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Exploring Rwanda's Continuing Education Capacity for Information Communications Technology (ICT) Skills

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Exploring Rwanda's Continuing Education Capacity for Information Communications Technology (ICT) Skills

SIT Study Abroad Rwanda: Post-Genocide Restoration and Peace Building Fall 2017

Independent Study Project Report

Li Keen 'Leeks' Lim

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List of Abbreviations

AUCA Adventist University of Central Africa

AVU African Virtual University

CCNA Cisco Certified Network Academy

DA(P) Digital Ambassadors (Program)

EICV Enquête Intégrale sur Les Conditions de Vie des Ménages (Integrated Household Living Conditions Survey)

GoR Government of Rwanda

KBE Knowledge-Based Economy

ICT Information and Communications Technology

MCITP Microsoft Certified Information Technology Professional

MICT Ministry of ICT

MINEDUC Ministry of Education

MS Microsoft

NGO Non-Governmental Organization

NICI National Information and Communications Infrastructure

NISR National Institute of Statistics Rwanda

RWF Rwandan Franc

TVET Technical and Vocational Education and Training

ULK Université Libre de Kigali (Independent University of Kigali)

UNESCO United Nations Educational, Scientific and Cultural Organization

UR-CST University of Rwanda College of Science and Technology (formerly Kigali Institute of Science and Technology)

WDA Work Development Authority

Abstract

As Rwanda strives to become *the* ICT hub of the region, it will need to develop its greatest asset: its people, in ICT skills. This exploratory study used 30 semi-structured interviews, observation and secondary data from different sources, schools, students and NGOs, to answer a simple question: how does an everyday, working adult Rwandan learn new computers skills for a new computer age? This study found that a wide variety of suppliers fulfil different niches that give prospective students a range of prices, content, schedules, certification, practices, etc., and that demand is increasing for a host of different reasons. It also described accessibility for different disadvantaged groups, specifically women, the poor, the disabled, the uneducated and illiterate, and those living outside Kigali. All of them face different challenges - for example for women it was more socio-cultural and for those living in rural areas it was infrastructure. Finally, quality was also touched upon, with generally healthy indicators but common themes found in terms of current and future challenges like inadequate formal education, and supply-side costs.

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1 General Introduction and Background of the Study

1.1 Background to the Study

Learning does not stop when one leaves school and starts working. Many working adults around the world continue to learn new skills or subjects for a variety of reasons: to improve their current work or shift to a new, possibly better paying job, to be able to tutor their kids regarding the same material, and or even for self-fulfilment/empowerment and a sense of personal achievement. Such learning is often facilitated by employers through on-the-job/in-service training, institutions of higher learning (both local universities and even foreign ones via the internet), NGO/corporation-sponsored courses and public (community) or private learning centres.

Meanwhile, ICT is one of the identified 'cross-cutting issues' of Vision 2020, the GoR development plan to bring the economy to a middle-income, and eventually knowledge-based economy including 'by 2020…internet access at all administrative levels, for all secondary schools and for a large number of primary schools.' (GoR, 2000, p. 18) However, as a result of the devastating effects of the civil war and 1994 Genocide against the Tutsis, 'Rwanda suffers from a shortage of skilled technicians and…at the same time, graduates from the few technical and vocational schools that do exist are having difficulty finding jobs, apparently because graduates do not receive appropriate training.' (Watkins & Verma, 2008) Education, especially (TVET) related to ICT, hence plays a major role in Rwanda's uptake of ICT. This includes educating and upgrading the skills of working adults.

1.2 Research Problem

Much attention, government and scholarly, is rightly given to formal education at the primary, secondary and tertiary levels to develop the next generation's human capital yet this often also leaves continuing education as an overlooked footnote, especially in the non-formal sector. In addition to enabling individuals to pursue the goals mentioned in the background of the study, this component of education is valuable to the country as a whole for multiple reasons and should hence be given the attention that is currently lacking in scholarship.

Firstly, a large segment of the population had been excluded from formal education as a child (or had theirs disrupted) in the turbulent civil war and 1994 Genocide against the Tutsis; they are now working adults who would benefit greatly from self-motivated skills upgrading if given the chance. Secondly, while formal education is expanding healthily (according to the EICV (NISR, 2014, p.8), net attendance rate of primary school is 90%) and becoming more equitable under the government, many Rwandans today may still fall through the cracks and would benefit in the same way. This includes Rwandans who did not go through formal education, those whom did not receive it adequately, and those who graduated with skills mismatching the market as mentioned earlier. Third, the children of both these groups would benefit from their parents being more educated (through possible higher income or because they can assist in their early education with the basic skills). Fourth, steady and rapid economic growth towards a knowledge-based economy tends to produce more displaced workers who may find their skills irrelevant in new sunrise industries. As Allmendinger et al. (2011) put it:

> "Education is no longer an asset achieved in youth that remains of constant value during a long and stable employment career without interruptions. Today and in the future, adults are having to learn continuously to keep up with flexible requirements at the workplace and to be able to find employment in different and rapidly changing fields." (p. 284)

Finally, basic ICT 'technical literacy' is important in promoting equitable growth due to the so-called 'innovation dilemma' which implies that the well-off and privileged tend to benefit from new technology like ICT, widening the gap between them and the poor and less-privileged. (Punie, 2007)

1.3 Research Objectives

This research aims to broadly describe the current capacity of ICT-related adult or continuing education and skills upgrading (from now on referred to only as **continuing education**) in Rwanda. Specifically, the goals of the study are:

1. Describe current trends in demand and supply of formal and non-formal forms of ICT-related continuing education, including accessibility and future growth or decline.

2. Assess the current quality of formal and non-formal ICT-related continuing education, this includes the status of teaching equipment and staff, graduation rates and standards of certification.

3. Identify current and possible future challenges in ICT-related continuing education as reported by the various stakeholders in the sector.

2 Research Methodology

2.1 Scope

2.1.1 Thematic Scope

One major (and likely main) provider of continuing education are employers through on-the-job training and in-service skills upgrading courses but this study did not interview educators and students in this area unless the service was outsourced to public institutions or private learning centres outside the employers' organizations. (i.e. they send their workers out-of-office to take classes). This decision was made because the researcher was interested especially in how the underemployed, unemployed, self-employed or workers in the informal sector could 'help themselves' get better jobs or move into the formal sector with new ICT skills.

In research related to labour economics, quantitative data is typically used to approximate variables such as supply of ICT-related continuing education in this study. However, due to time and resource constraints, the research primarily used qualitative data supplemented by known/ secondary quantitative data because it would have been impossible to sample a statistically significant enough population of suppliers, students, etc. to measure for example, indicators like the returns to education. Instead, the researcher gathered student and teacher perceptions of 'how much they gain' from undergoing continuing education and other information to 'get a picture' of how the market looked like.

2.1.2 Geographic Scope

Due to time and resource constraints, this study was limited to Kigali and Ruhengeri (or Musanze). Two of the most major cities in Rwanda where many ICT-related (continuing) educators are found. Huye (or Butare), a university town where UR's main campus is located, is another obvious choice for this study but Ruhengeri was prioritized because the researcher expected Huye to involve more educated youth and adults, whereas he was interested more in adult individuals who may have exited the education system early. In addition, Ruhengeri is a tourism boomtown that the researcher expected to involve more ICT training to workers in the tourism and hospitality sector. The research also did not cover courses taught via distance-learning (i.e. using the internet) since

it would be difficult to have an in-person interview with suppliers who may be based outside Rwanda and because the researcher was interested in basic ICT education, including using the internet in the first place.

2.2 Research Design

2.2.1 Data Collection Techniques

The researcher conducted 30 semi-structured interviews with individuals[1] from the following sources:

1. (Adult) Educators, which included teaching staff and managers from both public and private, formal and non-formal institutions. This group constituted the bulk (24) of the interviews.

2. (Adult) Students currently enrolled in courses provided by the (adult) educators above. This group was made up of 4 interviewees enrolled in 2 schools.

3. NGOs involved in the ICT-related education sector. 2 representatives from K-Lab and DOT Rwanda were interviewed and their organizations' objectives will be elaborated on later.

These interviews were supplemented by material that the sources themselves provided (for example, brochures or websites with information on prices and courses they offered) as well as observations the researcher made in visiting each source's premises (for example, the amount of class space available), which informed the researcher's questions and data interpretation. An observation guide was also made in order to focus the researcher's attention on gleaning relevant information. A Kinyarwanda-English translator was only used for one interview. For the list of interview questions and observation guide, see appendix A.

2.2.2 Sampling

The interviews were chosen using a mixture of snowball and purposive sampling. The researcher had informal knowledge from his experience in Rwanda and through some contacts involved in ICT had a rough idea of where the 'hot-spots' (for training centres) in Kigali and Ruhengeri were.

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[1] For one school (interviews A13 to A17G), two interviews were done in pairs as the principal directed the researcher to students and teachers in this way upon request. As the researcher was granted permission and kindly assisted in finding interviewees on such short notice, he found it inappropriate to ask for further conditions for the interviews. Although not ideal, the pairs all responded to questions separately and gave a mix of similar and different answers.

These were usually commercial centres which the researcher covered on foot thoroughly and looked for places advertising (in English or Kinyarwanda sometimes) their ICT training. A majority (25) of organizations were found this way. Another 4 were learned via contacts or informants and 1 organization was known to the researcher through their published activities in the local English-language newspaper The New Times. See appendix B for full list of interviews.

2.3 Ethical Values observed during the Study

Standard research norms were observed. Firstly, interviewees were asked if they wanted a translator or were comfortable in English. They were always interviewed at their offices or classes and told beforehand the objectives of the research as well as their right to withhold information or stop the interview at any time. Consent forms, which one interviewee signed, and information about SIT, which 3 interviewees read, were available upon request; in all cases, verbal consent was sought and obtained from the interviewees and their bosses if possible. They were given time to ask the researcher any questions they had pertaining to the study before and after the interview, including the small-scale nature of it and that its effects were limited at best. All were given the researcher's contact information so they could change or withdraw their answers, or request for feedback and research results, which one did.

Special considerations were also made related to the context of the study. No mention of the civil war and 1994 Genocide against the Tutsi was made and questions that could be indirectly linked to them were left open-ended. For example, many adult students may have cut short their schooling or not have gone at all because of the human catastrophe. They were asked hence asked only to share their educational experience with ICT. The researcher also avoided using technology - audio recording devices or laptops - for his interviews. This was firstly to avoid potentially embarrassing 'computer illiterate' adult students who were taking ICT courses precisely for that reason and may feel judged or inadequate watching a researcher much younger than themselves using 'sophisticated' technology with ease. Secondly, this was to avoid offending or embarrassing educators whom would be asked questions like the age of their equipment or funding for new computers while a student researcher typed away at his 'expensive looking' machine.

2.4 Limitations of the Study

This study was first and foremost limited by time and resource (or budgetary) constraints. The researcher had one month to sample and conduct interviews with the various stakeholders (listed in 2.2.1) around Kigali and Ruhengeri. Many organizations were not listed online or did not have updated contact details, so most were found covering large areas of both cities on foot. Furthermore, permission was sought from department heads or managers, when possible, before interviewing any staff and students, this especially limited the number of students. No government officials (from MICT, WDA, MINEDUC), who were part of the initial sample, could be contacted in time either. In addition, as this was a qualitative study, many of the self-reported figures are only approximations and because of the small sample size, could have resulted in skewed data. The limited time also means that the study confined itself to Kigali and Ruhengeri, neglecting other cities and rural areas - which may have less suppliers, but even information on what *is not* available is insightful for such an explorative study.

This study was also limited by the researcher's limited knowledge of Kinyarwanda. Although the researcher was able to recognize Kinyarwanda (or French) ads for computer training[2], many suppliers could also be advertising on the radio - especially important for places that cater to the illiterate. Some may not even be advertising at all, and rely on walk-in clients asking them if they do training. In addition, although all interviewees were asked if they wanted a translator, many training centres' managers may have purposely looked for English-speaking teachers and students when the researcher requested to speak to some of them, believing that they were helping the researcher. All this means that the sample is potentially biased towards the perspective of English speakers since all interviews except one were conducted in English with English speakers.

