Technology for Development:
A Solar Powered and Open Source ICT Training Proposal for Rural Namibia

Cedar Wolf, Master's Candidate, Regis University
    cedar@cedarwolf.com
    (970) 765-8060
    222 N 9th St Apt B
    Gunnison, CO 81230

Abstract

This paper analyzes lessons learned from past efforts to provide technology education in Namibia and proposes a new model for rural off-grid penetration of information and communication technology (ICT) training that emphasizes job skills development, environmental conservation, and gender equality. From 2016 to 2019, the Namibian founded and privately led Institute of Accounting and Economic Development (IAED) has been attempting to provide computer-training programs to students in rural secondary schools. This paper outlines strategies IAED has used to engage communities in the introduction of computer technologies, including providing information on return on investment for participating in training and agreements that must be maintained by various stakeholders involved. Challenges in computer maintenance, training, and funding are discussed. Due to the distributed nature of the Namibian population, many rural communities do not have access to electricity. This makes ICT education all but impossible. Of those who do possess access to electricity, men are more likely to be the owners or operators of ICTs. This paper concludes with a proposed training program that utilizes affordable solar powered Raspberry Pi computer kits to close this gendered digital divide.

Part I: Literature Review

The Digital Divide. It is hard to imagine life without the Internet. Yet, little to no Internet access is the reality for nearly half the people on the planet.[1] In the developed world, access to the Internet and computers is taken for granted. People in Africa experience the least access with only about 1 in 5 people using the Internet on a regular basis. Nevertheless, connectivity is catching on. In just the last decade global Internet users have more than doubled from 1.547 to 3.578 billion with the majority of new users coming from the developing world.[2] This disparity in access to technology is known as the "digital divide" and it is a key factor in the separation of developing from developed economies.

Technology for Development. It is generally agreed that access to technology will help countries achieve their development goals. This is clearly stated in the Sustainable Development Goal Target 9.c which aims to "Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020".[3] Information and communications technologies, or ICTs, is a very broad term that encompasses all digital devices that facilitate communication and the transfer of information. In most cases, ICTs will refer to devices that allow access to the internet

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[1] "ICT Facts and Figures 2017," *International Telecommunications Union,* 2017, https://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx.

[2] Ibid.

[3] "Annex: Global indicator framework for the sustainable development goals and targets of the 2030 agenda for sustainable development," *United Nations,* March 2017, https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework_A.RES.71.313 %20Annex.pdf.

or person-to-person communication, such as computers and mobile phones. In the field of development practice, these devices are referred to as ICTDs or ICT4Ds, which mean information and communications technologies for development.

Richard Heeks has described the evolution of ICT4D in stages. Heeks describes the mid to late 2000s as ICT4D 2.0 where the merging of computer science, information systems, and development studies was used to create the greatest impact with technology.[4] In retrospect, this stage of ICT4D could be seen as a tool in search of a problem. The spectacular failure of the One Laptop Per Child program is a good example of placing too much faith in the introduction of technology as an end-all solution in itself.[5] Bon and Akkermans[6] propose a new ICT4D 3.0 framework that embraces an iterative user-centered model. A typical technology intervention might assume, for example, that simply by providing a community access to computers development will occur. The ICTD 3.0 method begins with the user in mind and questions which technologies might be appropriate to solve their development needs. This approach allows more community participation and agency in meeting their goal. A common cause of failure for ICT4D programs is to put too much emphasis on the technology as the agent of change and not the people. Faced with an increasing number of failing ICT4D projects, in 2012 major development organizations such as the World Bank, UNESCO, USAID, and the UNDP convened to develop what would become the nine Principles for Digital Development.[7] These principles were largely developed from successful case studies that follow the ICT4D 3.0 approach. However, implementation and analysis of their effectiveness is still an important issue to pursue.

Technology for Development in Namibia. Namibia is a young but aspiring country. Having achieved independence only 29 years ago, this fledgling nation aims to transform itself into a knowledge-based developed economy, as outlined in its Vision 2030 national plan.[8] In addition, the government aims to make information and communication technologies the most important sector in this economic development. Included in Namibia's ICT objectives is a plan "to establish the country as a first-class regional ICT hub that will contribute towards job creation."[9] To facilitate this vision, the Ministry of Information and Communication Technology (MICT) recently established throughout the country 26 Multi-Purpose Community Centres (MPCC) with plans to provide free Internet access to the public. Regarding the plans, Minister Tjekero Tweya said, "The country will soon migrate paper-based documents and records into digital formats…" so that it will be "…easier for citizens to access public records, information and government services through the internet".[10] This new expectation of digital literacy emphasizes the need for ICT training. In addition to the MPCC facilities, a number of libraries, youth centers, and teacher resource centers across the country provide access to computers or computer

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[4] Richard Heeks, "The ICT4D 2.0 Manifesto: Where Next for ICTs and International Development?" *Development Informatics Group,* 2009.

