). Business models are still evolving.

2. **Execution risk.** Internet Service Provider (ISP) companies often experience difficulties with deploying and commercialising a network.

3. **Financing risk.** Return expectations of investors often do not align with available ISP deals.

4. **Regulatory risk.** Complexities emerge from legal regulations, ICT policies, consumer and data protection, and pricing and usage restrictions.

Regulatory risk is ecosystem-specific, and can have important implications across the other three risks. ↑USAID (2020) calls out the role of the government in mitigating this risk, given that "many Investors and ISPs

acknowledged their role was to react to regulations and not drive them"
(p.38).

In Lebanon, LMC projects have been and should continue to be driven by the
MoT, in partnership with ISPs. Given that such projects extend beyond the
scope of educational purposes, it is likely that the FCDO team should focus on
alternative connectivity efforts.

For additional information on LMC, please refer to International
Telecommunications Union (ITU)'s Last-Mile Internet Connectivity Toolkit.

3.2. Giga

A UNICEF-ITU initiative, Giga aims to provide connectivity to every school and
community in the world. Giga defines its aims as the following:

1. Map connectivity of schools in partnership with governments.

2. Advise on building sustainable models for finance and delivery.

3. Determine technical solutions to connect every school to the internet.

4. Advise on building sustainable models for finance and delivery.[7]

Launched in 2019, Giga develops country-specific financial models with
potential initiatives including lowering prices, developing technology to
bridge the last-mile gap, extending connectivity infrastructure, and increasing
access to relevant skills and learning. The initiative leverages both public and
private funding to produce returns. Giga also seeks to enhance digital
financial networks in order to improve efficiency of national governments in
managing payments to providers (↑UNICEF, 2020).

Giga is currently active in ten countries across sub-Saharan Africa, Latin
America, and Asia. In Kyrgyzstan, the government used Giga's mapping data
to renegotiate contracts with service providers and reduce rates (↑Ferguson,
2020; ↑Giga, no date). From these negotiations, internet speeds increased
from 2 Mbps to 4 Mbps and the government of Kyrgyzstan saved 40% of its
budget allocated for annual education connectivity (↑Giga, no date). Giga is
also partnering with Rwanda, Kenya, Sierra Leone, and Uganda to map
schools and build delivery models for connectivity (↑Ferguson, 2020).

3.3. Television whitespace

A creative way to bridge the last-mile gap, television whitespace (TVWS)
leverages unused broadcasting frequencies in the wireless 40 spectrum to

---

[7] (UNICEF, 2020b)

improve affordable internet coverage (↑Allier-Gagneur & Coflan, 2020). It is especially advantageous for rural areas, given that it can travel over 10 km and pass through buildings and vegetation better than other wireless communication technologies (↑Carpio, 2015). TVWS has multiple use cases, including high speed internet, WiFi access points, and internet of things (IoT) (↑Connelly, 2020).

Initial pilots of TVWS in the Philippines demonstrated its potential to increase connectivity across communities. TVWS was originally used in the fishing sector to issue certificates and licenses on a timely basis, manage resources, and collect sector data (↑Carpio, 2015). Following the introduction of TVWS to fishing, the government and Nityo Infotech, a TVWS technology firm, provided connectivity to several regions that were affected by a series of natural disasters in 2013. Though telecommunications networks were destroyed, TVWS enabled individuals to use social media and to contact their family and friends in the midst of a crisis. ↑Carpio (2015) points to the value of a disaster preparedness strategy that integrates a TVWS kit to enable communication amongst disaster response teams, a possible option for Lebanon as the country rebuilds from the Beirut explosion.

Microsoft Airband is a major player in the field of TVWS and seeks to close the digital divide in rural and unserved areas, with the goal of connecting 40 million people across the globe by July 2022. The initiative has focused on driving down TVWS costs by 60–70% over the past few years. It supports healthcare, agriculture, and education through partnerships with government ministries and other local partners (↑Connelly, 2020). Similar to Giga, all Airband initiatives are country-specific, given that timelines and contexts vary greatly.