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[2] Twigisha mudasobgwa - we teach computers (literally 'devices that never err')

3 Literature Review and Definition of Key Concepts

3.1 Note on Key Term 'Continuing Education'

So far, I have used the term 'continuing education' instead of 'adult education' even though the **latter** term is what existing literature uses to describe the type of education I am studying. In other words, the 'correct term' to use to align with literature on the subject at hand (and to research what is actually relevant to my study), **is** adult education. However, I have replaced this term (or use it interchangeably) with **continuing education** according to **how it is understood in Rwanda**.

Typically, adult education is understood here as referring mostly to education for adults who never went through formal schooling and are usually illiterate. Meanwhile, Rwanda believes the term continuing education is more applicable to the field of ICT because, as the logic goes, one needs to be literate first before they can use the computer. This is arguably largely correct, except that there are initiatives to expose **even illiterate** adult populations to ICT, especially in order to access 'government e-services' like those on IREMBO.[3] I plan to explore these initiatives where possible.

To avoid confusion when conducting interviews and to locally contextualize this small study, I use the term continuing education for most of my study. However, to preserve the integrity of and to tie the study back into the background research, the following literature review section will continue to use the term **adult education**. Again, this is because the literature on adult education is what is relevant to my study, and it would be unnecessary and haphazard to change all the wording and quotations of the existing literature to use 'continuing education' when they **mean the same thing** in this study.

3.2 Literature Review

3.2.1 Continuing or Adult Education

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[3] It is also possible to argue that some illiterate adults use phones and can perform basic call functions, which shows you not only literate people use ICT. In fact, the capabilities (especially graphic) of current ICT can even overcome some of these barriers.

In this study, *Continuing or Adult Education* refers to learning by individuals who have **exited**, meaning removed themselves from the 'typical' educational trajectory as defined by the society, typically the formal education system of the society, **regardless if they finished or dropped-out** at primary, secondary or tertiary levels of education (for continuing education), **or never went through** it at all (adult education in general). This learning is **sustained** and can take place in a *Formal, Non-formal or Informal* setting. This is a shortened and slightly modified version of UNESCO's (2015) definition:

> "Adult learning and education is a core component of lifelong learning. It comprises all forms of education and learning that aim to ensure that all adults participate in their societies and the world of work. It denotes the entire body of learning processes, formal, non-formal and informal, whereby those regarded as adults by the society in which they live, develop and enrich their capabilities for living and working, both in their own interests and those of their communities, organizations and societies. Adult learning and education involves sustained activities and processes of acquiring, recognizing, exchanging, and adapting capabilities. Given that the boundaries of youth and adulthood are shifting in most cultures, in this text the term "adult" denotes all those who engage in adult learning and education, even if they have not reached the legal age of maturity." (p.6-7)

I quote this UNESCO definition because it summarizes all the components, including the aims, motivations behind, methods and people involved, and defines the scope of adult education in a general context. It recognizes that adult education is both important for the individual and society and is a continuous, lifelong process that can happen in *formal, non-formal, and informal* settings and consequently can be done in many different ways. I use this definition of an 'adult' rather than deciding on an age not only to follow the definitions from existing literature but also in order to include 'adults' who have begun working or performing societal roles as an adult while excluding 'youths' who are just continuing their education at say a university level - while both individuals could be of the same age (or the former even younger), it makes more sense to apply the term 'adult education' to the former category's courses and modes of instruction.

3.2.2 Forms of Adult Education

At this point, it's good to clarify what the three types of settings I've mentioned repeatedly mean. *Formal* settings refer to 'education in formal learning institutions, such as schools and colleges for adult learners.' (Nafukho, Amutabi, & Otunga, 2005, p. 75) Such providers in Rwanda include UR, AUCA, polytechnics, etc. Graduating from such courses usually awards learners with **recognized** (societally) **certification** like 'Networking Systems Certification' from CCNA. Meanwhile, *non-formal* settings are non-governmental and private organizations (that are also not formal institutions of learning, by definition) that teach specific knowledge and skills in fields varying from music to computer skills. (Nafukho, Amutabi, & Otunga, 2005) Allmendinger et al. (2011, p.288) define non-formal training as 'institutionalized shorter training courses not leading to certificates'. In fact, many may involve some form of 'certification' provided by the organizers as a recognition of learners' accomplishments but they may or may not be recognized at a society-wide level for employment purposes. Finally, *informal* settings of adult learning mean learning that takes place in a less organized way at work (e.g. on-the-job training, or a senior employee giving a 'crash course' to a new employee), or at community centers/social groups (e.g. community baking classes or even a friend teaching handicraft skills every Tuesday). Some authors include all learning that takes place for adults in their daily lives. (Nafukho, Amutabi, & Otunga, 2005) This study focused on formal and non-formal settings.

3.2.3 The Purpose of Adult Education

Earlier, I mentioned many of the reasons an individual pursues adult education, and why a society should seek to provide it. UNESCO (2015, p. 8) says very much in general that 'the aim of adult learning and education is to equip people with the necessary capabilities to exercise and realize their rights and take control of their destinies.' Nafukho, Amutabi & Otunga (2005) agree, adding that adult education predates modern institutions of learning and was used to enable individuals to play their societal roles.[4] In fact addressing the needs of an individual and that of society is the effect - adult education empowers an individual in society and in doing so, society benefits. In addition, many authors such as Allmendinger et. al (2011, p.284) 'have stressed the growing societal importance of adult education… justified with ongoing globalization, skill-biased

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[4] Noting that the authors try to talk about 'African societies' in general, and the situation in specific localities could deviate.

technology change, and the development of a knowledge society (a goal explicit in Rwanda's Vision 2020).' (Punie, 2007; Nafukho, Amutabi & Otunga, 2005; GoR, 2000) Further, Singh (2000, p.601) reminds us that even for the informal economy, studies including Rwanda 'point to general competencies, in addition to capital and technical skills', all major topics in adult education, 'as the key to increasing the economic potential of people'. Hence, to reiterate what the purpose of adult education, it is to enable individuals to empower themselves and be more useful actors in a society that benefits accordingly.

3.2.4 Differences between Adult and Child Education

Adult education is sometimes referred to as andragogy, a term used to denote the field of teaching adults as opposed to pedagogy. One major difference is that in adult education, the teacher is often a facilitator rather than taking a leading role in a classroom. (Nafukho, Amutabi, & Otunga, 2005) Knowles, Holton and Swanson (2005, p. 64-69) postulated that there are six principles that lend uniqueness to the field. They are as follows:

1. Adults need to know why. They will only be invested in understanding new material, even if it's part of a larger subject they are trying to learn, if they know why they are learning that particular topic/skill/information.

2. Adults possess a 'self-concept' and want to take responsibility for decisions taken. They want to take ownership of their learning and may withdraw if they think ideas are being imposed on them. Nafukukho, Amutabi & Otunga (2005, p. 11) also emphasize that 'self-directedness is culturally bound', and that in more community based cultures, adult learners should be encouraged to work things out in groups.

3. Each adult learner brings their own experience. Activities that tap into each learners' life experiences/situations, rather than abstract general subject material are therefore more effective.

4. Adults are 'ready to learn'. This principle suggests that lessons should be held in settings/scenarios that help adult learners better survive or move on to the next 'developmental stage' according to the situation they are in at the moment. Older learners might be 'readier' to learn retirement planning for example.

5. Adults education should have real-life application. Adult education should teach skills relevant in society (and are 'problem-oriented' rather than 'subject-oriented' in ways that are culturally

specific. Nafukukho, Amutabi & Otunga (2005, p. 12-13) suggests for example, that learning programmes in Africa (in communal cultures) should 'encourage groups of evening students to remain intact…work in learning teams…and encourage each other to complete the programme'.

6. Adult learners are motivated to learn. They are often both externally and internally motivated. For example, a learner studying a foreign language could want higher salary (external) but is also self-driven to master multiple languages. These principles will inform some of my question-making and evaluation of information later on.

Finally, there is the issue of access to adult education. Every context carries with it their own challenges[5] but there are also some that may apply to adult education in general. For instance, Singh (2000) considers the training of people from low-income families and those who are working in the informal sector to be especially costly and time-consuming, requiring government intervention to make up for the severe disadvantages these groups have. Meanwhile, Allmendinger et al. (2011, p. 291) state that 'we know that women, in particular mothers, participate less in further training'. Nafukho, Amutabi, & Otunga (2005) also add that illiteracy rates tend to be higher amongst women in developing countries, severely limiting the educational options of women. Although these issues are not necssarily true of all contexts, adult education's accessibility for the poor, uneducated, informal workers, women (and also rural-urban divide) are all unfortunately and understandably common and one must keep them in mind when looking at the sector in any context.

3.2.5 ICT and Education

ICT refers to machines that can receive, store and transmit information such as telephone lines and computers. It has been around for more than a century but is only a recent phenomenon, mostly as a result of the latter's and the internet's proliferation. In fact, Kramer, Kenkins, & Katz (2007, p. 7) argue the strong case that 'ICT has become the foundation of every sector of every economy, everywhere', with benefits including reduced transaction and travel costs, and widening potential markets, choices and information channels. However, Heeks (2010, p. 629) warns that ICT's

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[5] I elaborate later on possible accessibility challenges related to ICT adult education to look out for under 'The Rwanda Context' in this literature review

potential for development was 'launched via a series of reports and events that were strong on promise and hype' but that excitement for this 'development silver bullet' was quickly followed by 'reports of little-used or abandoned ICT projects… and only a small minority succeeded.' He also points out that ICT can have a gendered impact - a study done in Mumbai found 'women were far more likely to be non-users and low users of ICTs (computers and the Internet) outside their college time…[but] women report greater levels of empowerment as a result of ICT training'. (Heeks, 2010, p. 633) Nafukho, Amutabi, & Otunga (2005, p. 118) also point out that 'Africa is disadvantaged in that few of the African languages can be read by computers.' Overall, it is clear that ICT has great potential in addressing many issues ranging from poverty to women's empowerment but is merely a tool and requires good policy and implementation to be effective.

ICT has also been increasingly used to try and enhance education (both as a teaching and an administrative tool) while also itself being a subject to be taught. These are not mutually exclusive, since both ICT and some academic subject can be taught at the same time through 'e-learning modules' for example. ICT has several uses when it comes to education. Firstly, 'the advancement of ICT supports andragogy as a method of teaching' since teachers merely facilitate learning while the students can discover or work out information/solutions by themselves. (Nafukho, Amutabi, & Otunga, 2005, p. 128) Secondly, ICT can provide individualized learning experiences tethered to real-life activities, directly responding to the principles of "learner experience" and "real-life application" I stated earlier regarding adult education. Thirdly, ICT can run courses 'incorporating visual, auditory, tactile and kinaesthetic learning processes' that is effective for differentiated learners. (Nafukho, Amutabi, & Otunga, 2005, p. 129) Finally, ICT has enabled teaching to be done remotely - that is, where the learner and teacher are not physically in the same space - in a growing sector of education called *distance-learning*.