[5] Berk Ozler. "One Laptop Per Child is not improving reading or math. But, are we learning enough from these evaluations?" *World Bank Blogs*, June 14, 2012.

[6] A. Bon and H. Akkermans, "Rethinking Technology, ICTs and Development: Why It Is Time To Consider ICT4D 3.0," December, 2014, https://www.researchgate.net/publication/270508612_Rethinking_Technology_ICTs_and_Development_Why_It_Is_Time_To_Consider_ICT4D_30.

[7] A. Bon, *Intervention or Collaboration? Rethinking Information and Communication Technologies for Development*, Pangea, March 2019.

[8] "Namibia Vision 2030," *Government of the Republic of Namibia,* 2004, https://www.namfisa.com.na/wp-content/uploads/2017/10/Vision-2030.pdf.

[9] "Overarching Information Communications Technology (ICT) Policy for the Republic of Namibia 2009," *Namibia Ministry of I&CT*, February 18, 2009.

[10] "MICT to provide internet facilities in remote areas," *New Era Live*, 2016, https://neweralive.na/posts/mict-to-provide-internet-facilities-in-remote-areas.

training workshops. These facilities are generally located in urban areas making them difficult to access for rural populations.

      U.S. Peace Corps: Computers For Kavango. A notable ICT4D effort from which many lessons can be learned is the Computers For Kavango project led by U.S. Peace Corps Volunteers from 2006 to 2010 in which nearly 200 refurbished computers were donated from the USA to set up computer labs in schools throughout the Kavango Region of northeastern Namibia. Despite the best of intentions to provide students with access to technology, and a valiant fundraising effort to ship the computers halfway around the world, the project would run into a number of roadblocks that would render it short-lived and unsustainable.

      First, the decision to ship computers from the US to Namibia was costly and damaging to the hardware. A better alternative would have been to purchase used machines from a reseller in Namibia or nearby South Africa. However, this decision was somewhat forced by donors' preference to give an old computer to a school in Africa rather than an equivalent amount of money to be used in the local economy. Second, local computer lab managers were not adequately trained in the maintenance and repair of the hardware and software systems. Volunteers made every effort to provide training but the sheer volume of computers, limited personnel, and volunteers' short timeframe in country made the task all but impossible. In addition, to avoid proprietary software fees, the computers were installed with the open source Linux operating system. This, unfortunately, added a prohibitive layer of complexity as most school staff had been trained in Microsoft Windows, the industry standard for the Ministry of Education.[11]

      U.S. Peace Corps: Girls Can Code! A more recent and positive example of successful ICTD training in southern Africa are the Girls Can Code Technology Camps in Zambia, also a Peace Corps Volunteer initiated project. These camps differ from Computers For Kavango in that they do not attempt to establish long-term training centers but rather their focus is to develop enthusiasm for technology that may inspire underserved girls to pursue technology as an educational or career path. Camps are held three times per year in between school semesters and last for about one week each. Leadership and group activities are interwoven into the technology training to build a sense of community and empowerment. The key to the success of the camps and their outreach to rural communities are the inexpensive and solar power operated Raspberry Pi computer systems they use to teach coding. A computer kit costs less than US$100 and can operate for days off a solar charged battery pack. This innovative model allows ICT4D training camps to reach even the most remote communities in Zambia. To scale their efforts, the student participants are encouraged to set up their own girls coding clubs when they return to their communities.[12]

Part II: Introduction to Community and Context

      Despite its difficult past and young history, Namibia is a stable, democratic, and peaceful country. Namibia was colonized twice, first by Germany in the 1800's and second by South Africa in the 1900's. During the German colonization, there was a genocide of the Herero tribe resulting in 24,000 to 65,000 deaths. During the South African colonization, the country was named Southwest Africa and was subject to apartheid discrimination. Namibia finally won its independence in a war with South Africa that ended on March 21, 1990.

      Namibia is a dry and arid land. The Kalahari Desert covers the eastern part of the country while the Namib desert covers the west and coastline. The economy is based primarily

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[11] S. Jackson, A. Pompe, and G. Krieshok, "Things Fall Apart: Maintenance, Repair, and Technology for Education Initiatives in Rural Namibia," *University of Michigan*, 2010.
[12] "How Peace Corps volunteers taught 3,600 Zambian girls to code," *Peace Corps*, 2018, https://www.peacecorps.gov/news/library/how-peace-corps-volunteers-taught-3600-zambian-girls-code/.

on fishing, mining and tourism. Namibia is about twice the size of California State but only has about two million people, making it the second least densely populated country next to Mongolia. Nevertheless, the country is known for its quality infrastructure and telecom penetration, making it "e-ready" to participate in the digital economy.