3.4. Zero-rating

Zero-rating provides internet access at no cost to users under select conditions; for example, users might only be able to access an LMS or an online educational platform through their devices (↑Allier-Gagneur & Coflan, 2020; ↑Trucano, 2016). Social media, such as WhatsApp, can also be zero-rated. It should be noted that zero-rating is a somewhat controversial initiative and has received criticism for creating an anti-competitive environment and isolating users within subsidised websites (↑Dixon, 2017; ↑Trucano, 2016). Further, a survey across Myanmar, Peru, Kenya, Nigeria, Rwanda, and South Africa found that zero-rating did not facilitate bringing new users online. Instead, zero-rating users tend to already have the means to access the internet on their own, but use zero-rated services to save money (↑Dixon, 2017).

While acknowledging the limitations of zero-rating, it still has uses in supporting education; several countries have leveraged it effectively to reach a greater number of learners during Covid-19. Over the past few months, the Egyptian, Saudi, and Palestinian governments provided free internet services to university professors and free SIM cards to learners to access learning platforms through their personal devices (↑Guermazi, 2020). In Morocco, the Ministry of Education, the Mohammed VI Polytechnic University of Ben Guerir, the Ministry of Industry, the National Telecommunications Regulatory Agency (ANRT), and Morocco's three telecommunications companies partnered together on a project to improve access to the TelmidTICE remote learning platform. As of May 2020, learners can access the platform at no cost and freely download lessons and other digital resources (↑Hatim, 2020). Similarly, learners in Jordan can access the Darsak educational platform for free between 6 am and 4 pm each day (↑World Bank, 2020).

3.5. Recommendations

↑Gelvanovska, et al. (2014) outlined three core objectives of building connectivity:

1. Enabling access to the internet.

2. Stimulating adoption.

3. Supporting competition.

The MoT in Lebanon has identified a 'Triple A Strategy' that similarly points to the role of government in addressing cost and other access factors. The three A's include: activating Ministry stakeholders and building a unified team to contribute to ICT policies; ameliorating the telecom infrastructure through a transition to a 4G (and 5G) network; and abating tariffs, including for mobile voice and data plans (↑Ministry Of Telecommunications (Lebanon), 2016). As covered in the first 'A', collaboration across multiple sectors, including both education and telecommunications, is of utmost importance. Given that the question of connectivity is not solely limited to educational purposes, the FCDO team may consider partnering closely with the MoT to make cross-sectoral investments in connectivity.

For the three objectives outlined by ↑Gelvanovska, et al. (2014)), the timelines can vary greatly depending on the national context and priorities of policymakers and partners. In general, ↑Diop (2020) recommends that governments direct their attention in the short-term to the first and second objectives: "increasing bandwidth, managing congestion to keep the internet from breaking, and connecting the unconnected."

3.5.1. A short-term approach using vouchers

In general, no education-specific initiative clearly presents itself to address existing connectivity issues in the short-term. One interesting initiative to address the cost of accessing the internet is the distribution of vouchers for a predetermined amount of data to ensure that learners can engage with online content. However, there is little published research available on the cost-effectiveness of buying vouchers for connectivity. While the evidence does not speak directly to the use of vouchers to support connectivity, findings from other sectors on the use of financial incentives suggest that these intervention types do not have significant effects. Instead, removal of user fees to access services led to larger effects (see, for example, ⇧Bassani, et al. (2013)'s work on health). The relevance of this evidence to the idea of using data vouchers to encourage children to access online learning is questionable. Even so, it might suggest that initiatives geared towards children's learning should likewise focus on lowering system costs, rather than providing financial incentives. Additional analysis on the distribution of data vouchers is included in Table 2.