UNESCO (2015, p. 7) certainly recognizes all of these benefits with regard to adult education, and in particular emphasizes its potential accessibility to 'people with disabilities…as well as for other marginalized or disadvantaged groups' if carefully planned steps are taken in the direction of inclusiveness. This is especially important, given that some authors like Ginsburg, Sabatini, & Wagner (2000, p. 79) believe 'up to the present the vast majority of ICT investment in education

worldwide has gone into statutory schools and higher education, without regard for the educational needs of disadvantaged adults.' Furthermore, even expanding ICT investment and infrastructure does not 'somehow automatically extend young people's capabilities…[since] the ways in which technology is taken up relates to both the social and cultural context of use as well as the design of the particular technology.' (Sutherland et al., 2009, p. 57) This lack of contextually appropriate access is dangerous because ICT skills are now seen as obligatory for employment by many.[6] (Punie, 2007; Ginsburg, Sabatini, & Wagner, 2000) Yet in addition to 'chronic under-funding of adult education in general…ICT investment has been thought too expensive, especially in developing countries', further widening the gap between disadvantaged adult groups, ('information-poor') and the 'information-rich'. (Ginsburg, Sabatini, & Wagner, 2000) It is clear that precisely because ICT has become so powerful a tool in education and employment, neglecting measures towards inclusiveness and equity and teaching basic ICT skills to all groups in society will result in a greater 'digital divide'. (Ginsburg, Sabatini, & Wagner, 2000; Nafukho, Amutabi, & Otunga, 2005)

3.2.6 The Rwandan Context

As already mentioned, ICT has gotten a lot of attention from Rwanda, featuring strongly as a cross-cutting issue in Vision 2020. (GoR, 2000) However, as already pointed out earlier about the early 'overhyping' of ICT, it is one thing to have ICT in your country, and another to effectively utilize it. For individuals, Selwyn (2002, p. 12) suggest that ICT should be considered in terms of both access and 'engagement… where the user exercises a degree of control and choice over technology and content…use that could be considered to be useful.' Extrapolating this idea onto a larger context, the GoR has focused on expanding ICT in TVET and schools to 'deal with the immense skills deficit… to strategically position herself to become the ICT hub of the region'. (Musobo & Gaga, 2012, p. 7; Farrell, 2007; Rubagiza, Were, & Sutherland, 2011) There are too many examples of such initiatives to list, but some noteworthy ones include the following:

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[6] This will certainly be the case for Rwanda with the government's emphasis on ICT as a cross-cutting issue.

1. The NICI plans[7], a series of phases that include the establishment of the National Information Technology Commission (NITC) 'to lead the process of creating the Rwandan information society and economy' and the Rwanda Information Technology Authority (RITA), the body actually in charge of implementing some of the associated projects and programmes under NITC. (Farrell, 2007, p. 4)

2. Development and laying of an expanding fibre optic network, beginning with 'linking schools, hospitals and government buildings in Kigali.' (Farrell, 2007, p. 7)

3. Tertiary-level ICT courses anchored by large universities like ULK, AUCA and distance-learning programs offered by AVU in collaboration with UR-CST.
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Yet much more still has to be done, according to some authors. Rubagiza, Were, & Sutherland (2011) found many secondary schools benefitting from the government's push to equip them with ICT but with caveats and wide variances between schools. Firstly, they observed that schools in rural areas may have ICT equipment but lack funding and expertise to maintain the equipment, limiting access to students for fear of costly damage. Secondly, competing usage for what is available is still very high in certain places, since administrators want to use them, as well as teachers both for ICT specific education and for other subjects. Finally, out-of-school usage varies based on a rural or urban setting, and gender. In particular, Rubagiza, Were, & Sutherland (2011, p. 41) found 'an increasing number of teachers and learners are gaining access to ICTs and the Internet through Internet cafés, especially in urban areas in Rwanda.' They found that 90% of young people accessed the Internet in this manner in addition to many having access to computers at home in urban areas, exacerbating 'gender differences as well as the rural-urban divide'. The former, they explain is because girls traditionally helped with the household at home, whereas boys have more free time, possibly to go out. This cultural context has also been repeated by other Rwandans.[8] The latter is meanwhile explained through the difference in availability of out-of-school ICT between rural areas and urban centers, particularly Kigali. Hence, both accessibility and engagement are still wanting in Rwanda.

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[7] Other noteworthy objectives of NICI includes training primary and secondary teachers in ICT and developing a curriculum, translating relevant content into Kinyarwanda,

[8] To be precise, the headmaster of a primary school in Mayange and the director of investments at RDB

Currently, except for some sporadic information, a study focused on ICT-related adult education in Rwanda, encompassing the wide variety of providers in this sector is unavailable. Yet this does not mean adult education has completely been neglected. Farrell (2007) notes that the NICI-2010 plan includes developing a 'national electronic distance education and training program that supplements and complements campus-based education at all levels, facilitates lifelong learning, and encourages in-service training in both the public and private sectors.' The AVU is one such initiative brought in by MINEDUC, who also said 'the development of human resources is one of the principal factors in achieving sustainable economic and social development…education and training has been considered as a critical lynchpin to achieve development and poverty reduction in Rwanda.' (MINEDUC, 2003) Hayman (2005, p. 7) believes this drive includes education 'in its varied forms - basic, post-basic, formal and informal' although she criticizes the poor transition and communication from trainers to employers, which leads to youth underemployment and unemployment, especially in the informal sector. Despite this however, she thinks there is still a huge 'hunger' for education in Rwanda, stating that 'Kigali's tertiary institutions are full of fee-paying students, often mature working people, who are doing degrees on a part-time basis.' (Hayman, 2005, p. 42) Unfortunately, this hunger may never be satisfied by marginalized groups of people, particular the poor, due to 'limited explicit focus on ensuring access for the poor beyond the basic levels of education.' (Hayman, 2005, p. 49) This may be particularly damaging in Rwanda, where according to Lassibille and Tan (2005), the returns to education are particularly high and increases exponentially as it reaches the tertiary level (where Rwanda pours an above average amount of subsidies).

4 Presentation, Analysis, and Interpretation of Data

4.1 Demand and Supply

4.1.1 The Stakeholders and their General Characteristics

After considering the information gathered, the researcher categorized the interviews as described in the following table.

Category	General Characteristics	Ref. No.
1. Internet or Cyber Cafés (Managers, Teachers)	• Provides informal (internship or on-the-job training) and non-formal training (unofficial certification provided by centre) • Limited organizational hierarchy and specialization; small number of staff (~<5) that often perform multiple roles like maintenance, managing, teaching, and secretarial services, etc. simultaneously • Limited educational facilities and amenities; small number of computers and equipment used/reserved for teaching, as well as teaching material like worksheets; space shared with other services (secretarial, internet, photography, etc.) • Capital usually depends on one person/source • Flexible/negotiable, often personalized (1-1) training in terms of duration, frequency, price, content of classes	A01, A08, A09, A10, A11, A12, A21M, A22M, A23M, A25M, A27
2. Specialized, Private Schools (Managers, Teachers)	• Provides non-formal (unofficial certification provided by centre) and formal training (official certification recognized by Rwandan government or international vendors like Microsoft) • Low to moderate organizational hierarchy and specialization; small to moderate amount of staff (~3-20), including dedicated administrative staff, typically perform 1-3 roles only. • Specialized educational facilities and amenities; dedicated class and or lab spaces, reserved equipment and teaching material; typically conducts more non-ICT training as well (like language) • Capital can come from partners/donors • Structured training (content, prices, etc.), with negotiable exceptions, class sizes vary	A02, A03, A04, A07, A13, A16G, A17G, A20, A24M, A28
3. Post-Secondary Institutions (Department	• Provides formal training (official certification recognized by Rwandan government, international vendors like Microsoft, or just using the institution's name as 'known brand') • Moderate to high organizational hierarchy and specialization; moderate to large amount of staff (>20) with segmented,	B19, B29, B26M

Staff, Teachers)	independent departments for different programs and highly specialized instructors/administrators. • General educational facilities and amenities for entire school; typically endowed with more expensive equipment/teaching material with sharing between faculties, programs and amongst large student bodies • Publicly or privately funded by large organizations • Short courses resemble private schools', separate formal education (undergraduate, polytechnic, etc.)	
4. Students (current)	• Individuals taking ICT courses in any of the 3 listed providers • Initially sought students who had completed ICT courses but did not manage to get any (and few students overall) • Typically, young adult and older, and have exited the formal schooling system and counted in the labour force (so unemployed, underemployed or employed.)	A05, A06, A14G, A15G
5. ICT Education Related NGOs	• K-Lab is an 'incubator' - its mission is to promote, facilitate and support the development of innovative ICT solutions by nurturing a vivid community of entrepreneurs and mentors • Also helps create and grow tech start-ups while hosting events, workshops, bootcamps, hackathons and networking sessions to promote collaboration/partnerships, investment and financing. • DOT Rwanda implements Rwanda's Digital Ambassadors Program where fresh graduates are trained to conduct basic ICT training and awareness programs in their home districts across Rwanda. • Their programs target precisely parts of the population which would otherwise have low interest and access in ICT	C18, C30

Table 4.1.1 Stakeholders

4.1.2 Supplier Niches: 'I get customers from nearby universities, even from town, for practice.'

Categories 1-3 can be grouped as 'suppliers' (of ICT skills education) and shows the 'spectrum' of training available that varies in types of certification, scheduling and personalization. For instance, all but one supplier in category 1 provide training in basic ICT skills (like MS office and using the internet), none in category 3 provide basic ICT skills training while there is a mix of those who do and those who do not in category 2. In general, the courses offered by suppliers becomes more advanced or complex and includes more official certification moving from category 1 to 3 (See appendix C.1 for detailed breakdown). This recategorization better reflects how in fact,

the supply of ICT skills education can be broken down into differentiated markets and may even supplement each other as can be inferred from quotes like in this section's sub-header. For example, a prospective student may want to get the officiality (and associated employability) of a school certificate (e.g. a degree from UR-CST) but also want the 'hands-on' time that small internet cafés provide or due to time limitations (or because he is self-employed, and so does not need the officiality part), just chooses the latter option.

18 out of 23 suppliers, of which all but 1 were from category 1 and 2, said the advantage of their courses was practice time, practical or specialized skills (for the job market) and or that schools taught too much theory only (see appendix C.3 for full list of 'advantage' categories). Many respondents (6) see themselves as precisely filling the supply gap in this kind of training. For example, one internet café manager said, 'in Rwanda we have a problem…in schools, you can only get theory, not practice…it's like 5% [practice]…it will take a long time to change.' This corroborates existing literature that suggests a lack of practice and labour-market centred TVET education in Rwanda. (Musobo & Gaga, 2012) This also aligns with a principle of andragogy - the need for real-life application ('practical skills') for adults to learn. Others (8) suggests the low cost (in terms of time, money and flexibility) of their courses is their main draw - again making it plausible for not only working adults, but full-time students from universities to participate. The variety of suppliers and differentiated markets is furthermore a sign of a healthy and up-and-coming sector, a point to be elaborated on next.

4.1.3 Demand Trends Linked to ICT Trends in Rwanda

A large majority of respondents (16 out of 21) to the question of how they expect future demand for their training to be said it was increasing[9] compared to 3 and 2 who said it would decrease or remain the same respectively. Many respondents unsurprisingly alluded to increasing computerization in Rwanda as the drive behind it. One said, 'everything is computerized, whatever area you work in', resembling Kramer, Kenkins, & Katz (2007)'s statement that 'ICT has become

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[9] These numbers together imply an upward general demand even though some individual responses said it was about more marketing on their part; somewhat balancing out this bias is that one respondent who said it would decrease said it was due to competition.

the foundation of every sector of every economy, everywhere.' One student (category 4) respondent said, 'for me, when I tried to see everywhere in the country, I see that our country is focusing on IT, they are importing those machines…it means that those machines will need someone to repair…' as the reason he was taking courses.

Different perspectives on the specific nature of this current and future demand is also noteworthy. In category 1, there was a wide variety of the types of courses, specific applications and coding related being common (3 each), that suppliers said they were planning to introduce or in the midst of 'teaching themselves' first in order to give lessons later. 3 were hoping to introduce 'professional courses' (in their words) or find partnerships, which on clarification meant offering more officially certified courses either accredited by the WDA or CCNA for example. (See appendix C.1 for full list of courses and certification) Many based their plans on walk-in client requests, demonstrating a responsive supply to demand. All suppliers in category 2 who discussed future plans (total 3) did so in a similar manner. For example, one supplier said they introduced new courses in accordance to 'market research'. In category 3, suppliers did not mention demand from the market but 2 said they were planning on introducing specific, accredited (like all their current ones) courses.