      Education and ICT as National Priorities. Namibia has made great strides in establishing itself as an educational leader in southern Africa. From 1990 to the early 2000s, "enrollment in primary education increased from 60 to 95 percent, there was a 30 percent increase in the teaching workforce, and 3,000 new classrooms were built".[13] In addition, Namibia's most recent president, Hifikepunye Pohamba, was the 2014 recipient of the prestigious Mo Ibrahim prize for good governance in which, under his tenure, primary school enrolment has reached near 100% due to the abolition of school fees.[14] Although still a developing country, Namibia "allocates more than 20% of its national budget to education" making it, in 2002, "one of the three countries with the highest percentage of GDP directed toward education in the world".[15] It is clear Namibia places education as a priority. This foundation of national support will strengthen efforts to pursue ICT training.

Historical Timeline of Education and Colonization in Namibia

- **1884**: Germany annexes the territory as South West Africa.[16]
- **1904-1908**: German forces engage in a genocide of tens of thousands of Namibians.[17]
- **1915**: Apartheid South Africa invades and takes control from Germany.
- **1960's**: Bantu community schools begin teaching primary education but subjects such as physical science and math are not taught to black Namibians.[18]
- **1990, March 21**: After a drawn-out battle lasting many years, Namibia becomes an independent country and is released from apartheid rule under South Africa. In its constitution, the Namibian government declares the right to education for all.
- **2004**: Founding President, Sam Nujoma, launches the Vision 2030 development plan which outlines ICT as "economically the most important sector in Namibia".[19]

      IAED Pilot Programs. Pontianus Mukishi is an ambitious entrepreneur from Namibia's Kavango Region. As a business trainer, Pontianus recognized a dearth of computer-related skills in his students. Businesses complained that their employees could not operate accounting programs or utilize spreadsheets. Pontianus believes Namibians should possess a digital literacy that leads to applicable skills for employment and business development. Seeing an opportunity to fulfill a need, Pontianus created the Institute of Accounting and Economic Development, or IAED.

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[13] Brian Faust, "The Unique History of Education In Namibia," *The Borgen Project,* December 2016, https://borgenproject.org/history-of-education-in-namibia/.

[14] "2014 Ibrahim Laureate - President Hifikepunye Pohamba," *Mo Ibrahim Foundation*, 2014, http://mo.ibrahim.foundation/prize/laureates/hifikepunye-pohamba/.

[15] "Education For All (EFA) National Plan of Action 2002-2015," *Government of the Republic of Namibia,* July 16, 2002, http://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/namibia_efa_npa.pdf.

[16] "A bloody history: Namibia's colonization," *BBC News,* August 29, 2001, http://news.bbc.co.uk/2/hi/africa/1514856.stm.

[17] Norimitsu Onishi. "A Colonial-Era Wound Opens in Namibia," *The New York Times,* January 21, 2017, https://www.nytimes.com/2017/01/21/world/africa/namibia-germany-colonial.html.

[18] Stephanie Quinn, "Education and development in Namibia," *The Namibian,* March 24, 2016, https://www.namibian.com.na/148916/archive-read/Education-and-development-in-Namibia.

[19] "Namibia Vision 2030," 2004, 69.

From 2016 to 2019, IAED has been conducting low-cost computer training workshops at partner schools in rural Kavango and Ohangwena regions of Namibia with about 20 second-hand laptops donated from the USA. While the commitment and enthusiasm of IAED leadership is high, a sustainable source of hardware and software has yet to be implemented. The current practice of importing used laptops only serves to replicate the previous problems of failed ICT4D experiments.

Part III: Needs Assessment

While anecdotal requests for ICT training have been received from various principals and students, a more thorough needs assessment for ICT training should be carried out in collaboration with interested communities and local governments. Once a pilot program is well established, IAED will consider expanding to these identified communities.

Methods of Community Engagement. In order to gain the trust of communities, IAED leadership will first seek approval for training from interested principals and the Minister of Education for the region. Second, the village chief and the School Board will be informed of the education plan.

Since schools hold regular parent teacher meetings throughout the year, a principal can be asked to introduce IAED to the community at one of these meetings. An IAED representative can talk about the benefits of being computer literate, what jobs require computer understanding, and how people can use computers to start their own business. The goal of this meeting will be to educate the community about ICT4D and, if support is present, come to an agreement with the community on how to implement the computer trainings.