Table 2. *Advantages and disadvantages of data voucher distribution. Source:* ⇧*McBurnie, et al. (2020)*

Advantages	Disadvantages
- Enables governments to set predetermined limits on the cost of data usage - Access to vouchers does not depend on a learner's network provider - Obviates the need to negotiate zero-rating contracts with network operators and content providers	- Governments have limited control over the use of data vouchers - Places an increased burden on parents to guide learners to appropriate content and facilitate home-based learning - The distribution of vouchers may prove difficult and time-consuming in pandemic conditions - A focus on registered learners neglects out-of-school learners - Does not address the high cost of data provision

If policymakers choose to move forward with the voucher approach to build connectivity, we recommend that a strategy be developed to achieve the following outcomes:

1. **Ensure that children use the vouchers.** In some cases, other family members may use the data vouchers that were intended for children.

2. **Ensure that children use the vouchers to access educational content.** What are children most likely to use the vouchers for? How might the government encourage children to use the vouchers for their intended educational purpose?

3. **Distribute vouchers to all children.** Policymakers must be careful to develop initiatives to distribute vouchers to unregistered and marginalised children, including those living in rural and remote areas.

3.5.2. Long-term approaches

In the long-term, policymakers and partners can take a systems thinking approach to focus on building capacity for a digital economy through adjusting market structures. This effort aligns with the third objective mentioned above (↑Diop, 2020; ↑Gelvanovska, et al., 2014). Engaging in these actions will ultimately drive down prices of connectivity and enable greater innovation in the country. In 2014, fixed and mobile broadband prices were 2.5% and 4.5% of the average Lebanese monthly income, respectively. However, since then, broadband prices have increased significantly due to hyperinflation, the ongoing economic crisis, and the Covid pandemic (↑anon. Lebanon Telecoms, Mobile and Broadband Markets 2020 - Pricing of Telecom Services Has Been Raised as an Issue in Recent Years, 2020). Across the MENA region, adoption and usage of available networks have been shown to increase after the price of broadband falls below 3–5% of monthly income in a country. For example, in Jordan, the mobile broadband price was less than 3% of the monthly income in 2014, which was linked to a penetration rate for 3G of over 50% (↑Gelvanovska, et al., 2014).

Partnership with the public and private sectors is key. Given the many complexities and risks associated with connectivity, we recommend that FCDO partners closely with the MoT and MEHE to build long-term connectivity. Across initiatives including last-mile connectivity, Giga, and Microsoft Airband, one of the first steps is to identify relevant stakeholders and partners for a sustainable financial model. In September 2019, the Lebanese government announced the decision to move toward a digital economy that would generate 4% of the national income, a key step to achieving digital capacity in the future that FCDO may wish to support (↑anon. Lebanon starts transformation process to digital economy, 2019).

We recommend that policymakers in Lebanon assess television whitespace as an option to enable additional access to the internet. With the potential to connect communities and disaster response teams in the midst of natural disasters and other disruptions to schooling, TVWS could serve as a cost-effective approach to strengthen the local infrastructure in Lebanon (↑Carpio, 2015). TVWS can be implemented both in the more populated cities and in the rural regions of Lebanon that may not have usable and affordable internet to date. It should be noted that the success of a TVWS implementation is largely dependent on the regulatory landscape in Lebanon.

Lastly, reaching low-income and marginalised populations by decreasing or subsidising costs is an important consideration. In Morocco, a household in the bottom 40% income bracket had to spend 30% of its disposable income on mobile broadband in 2014. Marginalised groups in Lebanon may encounter parallel situations, preventing them from accessing fixed and mobile broadband. Further analysis of population and learner segments can be collected to inform a tailored approach that will address this issue of affordability (↑Gelvanovska, et al., 2014). Based on this data, a sustainable financial model should then be developed.