Some implied it was not the proliferation of ICT per se, but increasing 'appreciation' of certain aspects. One supplier, who reportedly was the main contractor for government employees, said 'a lot of guys beginning to appreciate IT…security issues, most of the organizations want their staff trained in…more based on…as the tech changes, the people are buying things that are more vendor specific…they need appraisal, training, for the equipment…forcing people to come.' This may mean the growing importance of professional certification like CCNA and MCITP. Meanwhile, the interviewee from DOT Rwanda shared his experience: 'first cohort is very challenging (getting participation from the community), when they hear testimony (from their course graduates), that's when you start having the waiting lists… we are working with local community leaders… we interest them (and they help publicize them at weekly gatherings) …most of them don't know it requires only 10RWF to get the service (e-services via texts).' In other words, the ICT infrastructure and services already exists, but people are only now discovering their full potential.

Going back to the literature, Heeks (2010, p. 629) warned that excitement over ICT as the 'development silver bullet' was quickly followed by 'reports of little-used or abandoned ICT projects'. DOT Rwanda's assessment certainly backs this claim, as does another supplier who stated: 'I guarantee no single person has a private account [on Irembo]', and that people (he mentions the illiterate specifically) hence rely on internet cafés to do it for them. As the data shows, this may soon change.

4.1.4 Heavily Gendered Markets

At first glance, Heek's (2010) warning that 'women were far more likely to be non-users and low users of ICTs' does not seem to hold significantly true in the data. Out of 22 different suppliers from category 1 to 3, 8 reported that they had more female students, 5 said it was mixed, and 9 said there were more male students. However, further scrutiny, specifically self-reported percentages from specific suppliers, tells a different story. Except for 1, none of the 8 suppliers that offered formal training (i.e. awarded students a societally or internationally recognized certificate) reported having more female students. Even the 1 supplier that did report having more female students said that was only seasonal during the school holidays. In fact, out of all 22 suppliers, the 5 with the most extreme gender imbalanced classes were male dominated (0, 2, 6.6, 22, 25 percent female respectively). 4 were from the 8 that awarded formal certification while the last one (0%) not from the 8 formal suppliers only had 3 students so far and so had a very skewed dataset. In addition, a lesser percentage of suppliers in category 2 report having more female students than in category 1, and none of the 3 suppliers in category 3 report having more female students.

Taking both of these points into account and remembering also that the courses offered by suppliers became more advanced/specialized moving from category 1 to 3 (see 4.1.2), an obvious gender divide surfaces - women tend only to do basic ICT courses without formal certification, and do not advance further on to more specialized and complex ICT training with 'better' certificates. Many suppliers themselves are aware of this. One respondent tried to explain that 'in our country…they [girls] still have fear in them, to take cameras, to use computers…girls believe technical programs (i.e. more specialized ICT) require physical skills and so are [the] career of

boys…we are still changing their mindset, culture, history…they do not consider themselves equal with boys in technical skills, even those who come to our school, psychologically we see it…[it is also] the mindset of the parents is the root cause.' Another stated that 'they [girls] are left behind…need more support (to train them in ICT skills)'. Secondary data also backs this claim - the EICV showed that self-reported 'computer literacy' was 6.8% among female Rwandans aged 15 and above compared to 10.3% for boys. (NISR, 2014, p. 46) In other words, while women and girls might be starting to take basic ICT courses (and in fact the data implies they form the majority of the students), perhaps to make up for this gap, they may still face socio-cultural barriers to specializing in more advanced ICT skills.

Actually, only 3 of the 30 interviewees (representing the different suppliers) themselves were female. The researcher did not intentionally seek male or female interviewees and only requested to speak to 'ICT teachers (or the manager)' from each supplier, which implies ICT-related (adult) education itself could be a male-dominated field (because many women do not advance further in ICT skills, as just noted). All 3 taught mostly basic ICT courses, and what one had to say about the gender gap is noteworthy. She said (while grinning sheepishly), 'maybe boys like to learn, girls are lazy…here in Rwanda, women and girls, they don't like to learn…they cannot pay themselves [once] they think it's enough, unless they are paid by their company.' In other words, she believes female Rwandans consider basic ICT know-how 'enough' and anything more advanced 'extra, unnecessary costs' they will not pay themselves. This could also tie in with what an earlier quoted respondent stated as the 'root cause' - parents - since it may be that male students' advanced studies are financed more so than female students by their families, although EICV data (NISR, 2014) cannot support this claim.

Many interviewees were unsure if skewed gender ratios in their classes would change in the future and or references cultural forces larger than themselves. One respondent said, 'nowadays they like ICT' while another observed higher numbers among the youth, following a trend that the EICV also notes in higher computer literacy rates for girls aged 15-24 compared to everyone 15 and above. (NISR, 2014, p.46) Both NGOs in category 5 however, are actively trying to be part of that cultural force. K-lab cited examples of targeted programs in the Southern province, teaching girls

robotics and mobile development, as ways they are 'trying to fix it slowly', the fact that 'many women are not interested'. Meanwhile, DOT Rwanda explicitly targets a 50-50 ratio of men and women for both trainers and participants and notes that 'especially in rural areas, we find that women are trying to stay back (not participate in DAP), but when they see a young lady from university training them, they come out also…it takes time.'

Despite signs of catching up in terms of basic ICT skills, women and girls still face apparent socio-cultural and psychological barriers to gaining more advanced skills *and* teaching them. If DOT Rwanda's observation that other women and girls only overcome them via example is true, this could mean a self-perpetuating feedback loop where women and girls do not train to become teachers because they do not have teachers as examples. Active intervention as the NGOs is thus welcome, and more needs to be done.

4.2 Accessibility

4.2.1 Prices and the Poor

The EICV (2014, p. 46) reports that there is still a significant gap in computer literacy between the poorest and wealthiest quintiles (3% compared with 24% respectively), dangerously foreshadowing several author's point that ICT skills are now seen as obligatory for employment by many (Punie, 2007; Ginsburg, Sabatini, & Wagner, 2000). This is a point respondents also made: 'adult people come here to specialize to protect their work, to continue to occupy the same work'.

The price of a basic ICT course ranged widely among suppliers in category 1 and 2[10], and was more often reported as 'negotiable' in the former. For suppliers in category 1, the average and median prices (in RWF) were 45500 and 20000 respectively; for those in category 2, they were 149000 and 60000 respectively (see appendix C.1 for a more detailed breakdown). However, without a more extensive quantitative survey, it would not be possible to gauge whether these

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[10] None of the suppliers in category 3 offered comparable courses in basic ICT

prices were manageable[11] for an average working Rwandan to pay (cite GDP). Nevertheless, the wide range of prices, of which many were given by category 1 suppliers as negotiable (both total and payment structure) means more options for consumers, including the poor.

Other indirect findings may also help provide clues. 3 out of the 4 students interviewed (all of whom were taking advanced courses) recounted difficulty at some point in paying their school fees, even though all of them said the prices were fine, or high but worth it. Meanwhile, the researcher also found 3 suppliers who had given (and continues to give) ICT training for free to specific groups[12], although none of them advertised doing so. Another supplier had started a scholarship program 3 months prior to the interview, a program which all 72 current students at the time were under and essentially paid half the usual tuition. Teachers in the school cited previous dropouts (due to financial reasons) as the impetus for starting the program, which they say has helped students immensely. Both NGOs also provide all their services for free. Overall, access to ICT continuing education for the poor remains limited but made possible by the thankless work of several suppliers.

4.2.2 Disabled: 'Why not…it will be difficult but we have to.'

Out of 23 that responded to whether they teach the physically disabled or not, 6 said they had or could, another 6 said they could not, and 11 others said it depended on the disability. A majority from category 1 (6/11) said no, while 3 said it depends and only 2 said they had or could. In contrast, nearly all from category 2 (6/7) said it depends while 1 said they could, and all 3 from category 3 said they had or could. This trend also makes (conventional) sense since larger schools possess a larger pool of funds to finance special equipment, staff, and infrastructure, have a larger student body in general which means more disabled students that can share those specialized facilities (to make it worth it), and probably follow stricter regulation from GoR[13] to cater for the

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[11] All respondents who said they did not have students who dropped out halfway through a course due to financial reasons said they 'paid before'; which indicated that this was a better approximate of payment structure rather than prices, and hence was left out of the findings.

[12] The first allowed secondary students to 'intern' there for free (where he would give them on-the-job ICT training), typically 'internships' would cost money in Rwanda. The second gave free lessons to the physically disabled and (non-adult) students. The third said 'someone can come and needs it [the lessons] seriously to start a small business' and so he gives them free lessons.

[13] Who has made caring for the disabled a priority and part of their post-1994 vision of a more inclusive state

disabled. Indeed, a common reason given by respondents for not teaching the disabled was 'we don't have the facilities' or 'I don't have the skill'[14], corroborating the first point.

However, this also means that intersectional marginalized groups may not be catered for. As discussed in 4.2.2, the poor are often limited to seeking category 1 suppliers or NGOs (which I will elaborate on later why this may also not be an option) but prospective disabled students, as just noted, may have to seek more expensive options. Hence, if a Rwandan is both poor and disabled (which might even be more likely than not since jobs are harder to find, and they have to pay for medical care), continuing education in ICT skills might be entirely inaccessible. That being said, suppliers may have special programs or scholarships or just make exceptions for such individuals. One supplier did specifically that.[15]

Overall, the data collected on this area is limited, especially as the *types* of physical disabilities were not fully broken down (interviewees were allowed to expand on their own, and only prompted once, see appendix A.2 for full interview questions, including on disabilities) but hints at problems that may need to be addressed.

4.2.3 Illiterate and Uneducated: 'If you can learn to ride a bike, you can learn computers.'
8 out of 16 respondents to the question of teaching illiterate students said they had or could, while the other 8 said they could not. Asked if they thought the inequality between the literate and illiterate was worsened by ICT (the so called digital divide described by Ginsburg, Sabatini, & Wagner (2000), some suggested that the 'real problem' was 'lack of education' (and hence exposure to ICT in schools). For example, one respondent said, 'you know if I got to the case of my neighbours, they use phones…the real lack is not going to school, there are some basics the students should have.' Another said, 'there is nothing between being literate and computer literacy…being mobile money users people know how to read numbers...we have a term, "BBC", born before computers (i.e. did not have exposure in school)'. This point is somewhat contradicted by the fact that many people say their students, even though educated, have low exposure to ICT,

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[14] Since smaller suppliers from category 1 often rely on one individual to be both the teacher and manager
[15] See footnote 11.

a point I address in 4.3.3. Others suggests the problem is that most illiterate themselves are not interested or unaware of the full potential in ICT. For example, one respondent said, 'if those people can't read or can't write, it may cause them to not even discover what's going on, what's new in ICT' while another said, 'that, I would take to individuals…majority, there are those who you talk to, they already given up…there are some who come and want to learn, people with self-drive is minimal, we have seen some students who say 'my English is not good, please I need this Cisco certification, but they are keen on learning'.

Many, like the interviewee quoted in the sub-header to this section, also explained how they could overcome challenges to learning ICT, thus implying that the inequality is surmountable and not getting worse. Some suggests mixing literate and illiterate people helps the latter learn from the former. For instance, one respondent said, 'these ones who can read are the first learners, those not able use symbols' while another said, 'for short courses, we used to teach skilled and unskilled (he meant literate and illiterate), we train them together'. One even suggested, 'there is a big gap, ICT has been introduced in different sectors…we have people who don't even know how to manipulate computers [yet] they have to give their report…there is no centres that can have both people who know how to use computers and those who don't (so the latter can learn from the former) …the only access is through mobile phone, so those that don't have skills don't have skills 100%, especially in rural environment'. In other words, the 'bubbles' between the literate and illiterate populations (more of the latter found in rural environments) was precisely causing the gap, a topic discussed in the next section 4.2.4.

Proficiency in English can also be considered a barrier for many (and is listed as a significant challenge, see 4.3.3). 15 out of 21 unique suppliers either taught in English or mainly in English with Kinyarwanda for explanation compared to 6 who taught in Kinyarwanda with English for technical terms or any language depending on the student (including other languages like French and Swahili). One interviewee said the problem was that even if you teach in Kinyarwanda, terms like 'routing' could not be translated easily, making some English necessary anyway. Another interviewee said their 'courses are partner based…they have to be proficient [in English], if you don't understand English, I won't allow you in my class.