Geographical Maps. A mapping exercise for rural areas of Namibia can be conducted to identify communities that would be good potential beneficiaries for training. IAED can work with local government officials to identify which villages to visit to conduct more detailed community maps.

Daily Routine Diagrams. IAED can also conduct daily routine diagrams to identify how much time is available for people to engage in a training program. This will help identify responsibilities people have and help them to prioritize or rearrange certain tasks they have during the day.

Pairwise Ranking. With a pairwise ranking activity IAED can identify the goals and priorities of a community. This will help to see if the training would be of assistance in their long-term goals, as well as what the steps to achieving these goals would be.

Seasonal Calendars. IAED can engage community members in a seasonal calendar activity to see when would be the best time to provide training workshops. This will help to identify on school calendars and agricultural calendars when time is not available. This will also help identify when people have the most funds available to contribute to training programs.

Part IV: Theory of Change

To mitigate potential challenges, IAED will adopt the following Theory of Change for a computer training intervention.

ASSUMPTIONS	ASSUMPTIONS	GOAL
Will teach people modern job skills	ICT skills will help people run their own business	Reduce poverty
CRITICAL QUESTIONS		
What are relevant job skills that are needed in Namibia?	Are computer skills necessary to run a personal business?	Does knowing how to use a computer help a person

		engage in an income generating activity?
UNEXPECTED TURNS		
Computer related jobs are minimal and usually require advanced ICT knowledge	ICT skills do not help entrepreneurs because most do not own their own computers	Most income generating activities that are available to the average Namibian are vocational and do not require ICT skills
POSSIBLE INTERVENTIONS		
Form partnerships with businesses that have ICT jobs by teaching skills directly relevant to their needs	Work with local governments to facilitate community use of computers at Multi-Purpose Community Centers	Use computer classes to teach people vocational skills through online training programs
RETHINK		
Only offer ICT training to businesses that need the training for their employees	Explore analog business development activities that only require pen and paper	Provide vocational skills training to people through hands-on activities or demonstrations by experts

Table 1: Theory of Change

Part V: Program Description

Since technological competence is becoming more relevant in today's workforce, and since most people in Namibia do not own a computer, IAED will focus on providing access to basic computer training. Computer training programs will have a key subject focus of teaching the principles of entrepreneurship and leadership in the lives of Namibians who have historically been subjugated through apartheid and colonization. The end goal is to provide practical skills that can be used to obtain employment or to start a small business. The plan will focus primarily on engaging the youth with an emphasis on creating change in the communities they live in.

Alignment with Sustainable Development Goals. IAED will pursue a learning plan in direct alignment with Sustainable Development Goal 4, Target 4.4, which states, "By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship." By focusing on increasing indicator 4.4.1, the "Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill"[20], IAED will align with the Namibian government's long-term goal of becoming an information technology hub in southern Africa.

As this plan is developed, there are a number of issues to keep in mind to ensure a just, sustainable, and ethical program. Although IAED may succeed in providing a greater quantity of ICT training opportunities, many Namibians may not be able to access these trainings due to cultural, political, or economic reasons. For example, as a patriarchal society dominated by the majority Oshiwambo tribe, women and minority groups may be overlooked when it comes to educational opportunities. Poverty and rural lifestyles also make it difficult to access training facilities located in hard-to-reach towns. There is also the danger of mismanagement. Since donors want to hear happy stories of how their funds are changing people's lives, there can be pressure to display false or incomplete narratives of success in the media. The story of More

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[20] "Annex: Global indicator framework for the sustainable development goals and targets of the 2030 agenda for sustainable development," March 2017, 5.

Than Me covering up multiple rapes of their young female students by a male staff member serves as a cautionary tale.[21]

Raspberry Pi Computers. Following the successful example of the Girls Can Code! leadership camps in Zambia, IAED will adopt the use of Raspberry Pi computer kits during its next phase of training workshops. These computer kits have the advantage of a low enough power consumption to operate off of 25000+ mAh battery packs for multiple days. The battery packs can, in turn, be charged using a minimum 6-watt solar panel. Raspberry Pi computers also run the Linux open source operating system. By using this open-source solar-powered approach, IAED will be able to teach its learners two important Principals for Digital Development, Build For Sustainability and pursue Open Innovation. Finally, IAED will be able to meet the learners where they are located rather than forcing them to travel long distances.

Activities. The following learning plan outlines a series of high-level steps for the penetration of ICT learning into Namibia's educational system. The plan is a dynamic and repeatable framework meant to guide the actions of IAED as it scales its outreach. On an annual basis, IAED will reflect on the success of the plan and make adjustments as necessary before implementing the process again. Through this iterative process, IAED will gain momentum year after year.