4. References

About Our Organization. (n.d.). Jusoor. Retrieved September 29, 2020, from https://jusoorsyria.com/about-us/team/

Alliance for Affordable Internet. (2020). *From luxury to lifeline: Reducing the cost of mobile devices to reach universal internet access.* https://a4ai.org/wp-content/uploads/2020/08/Alliance-for-Affordable-Internet_Device-Pricing_PUBLIC.pdf

Allier-Gagneur, Z., & Coflan, C. M. (2020). *Your Questions Answered: Using Technology to Support Gender Equity, Social Inclusion and Out-Of-School Learning.* Zenodo. https://doi.org/10.5281/ZENODO.3874247

Angrist, N., Bergman, P., Brewster, C., & Matsheng, M. (2020). Stemming Learning Loss During the Pandemic: A Rapid Randomized Trial of a Low-Tech Intervention in Botswana. *SSRN Electronic Journal.* https://doi.org/10.2139/ssrn.3663098

Bassani, D. G., Arora, P., Wazny, K., Gaffey, M. F., Lenters, L., & Bhutta, Z. A. (2013). Financial incentives and coverage of child health interventions: A systematic review and meta-analysis. *BMC Public Health*, *13*(3), S30. https://doi.org/10.1186/1471-2458-13-S3-S30

Blom, A., Nusrat, M., & Goldin, N. (2020, August). *5 things MENA countries can do to design better digital skills development programs.* https://blogs.worldbank.org/arabvoices/5-things-MENA-countries-can-do-to-design-better-digital-skills-development-programs

Borzekowski, D. L. G. (2018). A quasi-experiment examining the impact of educational cartoons on Tanzanian children. *Journal of Applied Developmental Psychology*, *54*, 53–59. https://doi.org/10.1016/j.appdev.2017.11.007

Carpio, M. (2015). *TV White Space for Development Programs in the Philippines: Implications and Challenges.* https://papers.iafor.org/wp-content/uploads/papers/acset2015/ACSET2015_18915.pdf

Carroon, L. (2020, September). *Microsoft Airband* [Personal communication].

Chopra, V., & Talhouk, J. (2020). #LearningNeverStops(?): A teacher and refugee student's reflections on Covid-19 school closures in Lebanon | INEE. *Inter-Agency Network for Educatio in Emergencies.*

https://inee.org/blog/learningneverstops-teacher-and-refugee-students-reflections-covid-19-school-closures-lebanon

Connelly, K. (2020, September). *Airband Initiative: Connecting the unconnected*.

Damani, Kalifa, & Mitchell, Joel. (2020). *Radio: Rapid Evidence Review*. https://doi.org/10.5281/ZENODO.3948149

Diop, M. (2020, April). *COVID-19 reinforces the need for connectivity*. https://blogs.worldbank.org/voices/covid-19-reinforces-need-connectivity

Dixon, D. (2017, July). *Mozilla releases research results: Zero rating is not serving as an on-ramp to the internet*. The Mozilla Blog. https://blog.mozilla.org/blog/2017/07/31/mozilla-releases-research-results-zero-rating-not-serving-ramp-internet

Evans, D., & Acosta, A. M. (2020, August). *What Have We Learned from Recent Years of Education Research in Africa?* Center For Global Development. https://www.cgdev.org/blog/what-have-we-learned-recent-years-education-research-africa

Ferguson, S. (2020, August). *Giga Initiative Aims to Connect the World's Schools to the Internet*. UNICEF USA. https://www.unicefusa.org/stories/giga-initiative-aims-connect-worlds-schools-internet/37582

FTTX to be distributed by three companies: Ogero head. (2018). The Daily Star Lebanon. http://www.dailystar.com.lb/News/Lebanon-News/2018/Feb-13/437876-fttx-to-be-distributed-by-three-companies-ogero-head.ashx

Gaible, E. (2018). *Transforming education through technology: Second-stage report*. The Health & Education Advice & Resource Team (HEART).

Garba, A. A. (2019, May). *Connecting the Last Mile, a Fundamental of Digital Transformation*. ITU Workshop for Europe and CIS "ICT Infrastructure as a Basis for Digital Economy," Kiev, Ukraine. https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/Events/2019/Workshop%20Kyiv/Aminata%20Garba%203%20Last%20Mile%20Connectivity%20Kiev.pdf

Gelvanovska, N., Rogy, M., & Rossotto, C. M. (2014). Broadband Networks in the Middle East and North Africa: Accelerating High-Speed Internet

Access. *Directions in Development - Information and Communication Technologies.* https://doi.org/10.1596/978-1-4648-0112-9