Even if an individual can use English, learning is often handicapped if done in a secondary language. Recognizing this, one of DOT Rwanda's strategy to 'demonstrate the full value of the Internet' in its DAP program, attempts to provide 'digital literacy training to members of their own communities, in local languages and focusing on locally relevant digital content and services'. When asked what happened to the GoR's plan to translate essential software into Kinyarwanda, the interviewee from DOT Rwanda speculated that it had run out of funding as it took too long to translate before the software became obsolete.

Overall, the intersectional qualities between literacy, education, proficiency in English and computer literacy are acknowledged by suppliers but access to continuing education for ICT skills for such individuals remains a mixed bag; many believe the problems lie with the education system or the illiterate themselves.

4.2.4 Outside Kigali: Ruhengeri and Rural Areas

Ruhengeri is one of the 'secondary cities' the GoR has marked in its bid to decentralize government as vast differences between Kigali and other urban areas, as well as between urban areas and rural areas (which the majority of the population resides) still continue.

This study noted several differences between data from Kigali and Ruhengeri. Firstly, suppliers themselves were asked if they thought there were any differences in terms of ICT-related education, all of whom gave slightly different answers. 2 said prices were lower in Musanze, 1 of whom explained was because 'the money here is very low…hard to get good [good price from a client]', although the little amount of data the researcher collected did not show this. [16] 2 respondents also said there were more opportunities ('no big place', 'some devices you can't find here') to use ICT skills in Kigali (and hence get practice). Interestingly, 2 also said there was no difference, or that they did not know of any. The little amount of data collected also hinted at other noteworthy comparisons. All 6 suppliers in Musanze said they did or could teach illiterate students, yet all but 1 of the 6 also said they could not teach the physically disabled. The former could be the sheer result of the rate of illiteracy in each area. According to the EICV, the literacy rate for

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[16] The median was lower, but average price higher in Musanze. See appendix

those aged 15+ in Musanze district is 73.7%, significantly lower than all 3 districts that form Kigali district (88.4% Nyarugenge, 88.5% Gasabo, 90.5% Kicukiro). (NISR, 2014, p. 57) Suppliers in Ruhengeri may just be responding to the higher number of illiterate clients they get compared to Kigali. The reasons for the latter result (inability to teach disabled) remain varied and speculative.

As discussed in the scope and limitations of this study, the researcher did not physically visit rural areas of Rwanda. However, some insight was gained from some secondary data, and from the two NGOs, which do operate in certain rural areas. The EICV reports significantly higher computer literacy rates in urban (26%) compared to rural (4.3%) areas. (NISR, 2014, p. 46) This is possibly a result of low interest or appreciation of ICT's benefits. One supplier said, 'ICT is life, people are coming to our schools, etc. except people from the village, most of the people who come are from around town', which he elaborated further to mean low access and exposure to ICT in rural areas means people are unaware of its potential in the first place. The interviewee from DOT Rwanda said his organization recognized this early on and therefore adapted their DAP to address this issue. He said citizens like one farmer believed smartphones were only good for taking photos and music, but his organization showed this farmer apps (in Kinyarwanda) that displayed information on diseases and removed the need to consult under-supplied agronomists in the area.

Both interviewed NGOs also say basic infrastructure in rural areas is still lacking, hampering ICT adoption, corroborating Rubagiza, Were, & Sutherland (2011)'s observations that rural areas faced greater challenges in maintaining ICT infratructure. Both said they typically worked with schools (but also teach adults there) as they are equipped with the necessary infrastructure. DOT Rwanda said electricity problems in rural areas were 'very much…it's very challenging right now' while K-lab thinks improving access to reliable electricity in rural areas should be a priority: 'it is the foundation of everything…even water pumping requires it!' Overall then, the evidence from the study agrees with existing literature and remains a challenge to improving ICT education in rural areas. In the case of Rwanda, gaps are also still apparent between secondary cities like Ruhengeri and Kigali.

4.3 Quality and Challenges

4.3.1 Quality - General Findings

Recalling Sutherland et al. (2009)'s caution that ICT does not 'somehow automatically extend young people's capabilities…[since] the ways in which technology is taken up relates to both the social and cultural context of use as well as the design of the particular technology', this study tried to explore not just demand, supply and accessibility of ICT-related continuing education but also paint a rough picture of *how good it was.*

Some common approximations for the general quality of education are as follows. All suppliers gave a certificate at the end of their courses, although they varied in terms of recognition by society-at-large. In terms of student-teacher ratios, all but 1 supplier in category 1 gave training 1:1, those in category 2 ranged from 1:1 up to 25:1, while those in category 3 were all 15:1. In terms of student-computer ratios (where applicable), all except 1 supplier in category 1 allocated 1:1 during class (and even the exception was only 2:1). For category 2 and 3, all except 1 supplier allocated them 1:1 as well. No computers from any supplier was more than 5 years old, and all but 2 suppliers said their equipment were all fully functional. Regardless, all suppliers said they could perform self-repairs, had an in-house technician or else took less than a day to get equipment repaired.

All suppliers said students could come and practice outside of class, but given the number of computers the researcher observed in various places, this sometimes meant competing/sharing with students still having class at the time. Perhaps more telling is if the suppliers and students themselves taught the number of teachers and equipment was enough. For the former, a majority 15 responses from categories 1 to 3 were classified as just enough or at capacity[17], 5 were classified as fully sufficient[18] and 4 were classified as having insufficient teachers. 2 students' responses were classified as just enough, while the other 2 were classified as fully sufficient. The latter indicator (sufficiency of equipment and computers) fared slightly worse, with 12 responses classified as just enough or at capacity, 6 as fully sufficient, and 5 as insufficient. 3 student

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[17] For example, some specifically said 'enough, for now' or mentioned having more teachers prior and having to cover more than usual but this was manageable. For full list, see appendix C.2

[18] And implied they could even handle more students or the number of current students was lower than before while having the same number of staff. For full list, see appendix C.2

responses were classified as enough (and 2 had their own computer), the 1 other's response was classified as insufficient. Overall then, the general quality of continuing education for ICT skills can be deemed adequate at the moment, attention should perhaps be paid more to future constraints to improving it to be more than just adequate.

4.3.2 The Principles of Continuing (Adult) Education Revisited

Once again recalling the existing literature, the study found suppliers following the principles of continuing education by default or by design; regardless, this bodes well for the quality of ICT training. Firstly, as noted in 4.1.3, suppliers, especially those in category 1 are responding to what adult learners want to learn - this fulfils the principle of adults needing to know why they are learning, and the principle that what they are learning must have real-life application. One student responded that this was precisely why he was taking courses: 'to be stronger in [his] work'. The same student also said he always started the day by asking his teacher questions he encountered during work (as an IT manager) to which he always got a satisfactory answer, fulfilling the principle of adults bringing their own experience and so continuing education should take advantage of that. Finally, suppliers (again, from category 1 especially as noted in 4.1.2) fulfil the principle of adults wanting to take responsibility for their own decisions. They do so by acting as facilitators instead of teachers, and this is evidenced by the emphasis that many gave on practice. One supplier even went as far as to say, 'I will stand there, I will listen, I will sign, I get money, I get a card, I have never even seen a router, 4 years' in describing a typical university class (in contrast with their own classes).

Some interviews also revealed why educators should follow the principles of adult education, or risk losing their students' interests. One supplier described a unique challenge he encountered only in Rwanda (in contrast with other places where his organization operates) as 'a culture of "I know" …here is the only place where people want to learn more than the [class] outline; the students think 'they know', want to go beyond [the curriculum] … they "come with their own thing", has been frequent…it's like they didn't know what they are coming for.' In fact, this may be because the courses his organization offers, all fixed professional certification courses from international partners like MS and CCNA, do not respond to local contexts. Therefore, adults *do not know why*

they are studying certain material, do not see *real-life application*, and their prior *experiences* with ICT are not being taken into account. Hence, since this supplier's students are mostly sent by different organizations, the students are *ready* to take lessons only for the purpose of *moving on to the next developmental stage* - the certification to keep their job or get promoted, not the actual class content. This finding suggests that in fact, standardized professional courses like MCITP and Oracle may have to be adjusted and more flexible if they truly want adult students to gain something other than certificates.

Overall, it seems that while not purposely following the principles of continuing (adult) education, continuing (adult) educators for ICT skills in Rwanda, especially those in category 1 and 2, adhere to some of them by being responsive to the market. That being said, the lack of understanding of how andragogy works (and the awareness that the suppliers are continuing educators) may also be hampering the quality of some 'professional' courses.

4.3.3 Current Challenges: 'Local language is in Kinyarwanda and all our materials is in English.'
The researcher classified varied responses by suppliers of what challenges they face into different categories (see appendix C.2 for full list and definitions) The 3 most commonly cited[19] challenges by suppliers were:

1. (7/24) The language barrier. For example, one responded explained 'you know Africans, we do not speak very well English… [but] technology is always given in English.' This conforms with Nafukho, Amutabi, & Otunga (2005, p. 118) who wrote 'Africa is disadvantaged in that few of the African languages can be read by computers.'

2. (7/24) Inadequate education or prior exposure to ICT. For example, a respondent said, 'you know the problem, many of them is the first time they learn computers… I have to start from the beginning.' As mentioned earlier, many respondents believed schools did not teach students practice, obliging them to come train at private centres like theirs. This also contradicted a point respondents made about computer illiteracy really being about lack of education in 4.2.3.

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[19] Note that suppliers listed multiple challenges; the same supplier could have named all 3

3. (5/24) Lack of or too expensive computers, equipment and or software. This seemed to be especially problematic for places that taught courses in maintenance. One student respondent (taking maintenance) explicitly described this as the most challenging part of his course: 'we need tool box we don't have, we need printers we don't have…we don't have printers, they told us someone can buy for himself…the school they need a lot of things…it is difficult to get broken computers to fix…another one is projectors.'

These specific challenges often intertwined and were listed together by several suppliers, hinting at greater societal issues that these challenges originate from and that may warrant more attention.

The first can be considered challenges possibly arising from Rwanda's education system. Namely, they are the language barrier, low prior exposure to ICT and Rwanda's transition from French to English (which affects both students and teachers giving the courses, both of whom have to switch). In fact, one respondent listed all 3 challenges as interrelated: 'the problem which happen in Rwanda, for the student it's the first time they get the machine… and to study computers you have to study English, and because we transitioned from French…they don't know English, they don't know machines…'. 11 out of 24 listed at least one of these challenges.

The second are challenges more based on individual students: absenteeism, dropping out or even just personal difficulty with course content. One supplier in particular said about 65% of his students drop out, many right before finishing in order not to pay the final instalment (and get their certificate). 7 out of 24 listed at least one of these challenges.

The third are financing-related challenges which involve an inability to find sufficient funding and hence insufficient staff, equipment, teaching materials, land/space or just high taxes. 8 out of 24 listed at least one of these challenges.

Finally, the fourth group of challenges are related to national ICT infrastructure - electricity and internet - that is almost entirely out of the control of suppliers. Only 3 out of 24 listed these (as significant).

Overall, the major challenges that educators seem to face are related to the education system, not forgetting that it is itself still building up its capacity to teach ICT and English.

4.3.4 Future Challenges: 'My room is too small, to speak loudly is not authorized…'
Prompted to discuss potential future challenges, suppliers most commonly listed (classification of categories also in appendix C.2) the following 3:

1. (6/24) The rising cost of land, moving, or trying to find and pay for more space. (See sub-header quote for example) Unsurprisingly, 5 out of 6 who listed this challenge were from category 1.

2. (5/24) Future challenges are manageable, in other words, confidence in their ability to meet future challenges, foresees none, or seems them diminishing. For example, one supplier said, 'as you help people, students appreciate the service, and more people come…the challenge is accommodating them, but it's ok, no problem…just hire more.'

3. (5/24) The rapid/dynamic advancement of ICT (making the future uncertain) and associated obsoleting technology (unsure if they can keep pace with or afford new material, equipment, software, etc.).