Step 1: Identify the computer-related skills gaps of youth entering the workforce. A needs assessment is the first and most important step for the learning plan. The assessment targets three audiences: schools, businesses, and the government. Government data is used to identify high-needs schools and communities. Students in grades 9-12 are targeted since they will soon be entering the workforce. Rural and urban schools are targeted for comparison. Students and school officials are surveyed to gauge their perceptions of how ICT skills can benefit their lives as well as how technology-ready they are for training. Businesses are surveyed to identify the skills they need in employees. University professors and students are consulted to ensure accurate research methods are being carried out.

Step 2: Partner with schools, businesses, and the government to address skills gaps. Once the needs assessment has been completed, formal agreements for training can be established. A basic training curriculum will be developed to meet Ministry of Education standards while an advanced curriculum will be tailored toward business industry needs. Schools will be requested to apply for an IAED training program. In their application, the schools must identify an available space for training and a local community member or teacher who will be trained as an ICT instructor. IAED will provide laptops for the duration of training. An IAED trainer can split their time between multiple schools, focusing on training the community ICT teacher and analyzing training results. Agreements will be made with local business owners to offer internships to successful IAED graduates provided the students complete an advanced business-training program. IAED will request use of government Multi-Purpose Community Centers to conduct additional ICT trainings during the weekends.

Step 3: Identify sources of computers and funding to carry out computer trainings. IAED will need to secure a reliable source of funding in order to cover staff and equipment expenses. This can be obtained by applying for and winning ICT education grants. A comprehensive budget and training program will be developed. In some cases, additional focus areas will be incorporated into the training program, such as HIV/AIDS education or gender equality. Computers will be sourced from organizations in Namibia or South Africa to avoid transportation and custom fees that occur from shipping from the United States or Europe. Additional corporate trainings can be offered to supplement funding sources where grants are not available to cover costs.

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[21] J. Harper, "Report: Liberian Charity Worker Raped Girls He Was Supposed To Protect," *National Public Radio,* October 16, 2018, https://www.npr.org/sections/goatsandsoda/2018/10/16/657873106/report-liberian-charity-worker-raped-girls-he-was-supposed-to-protect.

Step 4: Conduct computer trainings, analyze results, and scale training efforts. In order to scale its outreach efforts and provide sustainable skills transfer, IAED will focus on training a local trainer for each school it works with. This will allow IAED staff to reach additional schools with fewer resources. To celebrate the completion of IAED training programs, an annual ICT leadership camp will be held at the end of each academic year. Training assessments will be conducted and analyzed on an annual basis. This data will be reported to Ministry and school officials, as well as business owners. All IAED basic training materials will be made available to the public.

Partners. The following key stakeholders have been identified as key partners and/or supporters of IAED's mission:

- The Namibian Ministry of Education wants to support communities with ICT education and income generating projects to reduce unemployment and poverty but they have limited resources in which to do so. From the meetings IAED has had with local government officials there is much support and enthusiasm for the work the organization is trying to do. If IAED can provide funding for its own operations then the government may be able to provide access to classroom buildings and outreach to rural communities.
- Local companies such as Big Daddy, Style, Coca Cola, and tourism lodges have been working with IAED since its first inception. They have seen the hard work, enthusiasm and commitment of its founder, Pontianus Mukishi. These organizations recognize the need IAED is trying to meet in the community and they believe in its vision.
- Elephant Energy is a US-based nonprofit that works in Namibia to promote the use of renewable energy technologies through business ventures. They are an important ally since their work compliments what IAED is trying to do in teaching business practices through technology access. In addition, Pontianus works as a full-time solar sales manager for the organization.

Feedback, Communication, and Ongoing Engagement. IAED will attend parent/teacher meetings 3-4 times throughout the school year to engage with the community members, in particular the parents of the learners receiving the computer training. At the conclusion of a computer training workshop IAED will arrange a day for celebration in which certificates of completion and prizes are given to the learners.

Monitoring and Evaluation. To monitor and evaluate community engagement, IAED will hold monthly meetings with advisers and board members. IAED will also meet with the principal of the school to ask him or her what is the feedback being received from the parents of the learners. In addition, at each parent-teacher meeting IAED will ask for feedback from the parents on their level of engagement. To test the effectiveness of the training IAED will hold regular exams to gauge learners' understanding of the material being taught.