Giga. (n.d.). *Kyrgyzstan*. Retrieved September 23, 2020, from https://gigaconnect.org/kyrgyzstan/

Göransson, M. (2018). *Apping and resilience: How smartphones help Syrian refugees in Lebanon negotiate the precarity of displacement.* Clingendael Netherlands Institute of International Relations. https://www.clingendael.org/sites/default/files/2018-07/PB_Mobile_phones_July_2018.pdf

GSMA. (2017). *Accelerating affordable smartphone ownership in emerging markets.* https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2017/07/accelerating-affordable-smartphone-ownership-emerging-markets-2017.pdf

Guermazi, B. (2020, July). *Digital transformation in the time of COVID-19: The case of MENA.* https://blogs.worldbank.org/arabvoices/digital-transformation-time-covid-19-case-mena

Hallgarten, J., Gorgen, K., & Sims, K. (2020). *Overview of emerging country-level response to providing educational continuity under COVID-19.* 29.

Harris, B. (2019, June 25). *How TV white space is helping bridge the digital divide.* On the Issues. https://news.microsoft.com/on-the-issues/2019/06/25/airband-white-space/

Haßler, D. B., Khalayleh, A., & McBurnie, C. (n.d.). *A five-part education response to the COVID-19 pandemic.* 32.

Hatim, Y. (2020, June 1). Moroccan Students Can Freely Access TelmidTICE Remote Learning Platform. *Morocco World News.* https://www.moroccoworldnews.com/2020/06/304457/moroccan-students-can-freely-access-telmidtice-remote-learning-platform/

Huawei. (2019). *Country Profile: Lebanon*. Global Connectivity Index. https://www.huawei.com/minisite/gci/en/country-profile-lb.html###

Internet connectivity in Lebanon impacted following blast. (2020, August 4). *NetBlocks.* https://netblocks.org/reports/internet-connectivity-in-lebanon-impacted-following-blast-YAE2RvB3

Investment Development Authority of Lebanon. (2018). *ICT Sector in Lebanon—2018 Factbook*. https://investinlebanon.gov.lb/Content/uploads/Publication/1812050110 04908~IDAL-ICT%20FACTBOOK%202018.pdf

ITU. (2017). *2017 Global ICT Development Index*. https://www.itu.int/net4/itu-d/idi/2017/index.html#idi2017economycard -tab&LBN

ITU. (2019, May 21). *How low cost wireless broadband networks are connecting 'last-mile' communities in Djibouti*. ITU News. https://news.itu.int/how-low-cost-wireless-broadband-networks-are-co nnecting-last-mile-communities-in-djibouti/

ITU. (2020). *The Last-Mile Internet Connectivity Toolkit: Solutions to Connect the Unconnected in Developing Countries*. https://www.itu.int/en/ITU-D/Technology/Documents/RuralCommunic ations/20200120%20-%20ITU%20Last-Mile%20Internet%20Connectivity %20Toolkit%20-%20DraftContent.pdf

Khalayleh, A., & Abeba Taddese. (2020). *EdTech in Jordan: A Rapid Scan*. Zenodo. https://doi.org/10.5281/ZENODO.3911128

Lebanon starts transformation process to digital economy. (2019, September). MENAFN. https://menafn.com/1099001749/Lebanon-starts-transformation-proce ss-to-digital-economy

Lebanon Telecoms, Mobile and Broadband Markets 2020—Pricing of Telecom Services Has Been Raised as an Issue in Recent Years. (2020, May 8). Business Wire. https://www.businesswire.com/news/home/20200508005337/en/Leba non-Telecoms-Mobile-and-Broadband-Markets-2020---Pricing-of-Tele com-Services-Has-Been-Raised-as-an-Issue-in-Recent-Years-Now-Exas perated-by-the-COVID-19-Outbreak---ResearchAndMarkets.com

Lebanon: Why the country is in crisis. (2020, August 5). *BBC News*. https://www.bbc.com/news/world-middle-east-53390108

McBurnie, C., Adam, T., Kaye, T., & Haßler, B. (2020). *Zero-rating educational content in low- and middle-income countries*.