Again, these specific future challenges were grouped under certain themes for more useful analysis. The first group involves supply-side costs (both variable and fixed): scaling up operations or specializing (into a school) to cope with future demands, finding and paying for space/land as mentioned, paying for future staff or lessons for self-teaching (so they can give lessons in the future), or paying for more equipment and teaching materials/software. 12 out of 24 interviewees responded with at least one of these as a future challenge they faced.

The second group is about increasing market saturation - increasing local competition and or the need for more self-advertising so they can stand out of the crowd. 6 out of 24 interviewees listed this as a future challenge.

Other future challenges were more separate and thus did not merit grouping together, they are as follows: they are manageable (5, as mentioned), overregulation of the market, bad policy or high taxation (2, government-related challenges), property or equipment security (2), the aforementioned rapid advance of ICT (5), and slow or unchanging Rwandan attitudes toward ICT (2, for example, one supplier said Rwandans were especially reluctant to pay for online classes, which his company is trying to move towards).

The researcher also classified suppliers' 'future supply' based on interview responses. Out of 19 unique responses, 8 were expanding with significant limitations, 9 were expanding normally, and 2 were contracting. The high number of suppliers who face significant limits to expanding their supply may be a sign that efforts need to be made to remove structural barriers constraining existing and even new suppliers. This is since an increase in demand (see 4.1.3) without a concurrent/subsequent increase in supply will cause the price of courses to rise[20], reducing accessibility to the poor.

Overall, the future supply of continuing education for ICT skills is set to increase, albeit with potentially significant constraints that could lead to inflation. These constraints vary widely, which limits the ability of the GoR or NGOs to address problems as a sector.

4.4 Conclusions

This research began with a simple question: how does an everyday working adult Rwandan go and learn new computer skills for a new computer age? This study attempted to explore the options

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[20] Of course, a rise in prices usually signals more firms to enter the market, thereby reducing the price again, but if there are high barriers to entry/supply-side costs or the supply curve is price-inelastic because of other constraints, prices will rise disproportionate to the increase in total output.

available for such an individual, whether they be a s*he* or *he*, poor or rich, educated or not, starting from scratch or looking to master, etc. - in other words, a Rwandan from any walk of life.

The study found that in general, prospective students could choose from 3 types of continuing educators - internet or cyber cafés, specialized, private schools or post-secondary institutions - all with its own advantages and disadvantages, even amongst themselves. One could choose the flexible, personal training conducted by the first group, or pay more to get international certification from the second and third group. More and more Rwandans across the board are doing both as the country fulfils its ICT-supported Vision 2020.

Yet not the options are open to all Rwandans all the same. Women and girls, while not technically barred from taking advanced courses, seem not to be taking them for other socio-cultural and psychological reasons. Meanwhile, the poor currently rely on the kindness and flexibility of some smaller suppliers and for others to keep their prices low, which may not be possible given supply-side challenges. The physically disabled may find their options either diminished or near non-existent, depending on the disability itself, unless they are willing to pay or are trained by NGOs. Access to the illiterate and or uneducated is also a mixed bag and in the first place, awareness of the importance and usefulness of ICT might be lacking in this group. Finally, while Ruhengeri was not significantly different from Kigali in many regards, rural areas seem to lag heavily due to poor basic infrastructure for ICT.

Besides demand, supply and accessibility, the quality of education provided was also briefly examined. Common indirect indicators like student-teacher ratios are all healthy, although many suppliers seem to only have *just enough*, which could be a sign of business efficiency or more likely, judging from interview responses, constraints to improving and growing their services. In fact, patterns of common future challenges were found, mainly surrounding funding associated fixed (like space and equipment) and variable costs (like staff hours and teaching material) to expanding supply. Needless to say, many ongoing challenges were also shared by interviewees, again revealing commonalities between suppliers - nearly half listed challenges that could be

associated with the current state of Rwanda's education system, be it poor background in English or computers.

In order to help that everyday working adult Rwandan then, efforts must be made by all stakeholders - the GoR, suppliers themselves, and even potential continuing (adult) students themselves in addressing some of these issues and continuing to improve the quality of Rwanda's continuing education for ICT skills. In fact, both NGOs said Rwanda was on the right track, led by a responsive government 'trying its best' to address issues they have observed and this study has repeated.

This study is by no means representative of Rwanda, involving a mere 30 interviews sampled from specific commercial centres just in Kigali and Ruhengeri, but it does provide a glimpse at the options, challenges and demand that's *out there*.

4.5 Recommendations for Further Study

As this research is the first such foray into understanding Rwanda's capacity for continuing education for ICT skills, many of its discussion points can and should be further looked in to. For example, more focused, in-depth studies could investigate access for the disabled according to different disabilities, and also include mental or learning disabilities, which this study did not explore. This is since ICT itself, as also mentioned in the literature, can be a tool to help the disabled bridge existing inequalities with the able-bodied. DOT Rwanda for example, has a blind trainer that uses a special computer and also teaches other blind citizens to take full advantage of ICT like that.

In addition, as stated in the limitations, time and resource restraints meant that not all relevant stakeholders were reached for interviews - future studies would certainly benefit from including their perspectives as well. These include government officials in MICT, WDA, MINEDUC, students and teachers in UR-CST, more current and graduated students, as well as employers who can provide insight on what ICT skills are in demand in the labour market. Distance learning, a

major component of continuing education in many parts of the world, is also a service in Rwanda not yet explored by this study or the existing literature.

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Appendix A Preliminary Materials

A.1 Operationalized Variables

<u>Demand & Supply</u>

(1) Local (to the training centre) and aggregate (total) demand - actual number of students in a year doing courses[21] related to:

    a. Introductory computer literacy (e.g. how to connect and switch on equipment, explore files, use internet, use basic word processing, graphics and music software)

    b. Application-specific training (e.g. using Microsoft Excel, photoshop)

    c. Coding and Machine language from basic to advanced skills (e.g. http, java, python, C++/#)

    d. Networking to other computers and machines (e.g. CISCO Certified Networking Academy, creating and accessing local, regional and global networks)

    e. Hardware specific courses (e.g. dismantling, cleaning, fixing and building computers, planning and setting-up a local area network for the office)

    f. Other specialized ICT-related courses (e.g. Human-Computer Interactions, artificial intelligence, cyber-security, etc.)

    g. Hybrid courses (combining multiple categories)

(2) Local (to the training centre) and aggregate (total) supply - maximum number of students in a year doing courses related to the courses listed in (1).

(3) Course fees

(4) Course times (length, frequency of sessions)

(5) Gender ratio of students

(6) General age of students

(7) Presence of physically or mentally impaired students

(8) Accessibility to the illiterate

(9) Percentage of primary, secondary and tertiary level students

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[21] Note: Applies to any operating system (e.g. Windows, Mac, Linux, Android, etc.) and in any language (typically Kinyarwanda, French or English)

(10) Expected future local and aggregate demand - Increasing, decreasing or similar number of future students per class

(11) Expected future local and aggregate supply - Increasing, decreasing, or similar number of future spots for students per class

Quality & Challenges

(12) Student-teacher ratio

(13) Presence of locally adapted/relevant course material (not, somewhat, very locally adapted/relevant course material)

(14) Perceived (student) relevance of courses to life

(15) Course language of instruction

(16) Student-computer ratio

(17) Student-equipment ratio (where relevant, for example, how many students per scanner)

(18) Percentage of operational computers/auxiliary equipment (i.e. number of broken, not fully functional and fully functional computers/auxiliary equipment)

(19) Length of time to restore/replace computers/equipment

(20) How updated are the software used (e.g. pre-2005, between 2000 and 2016, up-to-date for some, most or all the equipment)

(21) Frequency of uncontrollable problems (e.g. power outages)

(22) Graduation/dropout rate

(23) Perceived sufficiency of equipment (not at all, somewhat/adequate, fully sufficient)

(24) Perceived sufficiency of staff (not at all, somewhat/adequate, fully sufficient)

A.2 Interview Questions

Note: Prepared but unused interview questions for MICT for example, are not included.

- Demand and supply, includes current/estimated class capacities, accessibility and future growth/decline.

- Quality includes staff, equipment, certification, and course completion.

- Challenges include current and future obstacles as related to demand, supply and quality.

Demand & Supply - Internet Cafés or Specialized Private Schools

1. When did you start teaching?

a. When did the school start teaching ICT?

2. What courses do you teach?

   a. Do students get a certificate after finishing?

      i. Is the certificate recognized by the government, for example through WDA?

   b. What language do you teach in?

   c. Are these the same classes since you began teaching? (Are some of them newer?)

   d. Are there plans to introduce new courses?

3. Do you take in students with physical disabilities (like people who can't hear or can't see)?

   a. Are there disabilities you think are too difficult to teach?

   b. Do you teach people who can't read or write?

4. Are your students below 25 or above 25, in general?

5. How much do students pay for courses?

   a. Have there been students who started, but dropped out because they had no more money?

6. How long does each course last? (One month, two?)

   a. How long is one session? (One hour, two hours a day?)

   b. Have courses always been this long [cite period of time, length and number of sessions]?

   c. Do you think this is enough time?

   d. Are there plans to change them?

7. Do you have an intake? (Can a student walk-in tomorrow and start tomorrow?)

8. What is your average class size?

   a. Has the number of students been decreasing, increasing, or is about the same since you started?

9. What is your maximum class size? (How many can you teach at most, per day or per month?)

10. What is your minimum class size?

11. How often does the number of eligible students exceed [class size]? (Have you ever had so many people you had to tell them 'sorry, there are too many students now.'?)

    a. Is there a waitlist if this happens? (i.e. they are given priority if more slots are open in the current or next cycle)

    b. Do you think the number of students will increase, decrease, or remain the same in the future?

12. Do you receive a similar number of female and male applicants for each course?

    a. Do you think this is changing?

Quality & Challenges - Internet Cafés or Specialized Private Schools

13. What challenges do you face when teaching courses?

    a. Do you face issues like power outages (electricity going out) or internet problems; that you cannot control?

14. What is your graduation rate? (Do all students finish?)

    a. Are there students who skip class for any reason?

    b. How often does this happen?

15. How many teachers do you have?

    a. Do they all teach their own class? (e.g. you teach Office, another teaches…)

    b. Has it always been __ teachers teaching?

    c. Do you think the number of teachers is enough?

    d. Are you planning to hire more?

16. How many computers do you have per class?

    a. How new are the computers?

    b. Are any of them broken? How many?

    c. If something breaks down, how do you get it fixed?

    d. And how long does it usually take?

    e. Can students come and practice outside of class time?

17. What other equipment do you have?

    a. How new are the [equipment]?

    b. Are any of them broken or not fully functional? How many?

18. Do you think the number of computers you have is enough?

      a.   Are there plans to get any more computers?

      b.   Do you think the number of equipment (cite examples) you have is enough?

      c.   Are there plans to get any more equipment?

19. What challenges do you think you might face in the future?

      a.   Do you think the cost of equipment is increasing or decreasing?

      b.   Do you think the cost of teachers is increasing or decreasing?

20. Do you think you face competition for students (around here)?

      a.   What other centres in Kigali/Musanze do you know conduct ICT courses like this?

      b.   What do you think is the advantage of taking courses at places like this instead of at universities/big schools/small cyber cafés?

21. How do you think continuing education [explain] related to ICT will change in the future?

      a.   Research in other countries shows that sometimes, there is gap between people who can use ICT and those who cannot because those who can use it usually are educated and can read and write while people who cannot use it are also not educated and cannot read and write. Do you think this gap is getting better or worse in Rwanda?

      b.   Do you think this problem is being addressed?

22. (Ruhengeri/Musanze only) Do you think there is a difference in terms of ICT education between here and Kigali?

      a.   What are they?

Demand & Supply - Post-Secondary Institutions

These places typically offer both the regular undergraduate program as well as short courses; all questions were repeated for each program unless stated otherwise.