Example indicators for assessment are:
- Noting students' interest to enroll in further computer courses or to receive more advanced computer training
- Desire to purchase their own computer set or mobile devices
- Performance on practical computer training tests
- Student participation, commitment, or volunteerism to train others
- Rate of enrolment in the course
- Increased collaborations between parents and community members
- Parent and teacher interest to receive training
- Seeking independent feedback from third party organizations or groups

Part VI: Implementation

Timeline. The engagement plan will follow the academic and agricultural calendar year for the community. Ideally, IAED will stay at a community for one year to gather results. The school day goes from 7 am to 1 pm so IAED will seek to teach training courses from 2 pm to 5 pm. Classes will be taught three days per week with two sessions each day, one for boys and one for girls. The classes will be separated by gender in accordance with local cultural norms; however, equal numbers of girls and boys will be enrolled. During the end of year celebration the girl and boy learners will be intermingled into teams and accompanied with workshops on gender equality.

Month	Classes	Engagement	Community
January	1st term begins	Start computer training	No $
February			
March			
April	1st term ends		
May	2nd term begins	Parent-teacher meeting (M, J); discuss payments	Harvesting time ($)
June			Harvesting time ($)
July			
August	2nd term ends; exams	Parent-teacher meeting (A, S)	
September	3rd term begins		
October	Final exams	Visit schools to start in January	
November	Final exams		
December	3rd term ends; school closes	School Board meeting; student celebrations and camp	Community invited to celebrations

Table 2: Annual School Calendar

Capacity. Initially, only one trainer is needed to carry out a successful pilot project. The founder, Pontianus, and the marketing specialist, Cedar Wolf, will provide additional leadership. If the pilot program proves successful, then additional staff may be hired such as an accountant and regional managers.

Money. Startup costs to purchase 20 Raspberry Pi setups will be approximately $7,839. Personnel costs will be minimal due to low cost of living. If additional funds are available, then a celebratory week-long coding camp may be funded for an additional $7,500. These funds can also be used to purchase additional Raspberry Pi setups for expansion of the project.

Equipment	$7,839
Personnel	$2,513
Coding Camp (optional)	$7,500
TOTAL	$17,852

Table 3: Total expenses for one year of training

Conclusion

With the success of a pilot program, expansion can be made to provide trainings to adults, out-of-school youth, employees of small businesses, and entrepreneurs. Efforts can also be made to meet additional Sustainable Development Goals, such as increased focus on gender equality. Throughout this process, IAED will maintain a commitment to transparency and

critical analysis of its effectiveness. If a project is not producing desirable results then it will be modified or abandoned. Failures will be owned and only true stories of success be shared, always at the agreement of all involved. A well-vetted Board of Directors will be recruited. This leadership team must have specific industry knowledge and connection to Namibia. All IAED leadership and staff will be held to high ethical standards of conduct and behavior. By setting a positive example, IAED stakeholders and graduates will become loyal brand ambassadors to help promote a mission of lifelong learning and accountability.

Notes

1. "ICT Facts and Figures 2017," *International Telecommunications Union,* 2017, https://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx.
2. Ibid.
3. "Annex: Global indicator framework for the sustainable development goals and targets of the 2030 agenda for sustainable development," *United Nations,* March 2017, https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework_A.RES.71.313 %20Annex.pdf.
4. Richard Heeks, "The ICT4D 2.0 Manifesto: Where Next for ICTs and International Development?" *Development Informatics Group,* 2009.
5. Berk Ozler. "One Laptop Per Child is not improving reading or math. But, are we learning enough from these evaluations?" *World Bank Blogs*, June 14, 2012.
6. A. Bon and H. Akkermans, "Rethinking Technology, ICTs and Development: Why It Is Time To Consider ICT4D 3.0," December, 2014, https://www.researchgate.net/publication/270508612_Rethinking_Technology_ICTs_and _Development_Why_It_Is_Time_To_Consider_ICT4D_30.
7. A. Bon, *Intervention or Collaboration? Rethinking Information and Communication Technologies for Development*, Pangea, March 2019.
8. "Namibia Vision 2030," *Government of the Republic of Namibia,* 2004, https://www.namfisa.com.na/wp-content/uploads/2017/10/Vision-2030.pdf.
9. "Overarching Information Communications Technology (ICT) Policy for the Republic of Namibia 2009," *Namibia Ministry of I&CT*, February 18, 2009.
10. "MICT to provide internet facilities in remote areas," *New Era Live*, 2016, https://neweralive.na/posts/mict-to-provide-internet-facilities-in-remote-areas.
11. S. Jackson, A. Pompe, and G. Krieshok, "Things Fall Apart: Maintenance, Repair, and Technology for Education Initiatives in Rural Namibia," *University of Michigan*, 2010.
12. "How Peace Corps volunteers taught 3,600 Zambian girls to code," *Peace Corps*, 2018, https://www.peacecorps.gov/news/library/how-peace-corps-volunteers-taught-3600-zambian-girls-code/.
13. Brian Faust, "The Unique History of Education In Namibia," *The Borgen Project,* December 2016, https://borgenproject.org/history-of-education-in-namibia/.
14. "2014 Ibrahim Laureate - President Hifikepunye Pohamba," *Mo Ibrahim Foundation*, 2014, http://mo.ibrahim.foundation/prize/laureates/hifikepunye-pohamba/.
15. "Education For All (EFA) National Plan of Action 2002-2015," *Government of the Republic of Namibia,* July 16, 2002, http://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/namibia_efa_npa.pdf.
16. "A bloody history: Namibia's colonization," *BBC News,* August 29, 2001, http://news.bbc.co.uk/2/hi/africa/1514856.stm.
17. Norimitsu Onishi. "A Colonial-Era Wound Opens in Namibia," *The New York Times,* January 21, 2017*,* https://www.nytimes.com/2017/01/21/world/africa/namibia-germany-colonial.html.