McBurnie, Christopher. (2020). *Using Interactive Radio Instruction to mitigate the educational impact of COVID-19: A curated resource list* (Version 1). Zenodo. https://doi.org/10.5281/ZENODO.3762228

MCourser. (2020). https://www.mcourserlb.com

Metni, E. (2019). *Digital Learning Innovations for Syrian Refugees and Host Communities in Lebanon*. https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/58166/58301.pdf

Ministry of Education and Higher Education (Lebanon). (2016, August). *Reaching All Children with Education: RACE II (2017-2021)*. https://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/lebanon_race-ii_2017-2021.pdf

Ministry of Education and Higher Education (Lebanon). (2020). *Distance Learning Initiative Interim findings: May 15, 2020*.

Ministry of Education and Higher Education (Lebanon), & Center for Educational Research and Development. (2020). *Digital Learning Initiative*. https://dl.crdp.org/?fbclid=IwAR1pC1BY2YrWrp2pFUM9e2OAqL7l12QThpW1A601O8aQkmG8saDwx156wwY

Ministry Of Telecommunications (Lebanon). (2016). *Daring Progress: Telecommunications Public Policy 2014-2015*. http://www.mpt.gov.lb/Telecom_Eng_V5.pdf

Nakhoul, S. (2019). *Third submarine cable to boost Internet service*. BusinessNews.Com.Lb. http://www.businessnews.com.lb/cms/Story/StoryDetails/7158/Third-submarine-cable-to-boost-Internet-service

OGERO. (2020). *FTTx Deployment*. https://www.ogero.gov.lb/dep.php?id=4

Rasbey, S. (2018, August). *First 50Mb/s Internet connection put online*. BusinessNews.Com.Lb. http://www.businessnews.com.lb/cms/Story/StoryDetails/6655/First-50Mb/s-Internet-connection-put-online

Roberts, S., Garnett, P., & Chandra, R. (2015). Connecting africa using the TV white spaces: From research to real world deployments. *The 21st IEEE International Workshop on Local and Metropolitan Area Networks*, 1–6. https://doi.org/10.1109/LANMAN.2015.7114729

Saalim Koomar, Allier-Gagneur, Z., & McBurnie, C. (2020). *HDR21 Effective Teacher Education in Low-connectivity Settings: A Curated Resource List*. https://doi.org/10.5281/ZENODO.3407498

Segal, L., Cole, C. F., & Fuld, J. (2002). Developing an HIV/AIDS Education Curriculum for Takalani Sesame, South Africa's Sesame Street. *Early*

Education and Development, 13(4), 363–378.
https://doi.org/10.1207/s15566935eed1304_2

Silver, L., Smith, A., Johnson, C., Jiang, J., Anderson, M., & Rainie, L. (2019, March 7). 1. Use of smartphones and social media is common across most emerging economies. *Pew Research Center*.
https://www.pewresearch.org/internet/2019/03/07/use-of-smartphones-and-social-media-is-common-across-most-emerging-economies/

Tauson, M., & Stannard, L. (2018). *EdTech for Learning in Emergencies and Displaced Settings: A rigorous review and narrative synthesis.* Resource Centre.
https://resourcecentre.savethechildren.net/node/13238/pdf/edtech-learning.pdf

Telecommunications Regulatory Authority (Lebanon). (n.d.). *Fiber Optics Lebanon*. Retrieved September 29, 2020, from
http://www.tra.gov.lb/SubPage.aspx?pageid=3595

Trombetta, L. (2018). *Lebanon—Media Landscape*.
http://www.databank.com.lb/docs/Media%20Landscape%202018.pdf

Trucano, M. (2013). *10 principles to consider when introducing ICTs into remote, low-income educational environments.*
https://blogs.worldbank.org/edutech/10-principles-consider-when-introducing-icts-remote-low-income-educational-environments

Trucano, M. (2016, March). *Zero-rating educational content on the Internet*. World Bank Blogs.
https://blogs.worldbank.org/edutech/zero-rating-educational-content-internet