1. Tell me about what undergraduate programs you have (and what short courses you teach, if relevant).

      a.   Do students get a certificate when they finish? (Only short courses)?

      b.   What language do you teach in?

    c. Is there a requirement to join? Are these the same classes since you began teaching? (Are some of them newer?)

    d. Are there plans to introduce new courses?

2. Do you teach students who are physically disabled (those who can't see, can't hear)?

    a. Do you teach students who can't read or write?

3. Are your students below 25 or above 25, in general?

    a. Does your undergraduate program have part-time students (i.e. those who are also working while studying)?

4. How much do students pay for courses?

    a. Have there been students who started but dropped out because they had no more money?

5. How long does each course last? (One month, two months?)

    a. How long is one session? (One hour, two hours per day?)

    b. Do you think this is enough time?

    c. Are there plans to change [the time]?

6. Do you have an intake? (e.g. one class starts every two months or can students start anytime?)

7. What is your average class size?

    a. Has the number of students been increasing, decreasing or is about the same since you started?

8. What is your maximum class size? (How many can you teach at most, per day or per month?)

    a. Has it changed in the past?

    b. Will it change in the future?

9. What is your minimum class size?

10. How often does the number of students exceed [class size]? (i.e. you had to tell students 'sorry, there are too many right now')

    a. Is there a waitlist if this happens? (i.e. they are given priority if more slots are open in the current or next cycle)

       b. Do you think the number of students will increase, decrease, or remain the same in the future?

11. Do you receive a similar number of female and male applicants for each course?

       a. Do you think this is changing?

Quality & Challenges - Post-Secondary Institutions

12. What challenges do you face when teaching courses?

       a. Do you face issues like power outages (electricity going out) or internet problems; that you cannot control?

13. What is your graduation rate? (Do all students finish?)

       a. Are there students who skip class for any reason?

       b. How often does this happen?

14. How many teachers do you have?

       a. Do they each teach their own class (also ask for own subject)?

       b. Has it always been ___ teachers since you started?

       c. Do you think the number of teachers is enough?

       d. Are you planning to hire more?

15. How many computers do you have per class?

       a. How new are the computers?

       b. Are any of them broke? How many?

       c. If something breaks down, how do you get it fixed?

       d. And how long does it usually take?

       e. Can students come and practice outside of class time?

16. What other equipment do you have? (Ask specifically for the course if applicable)

       a. How new are the [equipment]?

       b. Are any of them broken? How many?

       c. If something breaks down, how do you get it fixed?

       d. And how long does it usually take?

17. Do you think the number of computers you have is enough?

       a. Do you think the amount of [equipment] you have is enough?

       b. Are there plans to get any more computers?

c.   Are there plans to get any more equipment?

18. What challenges do you think you might face in the future?

   a.   Do you think the cost of equipment is increasing or decreasing?

   b.   Do you think the cost of teachers is increasing or decreasing?

19. What other places in Kigali/Musanze do you know conduct ICT courses like this? (Unless asked earlier)

   a.   What do you think is the advantage of taking courses (either undergraduate or short courses) here rather than at small private schools or cyber cafés?

20. How do you think adult education related to ICT will change in the future?

   a.   Research in other countries shows that sometimes, there is gap between people who can use ICT and those who cannot because those who can use it usually are educated and can read and write while people who cannot use it are also not educated and cannot read and write. Do you think this gap is getting better or worse in Rwanda?

   b.   Do you think this problem is being addressed?

21. (Ruhengeri/Musanze only) Do you think there is a difference in terms of ICT education between here and Kigali?

   a.   What are they?

<u>Demand & Supply - Current Students</u>

1.   What courses are you taking?

   a.   What languages are they in?

   b.   Do you prefer the courses be taught in a different language? (If there was a course in ___ would you take it instead of this?)

2.   Did you take courses here before?

   a.   Did you take ICT-related courses elsewhere before?

   b.   Tell me about your educational background, especially any ICT-related experiences

3.   Do you think course fees/prices are good or too high?

   a.   Have you had any difficulty getting money to pay for this?

4.   Do you think the number of sessions a week is too little, alright or too much?

      a. Do you think the amount of work you have to do (for courses) is too little, alright or too much?

Quality & Challenges - Current Students

5. What's the most difficult thing about this course?

      a. What's the easiest thing about this course?

6. Why did you decide to take these courses?

7. Are your classes too big, too small or about right?

      a. Do you think there is enough working computers and other equipment in class?

8. Are your teachers able to answer all your questions in class?

9. Do teachers try to make course material relevant to your real life?

      a. Can you apply the things you learn in class to real life? (Ask for examples)

10. Do you have computers to practice with outside of class time?

11. Do you think you might take more courses in the future?

      a. Do you wish the time the class is held was different?

      b. Are there lessons/skills/courses you wished they would teach but currently don't?

12. Research in other countries shows that sometimes, there is gap between people who can use ICT and those who cannot because those who can use it usually are educated and can read and write while people who cannot use it are also not educated and cannot read and write. Do you think this gap is getting better or worse in Rwanda?

      a. Do you think this problem is being addressed?

NGO

As the different NGOs had vastly different mandates, the following section was specific questions to different NGOs, and the interviews were also more unstructured and included additional questions/follow-ups to each topic.

DOT Rwanda

1. How big, do you think the *digital divide* (they have used this term themselves), meaning the growing inequality between people who can use ICT and those who cannot, is in Rwanda?

    a. What are some ways you're trying to address this issue?

    b. What are some ways other organizations are trying to address this issue?

    c. Do you think the divide is getting better or worse?

2. In terms of ICT education in (formal) schooling (say for universal-9), what do you think the government is doing well?

    a. What challenges do you think the government needs to focus on?

3. Tell me about your digital literacy programs.

    a. What is the goal of your digital literacy programs?

    b. How well do you think these goals were achieved?

    c. What are the main obstacles to achieving these goals?

    d. Are they taught in Kinyarwanda, French or English?

    e. Who exactly is your target audience?

4. How long do your programs last?

5. What is the gender ratio of your participants?

6. What is the general age of your participants?

7. Do you target physically impaired students?

    a. What about students with learning disabilities?

8. Your programs target the illiterate, do you think there is sufficient attention being paid to the literate without ICT skills?

9. Do you feel you have enough resources to implement your program effectively?

    a. Are there parts of Rwanda you are still trying to reach?

    b. How receptive/enthusiastic are participants to your program at first?

    c. Do they understand the importance and usefulness of the skills you are teaching right from the beginning?

10. What equipment do you use to teach them?

    d. Do you think it is enough?

    e. How do you get them fixed or replaced if they break down, especially outside the city?

11. What are your long-term plans?

K-Lab

1. K-Lab is an open tech hub but also 'hosts events, workshops, bootcamp, hackathons and networking session', could you tell me about some of these programs?
    a. Do you get a certificate after finishing? (Is it recognized by the government?)
    b. How do people get to know about your programs?
    c. Tell me about some of your success stories from any of your programs.
    d. What are some challenges you've seen or faced so that everyone is successful?
    e. Are these programs free to all? (So anyone can join?)
    f. Most of your programs seem targeted at people who already have basic ICT skills, do you conduct any introductory training for people who have little to no experience with ICT?
        i. If yes, how do people apply for such programs?
        ii. What languages are they taught/conducted in?
        iii. Do they have to be literate?
        iv. If not, who do you think should conduct such training for people who may have dropped out of school early, or had little access to ICT in their schools?
    g. How do you make sure your programs are relevant/fit locally here in Rwanda?
2. Do you notice a gender gap in terms of the people who come here? (Ask in terms of numbers, and if they do different things)
3. What is the general age of people who come here and participate in your programs?
    a. How educated are the people who come here and participate in your programs?
4. Do you teach the physically disabled?
5. Are there programs that target or assist people who may not have the ability to come to K-Lab here in Kacyiru?
6. Where does funding for K-lab primarily come from?
    a. What are your facilities like?
        i. How frequently do you update your hardware and software?
        ii. How do you usually fix or replace broken equipment? (Ask about time also)

        iii. Do you think current facilities are sufficient to cope with the number of people who come to K-lab?

    b. How many staff members do you have?

        i. Do you think the number of staff, including mentors, you have right now is sufficient to cope with the number of people who come to K-lab?

7. Do you think K-lab caters equally to people who speak Kinyarwanda, English and French respectively?

    a. Can you use your facilities in all 3 languages?

    b. Do you think there are enough staff who speak in the 3 languages?

8. In terms of ICT education, what do you think Rwanda does well in?

    a. What issues do you think Rwanda still needs to address?

    b. Do you think there is a growing inequality between people who can use ICT and those who cannot in Rwanda?

9. Over the years K-Lab has operated here in Kigali, have you seen an increase, decrease, or about the same number of people who come to K-Lab and or participate in your programs?

10. How often do you face 'uncontrollable' problems like power outages or internet connectivity issues?

    a. What do you think the government does well in terms of ICT-related infrastructure?

    b. What do you think the government might need to improve on more?

11. Are you expecting an increase, decrease, or about the same number of people in the future?

    a. What are your future plans in terms of programming and physical infrastructure?

A.3 Observation Guide

<u>Building/Facilities Tour</u>

- Cleanliness and Clutter of equipment

- Number of available/used computers, people sharing

- General age of users

- Accessibility to physically disabled

- Usage requirements/rules for general use of equipment visible/explained

- Number of non-functioning computers

- Internet connectivity (if possible)

- Other amenities like toilets, food and drink areas (same for both genders?)

Appendix B List of Interviewees

In this paper, references may be made to different interviews for specific quotes or unique points. The researcher labeled interviews with prefix **A** when the source was a private training centre (i.e. places that do not have a full-time student body doing degree or diploma programs) and includes teachers, managers and students. Interviews were labeled with prefix **B** when the source was a large institution (typically post-secondary) that offers degree or diploma programs for a full-time student body. Interviews were labeled with prefix **C** when the source was an NGO. Interviews with suffix **G** were group interviews, while those with suffix **M** were conducted in Ruhengeri (or Musanze). In the analysis of the data, these groups were **recategorized** to discuss a finding on the different niches different places fulfil that the researcher did not anticipate prior to conducting interviews and filling his field journal.

ID	Occupation	Gender	Age	Date of Interview
A01	Teacher	Male	24	2 November 2017
A02	Teacher	Male	25	3 November 2017
A03	Teacher	Female	24	3 November 2017
A04	Teacher	Male	28	3 November 2017
A05	Journalist, part-time Student	Male	25	3 November 2017
A06	Student	Male	20	3 November 2017
A07	School Manager	Male	32	3 November 2017
A08	Manager, Teacher	Male	35	6 November 2017
A09	Manager, Teacher, Repairman	Male	32	6 November 2017
A10	Manager, Teacher	Male	32	6 November 2017
A11	Manager	Male	31	8 November 2017
A12	Manager, Teacher	Male	43	8 November 2017
A13	School Manager	Male	34	9 November 2017
A14G	Student	Male	29	9 November 2017
A15G	IT Manager, part-time Student	Male	33	9 November 2017
A16G	Teacher	Male	23	9 November 2017
A17G	Teacher	Male	33	9 November 2017
C18	General Manager	Male	32	9 November 2017
B19	Professor	Male	33	9 November 2017
A20	Teacher	Female	29	10 November 2017
A21M	Assistant Manager, Teacher	Male	21	14 November 2017
A22M	Manager	Male	27	14 November 2017
A23M	Co-Manager, Teacher, Repairman	Male	21	14 November 2017
A24M	Teacher	Male	28	14 November 2017
A25M	Manager, Teacher	Female	24	14 November 2017

B26M	Teacher, Department Head	Male	30	14 November 2017
A27	Manager	Male	31	16 November 2017
A28	Department Head	Male	34	16 November 2017
B29	Professor	Male	42	16 November 2017
C30	IT Manager	Male	-	17 November 2017