18. Stephanie Quinn, "Education and development in Namibia," *The Namibian,* March 24, 2016, https://www.namibian.com.na/148916/archive-read/Education-and-development-in-Namibia.
19. "Namibia Vision 2030," 2004, 69.
20. "Annex: Global indicator framework for the sustainable development goals and targets of the 2030 agenda for sustainable development," March 2017, 5.
21. J. Harper, "Report: Liberian Charity Worker Raped Girls He Was Supposed To Protect," *National Public Radio,* October 16, 2018, https://www.npr.org/sections/goatsandsoda/2018/10/16/657873106/report-liberian-charity-worker-raped-girls-he-was-supposed-to-protect.

Works Cited

"2014 Ibrahim Laureate - President Hifikepunye Pohamba." *Mo Ibrahim Foundation*, 2014. Retrieved from http://mo.ibrahim.foundation/prize/laureates/hifikepunye-pohamba/.

"A bloody history: Namibia's colonisation." *BBC News,* August 29, 2001. Retrieved from http://news.bbc.co.uk/2/hi/africa/1514856.stm.

"Annex: Global indicator framework for the sustainable development goals and targets of the 2030 agenda for sustainable development." *United Nations,* March 2017. Retrieved from https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework_A.RES.71.313%20Annex.pdf.

Bon, A. and Akkermans, H. "Rethinking Technology, ICTs and Development: Why It Is Time To Consider ICT4D 3.0." December, 2014. Retrieved from https://www.researchgate.net/publication/270508612_Rethinking_Technology_ICTs_and_Development_Why_It_Is_Time_To_Consider_ICT4D_30.

Bon, A. *Intervention or Collaboration ? Rethinking Information and Communication Technologies for Development*. Pangea, March 2019.

"Education For All (EFA) National Plan of Action 2002-2015." *Government of the Republic of Namibia,* July 16, 2002. Retrieved from http://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/namibia_efa_npa.pdf.

Faust, Brian. "The Unique History of Education In Namibia." *The Borgen Project,* December 2016. Retrieved from https://borgenproject.org/history-of-education-in-namibia/.

Harper, J. "Report: Liberian Charity Worker Raped Girls He Was Supposed To Protect." *National Public Radio,* October 16, 2018. Retrieved from https://www.npr.org/sections/goatsandsoda/2018/10/16/657873106/report-liberian-charity-worker-raped-girls-he-was-supposed-to-protect.

Heeks, Richard. "The ICT4D 2.0 Manifesto: Where Next for ICTs and International Development?" *Development Informatics Group,* 2009.

"How Peace Corps volunteers taught 3,600 Zambian girls to code." *Peace Corps*, 2018. Retrieved from https://www.peacecorps.gov/news/library/how-peace-corps-volunteers-taught-3600-zambian-girls-code/.

"ICT Facts and Figures 2017." *International Telecommunications Union,* 2017. Retrieved from https://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx.

Jackson, S., Pompe, A., and Krieshok, G. "Things Fall Apart: Maintenance, Repair, and Technology for Education Initiatives in Rural Namibia." *University of Michigan*, 2010.

"MICT to provide internet facilities in remote areas." *New Era Live*, 2016. Retrieved from https://neweralive.na/posts/mict-to-provide-internet-facilities-in-remote-areas.

"Namibia Vision 2030." *Government of the Republic of Namibia,* 2004. Retrieved from https://www.namfisa.com.na/wp-content/uploads/2017/10/Vision-2030.pdf.