UNESCO. (2013a). *Information and Communication Technology (ICT) in Education in Five Arab States. Information paper*. UNESCO Institute for Statistics.
http://uis.unesco.org/sites/default/files/documents/information-and-communication-technology-ict-in-education-in-five-arab-states-a-comparative-analysis-of-ict-integration-and-e-readiness-in-schools-en_0.pdf

UNESCO. (2013b, February 25). *Broadband "the missing link" in global access to education*.
https://en.unesco.org/news/broadband-%E2%80%9C-missing-link%E2%80%9D-global-access-education

UNESCO. (2019, October 29). *UNESCO schools give hope to Syrian refugees in Lebanon*.

https://en.unesco.org/news/unesco-schools-give-hope-syrian-refugees-lebanon

UNESCO. (2020, September 7). *Global Education Coalition members pledge to support emergency response in Beirut.* https://en.unesco.org/news/global-education-coalition-members-pledge-support-emergency-response-beirut

UNHCR, UNICEF, & WFP. (2017). *VASYR 2017: Vulnerability Assessment of Syrian Refugees in Lebanon - Lebanon.* ReliefWeb. https://reliefweb.int/report/lebanon/vasyr-2017-vulnerability-assessment-syrian-refugees-lebanon

UNICEF. (2020a). *GIGA.* https://www.unicef.org/innovation/giga

UNICEF. (2020b, August). *OECS to implement school connectivity initiative towards digital education vision.* https://www.unicef.org/easterncaribbean/press-releases/oecs-implement-school-connectivity-initiative-towards-digital-education-vision

USAID. (2020). *Barriers to Investing in Last-Mile Connectivity.* https://www.usaid.gov/sites/default/files/documents/15396/Barriers_to_Investing_in_Last-Mile_Connectivity.pdf

Uwezo. (2020). *Are Our Children Learning? The Status of Remote-learning among School-going Children in Kenya during the Covid-19 Crisis.* https://palnetwork.org/wp-content/uploads/2020/05/Usawa-Agenda-2020-Report.pdf

Valk, J.-H., Rashid, A. T., & Elder, L. (2010). Using mobile phones to improve educational outcomes: An analysis of evidence from Asia. *The International Review of Research in Open and Distributed Learning, 11*(1), 117–140. https://doi.org/10.19173/irrodl.v11i1.794

War Child. (n.d.). *Can't Wait To Learn.* Retrieved October 1, 2020, from https://www.warchildholland.org/projects/cwtl/

War Child. (2019). *Can't Wait to Learn Lebanon.*

Watson, Joe. (2020, March 31). Learning through television in low-income contexts: Mitigating the impact of coronavirus (COVID-19). *EdTech Hub.* https://edtechhub.org/2020/03/31/learning-through-television-in-low-income-contexts-mitigating-the-impact-of-covid-19/

Watson, Joe, & McIntyre, N. (2020). *Educational Television: Rapid Evidence Review.* https://doi.org/10.5281/ZENODO.3956366

Watson, Joseph. (2019). *The relationship between educational television and mathematics capability in Tanzania.* 274. https://doi.org/10.17863/cam.54714

World Bank. (2017). *Individuals using the Internet (% of population).* https://data.worldbank.org/indicator/IT.NET.USER.ZS

World Bank. (2018). *Mobile cellular subscriptions (per 100 people).* https://data.worldbank.org/indicator/IT.CEL.SETS.P2

World Bank. (2020a). *How countries are using edtech (including online learning, radio, television, texting) to support access to remote learning during the COVID-19 pandemic.* https://www.worldbank.org/en/topic/edutech/brief/how-countries-are-using-edtech-to-support-remote-learning-during-the-covid-19-pandemic

World Bank. (2020b). *Rapid Response Guidance Note: Educational Television & COVID-19.* http://documents1.worldbank.org/curated/en/659411587145759242/pdf/Rapid-Response-Guidance-Note-Educational-Television-COVID-19.pdf