Onishi, Norimitsu. "A Colonial-Era Wound Opens in Namibia." *The New York Times,* January 21, 2017. Retrieved from https://www.nytimes.com/2017/01/21/world/africa/namibia-germany-colonial.html.

"Overarching Information Communications Technology (ICT) Policy for the Republic of Namibia 2009." *Namibia Ministry of I&CT*, February 18, 2009.

Ozler, Berk. "One Laptop Per Child is not improving reading or math. But, are we learning enough from these evaluations?" *World Bank Blogs*, June 14, 2012.

Quinn, Stephanie. "Education and development in Namibia." *The Namibian,* March 24, 2016. Retrieved from https://www.namibian.com.na/148916/archive-read/Education-and-development-in-Namibia.

Appendix

Table 4: Example Monitoring and Evaluation Framework

	Indicator	Definition	Baseline	Target	Data Source	Frequency	Responsible	Reporting
Goal	Implement computer training workshops for two schools by Dec 2020 in Namibia	Computer training program: secondary students, community trainer/teacher	Currently no computer training program accessible by schools	Two computer training programs in Namibia	Review and analysis of computer training program and computer literacy test results	Annual	Regional Trainer	Annual Report
Outcome	Understanding of basic computer literacy and software coding	Computer literacy based on completion of 3-month training and test results	*TBD at program start	50% passing rate	Analysis of computer literacy tests	Every 3 months	Regional Trainer and local counterpart	Project completion and exam results
Outputs	Number of secondary level girl learners trained	Total number of girls who complete the training	0	40	Attendance, pre/post test results	Attendance beginning of each training; skills test once a month	Regional Trainer and local counterpart	3 skills tests per school
	Number of secondary level boy learners trained	Total number of boys who complete the training	0	40	Attendance, pre/post test results	Attendance beginning of each training; skills test once a month	Regional Trainer and local counterpart	3 skills tests per school
	Number of community member trainers trained	Total number of community members trained	0	2	Attendance of student trainings	Beginning of each training session	Regional Trainer	2 program training reports (1 per school)

	Number of IAED staff trained	Total number of IAED staff trained	0	1	Training days completed and trainings logged at schools	Skills test prior to training; weekly check-ins	Program Director	Annual Report
	Number of schools that have received computer training	Total number of schools that complete training	0	2	Learner and community member attendance records	Every 3 months	Program Director; Principals	2 program training reports (1 per school)
	Number of girl learners who attend end of year camp	Total number of girl learners who attend camp	0	20	Attendance, workshop project completion	Annual	Program Director, Regional Trainer and local counterpart	Annual Report
	Number of boy learners who attend end of year camp	Total number of boy learners who attend camp	0	20	Attendance, workshop project completion	Annual	Program Director, Regional Trainer and local counterpart	Annual Report
	Increased understanding of computer systems	Passing rate for testing of computer systems knowledge	*TBD at program start	25% improvement	Pre/post test results	Every month	Regional Trainer and local counterpart	2 program training reports (1 per school)

Table 5: Example Annual Equipment Budget

Expense	Item	US$	#	Total
computer	Raspberry Pi 3 - Model B+ - 1.4GHz Cortex-A53 with 1GB RAM	$35	20	$700
computer	16GB class 10 microSD card	$4	20	$80
computer	Bluetooth keyboard	$20	20	$400
computer	USB mouse	$7	20	$140
display	7" Touchscreen Display	$80	20	$1,600
display	display/smartphone stand	$8	20	$160
software	Raspbian (opensource operating system)	$0		$0
software	LibreOffice (opensource software)	$0		$0
power	PiJuice HAT (1820mAh)	$65	20	$1,300
power	USB battery pack 10000mAh, 2x5V output, 1A 2A	$40	20	$800

power	PiJuice Solar Panel - 22 Watt	$79	20	$1,580
power	5V 2.5A Switching Power Supply	$8	20	$150
power	US to EU power adapter, 5x	$3	4	$12
power	power strip surge protector	$25	4	$100
training	Nebra AnyBeam HAT projector	$260	1	$260
training	laptop for Rasperian installation	$175	1	$175
training	ethernet cable	$2	1	$2
other	USB to smartphone adapter	$9	20	$180
other	shipping, tax	$200	1	$200
	TOTAL			$7,839

Table 6: Example Annual Personnel Budget

Expense	US$	#	Total
Trainer rent per month	$62	11	$682
Trainer pay/MI&E per month	$124	12	$1,487
Marketing, logistics, travel	$344	1	$344
TOTAL			$2,513

Table 7: Example Coding Camp Budget

Week long end of year coding camp for 40 learners (lodging, food, transportation)			$7,500