Appendix C Data

C.1 Demand & Supply Data

<u>Definitions of Variables</u>

Local Demand	Local Supply	Courses Offered (refer to classification below)	Course Fees (Basics)
Self-reported average # of students enrolled at one time; if per class value given, estimated using # of students per class multiplied by total # of (different) classes ongoing concurrently	Self-reported maximum number of students per month, see above for estimation (e.g. 8stu/sesh x (3sesh/wkday+2sesh/ wkend) = 40stu max enrolled	For classes that cover multiple types of content, all types listed	Courses are not identical in nature, but basic material is the most universally comparable; total in RWF, if in USD, converted using 850RWF:1USD
Course Fees (Range)	**Course hours/day**	**Course Duration**	**% Female Students**
Lowest to highest priced (total), again, the variation of content and certification not taken into consideration, see above for total and exchange	If multiple options available, both listed	In weeks	Self-reported, suffix for Will Increase (I), remain the same (R), Will Decrease (D) or Unsure (U)
% Over 25 years old	**Teaching physically disabled?**	**Teaching illiterate?**	**Education Level**
Self-reported, if no estimate given, value given	Categorized as Yes (Y), No but Can (C), and No and can't (N), with suffix 'D' if depends on disability	Categorized as Yes (Y), No but Can (C), and No and can't (N)	Limited direct data, inferred from qualities like proficiency in English (E), background in ICT (B) or entry requirements/ self-reported education level (U, P, S for Uneducated, Primary, Secondary graduate respectively)

Future Demand	Future Supply		
Increasing (N), Remain the Same (R) or Decreasing (D)	Normal (N), i.e.manageable expansion, Limited (L), i.e. expanding but mentions significant obstacles, or Contracting (C), i.e. possible scaling down; includes future types of courses (refer to list, use 7 for 'depending')		

Classification of Courses

Suffixes P and S means courses award graduates with internationally recognized, 'professional' certification and locally, 'societally' recognized certification respectively. Examples of former: Computing Technology Industry Association (CompTIA) Basics, A+, (European) International Computer Driving License (ICDL), etc. Examples of latter: WDA accreditation, or certificates from well-known institutions or organizations like ULK or K-lab.

1(P, S)	2(S)	3(S)	4(P, S)
Basics: MS Office Apps and Using the Internet incl. International Computer Driving License (ICDL)	Application-Specific Training: SAGE Graphic Design, ArchiCAD, etc.	Coding Languages, basic to advancced: Software Development, Web Design, etc.	Networking: Setup, trouble-shooting, incl. Cisco Certified Network Academy (CCNA)
5(S)	**6(P)**	**7(P,S)**	
Hardware: Maintenance, Repairing, ICT Devices etc.	Operating Systems and Servers: Oracle, Linux, incl. Microsoft-Certified IT Professional (MCITP)	Other ICT-Related Specialist Courses: Videography & Editing, Music, EC-Council's Certified Ethical Hacker (CEH)	

Tabled Variables

'No Data' is input in the following scenarios:

a) The interviewee could not or refused to answer or requested the information be withheld.

b) The researcher deems the information unreliable because the interviewee gave a vague answer, seemed like she or he did not understand the question properly or the researcher felt like in explaining what certain concepts meant, begged the question too much for the interviewee to give an independent answer.

'Repeat' is input when multiple interviewees were representatives of the same organization and the collected data was a 'fact' of the organization like % of female of students rather than an 'opinion' of an individual from that organization like whether future demand was increasing. Hence, only one answer was needed from one 'unique' supplier

Ref. No. / Variable	Local Demand	Local Supply	Courses Offered (refer to list)	Course Fees (Basics)	Course Fees (Range) in RWF	Course hours/day (days)	Course Duration (weeks)	% Female (I/R/D/U)	% Over 25 years old	Teaching physically disabled?	Teaching illiterate?	Education Level	Future Demand	Future Supply
Internet or Cyber Cafés (Managers, Teachers)														
A01	No Data	No Data	1	40000	40000	2(M-F)	4	50R	30	N	No Data	U	No Data	No Data
A08	No Data	15	1,2,5	~35000	15000	3(M-F)	Depends	More F	Seasonal	Y	C	S	I	L
A09	4+	No Data	1,5	20000	free - 20000	2(M-F)	12	50	Seasonal	YD	N	S	R	L, 5
A10	6	10	1,2	Negotiable	Negotiable	1.5(M-F)	Depends	0	Most Under	CD	No Data	S	I	L, 2
A11	15	No Data	1,3,5,6	10000	10000 - 15000	2(2x/wk)	4 to 8	50	24	Y	No Data	U	I	L, 4P, 6P
A12	3	3+	1,2,4,5	60000	60000	2(M-F)	4	66	Most Under	YD	No Data	S	I	N, 2, 3
A27	12	No Data	1,2,5,7	20000	20000	3(M-F)	4	65R	~8	N	N	No Data	I	N
A21M	10	10	1,3	10000	10000-20000	2(M-Su)	4	65	40	N	C	S	I	L, 4P
A22M	5	7	1	15000	15000	2(M-F)	4	70	80	N	Y	U	D	C, 2, 3
A23M	1	3	5	200000	200000	8(M-Su)	16	More M	20	N	Y	No Data	No Data	L, 3, get S
A25M	5	5	1	Negotiable	Negotiable	3	24	More F	Most Above	N	Y	No Data	D	No Data
Specialized, Private Schools (Managers, Teachers)														
A02	42	56+	1,2,3,4,5	110000	110000-455000	2(M-F), 3.5(wkend)	12	More F	Most Under	YD	N	No Data	I	N, 7
A03	30	72	1,2,3,4,5	50000	15000-100000	2	1 to 4	More F	Mixed	YD	Y	U	D	C
A04	~35	35+	2,3,7(all S)	No Data	127500-170000	2(M-F), 3.5(wkend)	12	Repeat	30	YD	N	E, B	I	Repeat
A07	Repeat	Repeat	Repeat	Repeat	Flexible	Repeat	Repeat	25R	Repeat	Repeat	Repeat	Repeat	I	L
A13	72	540	2,3,5,7(all S)	No Data	150000-370000	Repeat	24	~6.6	41	YD	N	S	I	L, 7
A16G	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	I	Repeat
A17G	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	I	Repeat
A20	No Data	300+	1,2,3,4P,6P,7P (all S)	60000	60000-800000	2(M-F), 6(wkend)	4 to 16	More M	20	YD	N	U	I	N, 7
A28	300	~540	1,4,6,7 (all SP)	510000	510000-2550000	4 or 8 (both M-F)	1 to 6	~22I	Close to 100	C	N	E	I	N
A24M	Seasonal	50	1,2 (all S)	15000	15000-100000+	1.5(M-F), ?(wkend)	4 to 12	50 (usually), More F (seasonal)	Mixed	YD	C	S	I	N
Post-Secondary Institutions (Department Staff, Teachers)														
B19	240+36	240+150	3S,4PS,6PS	No Data	4000000, 510000-1020000	4(M-Th), 8(Su)	6 to 16	40I and 2I	No Data	Y	N	S or E, B	No Data	N
B29	15	20	3S,4PS,5S	No Data	1170000, 10000-20000	3(M-F)	8 to 12	50	Mixed	C	No Data	S	R	N, 3P,6S
B26M	15	15	4,5 (all S)	No Data	10000	5(M-F)	12+12(intern)	35I	Mixed	Y	Y	Mixed	I	N, 3S
Total (3)	15-36	15-150			10000-1020000	3-5 wkday	6 to 24	Mixed or lower	Mixed	2 Y, 1 C	1 Y, 1 N; 1 no data			
Students (current)														
A05				High but worth some difficulty		Not enough	Not enough					S	When he gets $, 7	
A06				Fine, no difficulty		Somewhat little	Somewhat little					S	Definitely, 3	
A14G				Fine, some difficulty		Not enough	Too little					E, S	Depends on $, 2,3	
A15G				Worth it, some difficulty		Ok	Too little					B, S	Depends on $, 3	
ICT Education Related NGOs														
C18	No Data	No Data	2,3,6,7 (all S)	Free	Free	Depends	Depends	37I	Most Under	Y	Y	Varies	I	N
C30	12500	12500	1	Free	Free	2	4	50	20	Y	Y	U	I	N

C.2 Quality & Challenges Data

Definitions of Variables

Student-Teacher Ratio	Student-Computer Ratio	Age of computers used for teaching	%Broken (Computers)
Self-reported average number of students per teacher	Self-reported number of students per computer used for teaching	Tilda (~) if estimate	Out of total used for teaching
Method of Repair	**Language used**	**Graduation Rate**	**Perceived Relevance of content (Students)**
Instructor can self-fix (S), In-house technician (T), if using outside source, time to repair in days	Primarily English with Kinyarwanda to explain if needed (EK), Depends on student, no default (D), Kinyarwanda with English for technical words (KE) or just English (E)	Self-reported %	Relevant (R), Unsure (U), Irrelevant (I), Somewhat Relevant (S)
Perceived Sufficiency of computers and equipment	**Perceived Sufficiency of staff**	**Challenges (refer to list)**	**Future Challenges (refer to list)**
Sufficient (S), at capacity or 'enough for now' (E) or Insufficient (I)	Sufficient (S), at capacity or 'enough for now' (E) or Insufficient (I)	Many related challenges (for example, lack of money and expensive equipment), thus main category used with sub-categories	Many overlaps with challenges, see above remarks

Classification of Challenges

1a	1b	1c	2a	
Inadequate education or prior exposure to ICT or electronics	Language Barrier: Students only speak Kinyarwanda while material is in English/French	Transition from French to English (affects students but teachers as well)	Based on individual students	
2b	**2c**	**3a**	**3b**	
Student absenteeism, dropping out, busy schedules, no money	Content Difficulty	Financial/Funding difficulties, high taxes	Lack of Infrastructure, Space or high rent	
3c	**3d**	**3e**	**4a**	**4b**
Lack of/expensive trainers	Lack of/expensive 'materials' for teaching; includes curriculum, worksheets, training software	Lack of/expensive Computers, Equipment, Software	Electricity Issues	Lack of/ Problematic Internet

Classification of Future Challenges

1a	1b	1c	1d
Scaling up operations/ specializing further/coping with future demand	Rising cost of infrastructure/land or finding and moving to new spaces/locations	Rising cost of staff/self-teaching	Rising cost of equipment and teaching materials/software
2a	**2b**	**3**	**4**
Decreasing local demand/increasing local competition (suppliers)	Marketing	Manageable (does not see significant future challenges)	Overregulation/high taxes/bad policy
5	**6**	**7**	**8**
Property/Equipment security	Dynamic/rapid ICT advancement or technological obsoletion	Slow/unchanging Rwandan mentality towards ICT (e.g. reluctance to pay for online courses)	Financing future classes (students)

Tabled Variables

'No Data' is input in the following scenarios:

a) The interviewee could not or refused to answer or requested the information be withheld.

b) The researcher deems the information unreliable because the interviewee gave a vague answer, seemed like she or he did not understand the question properly or the researcher felt like in explaining what certain concepts meant, begged the question too much for the interviewee to give an independent answer.

'Repeat' is input when multiple interviewees were representatives of the same organization and the collected data was a 'fact' of the organization like student-teacher ratio rather than an 'opinion' of an individual from that organization like the perceived sufficiency of computers and equipment. Hence, only one answer was needed from one 'unique' supplier.

Ref. No. / Variable	Student-Teacher Ratio	Student-Computer Ratio	Age of computers used for teaching (in years)	%Broken (Computers)	Method of Repair	Language used	Graduation Rate (%)	Perceived Relevance of content (Students)	Perceived Sufficiency of computers and equipment	Perceived Sufficency of staff	Challenges (refer to list)	Future Challenges (refer to list)
Internet or Cyber Cafés (Managers, Teachers)												
A01	No Data	No Data	No Data	0	<1 Day	D	85		No Data	E	1b	No Data
A08	5 to 3	1 to 1	5	~20	S	EK	35		E	I	2b	1a
A09	1 to 1	1 to 1	'Mixed old, new'	0	S	KE	100		S	E	2c,4a	1c,1d
A10	1 to 1	1 to 1	<1	0	S	EK	100		I	E	1a,1b	1b
A11	1 to 1	1 to 1	No Data	0	S	EK	100		E	E	1a,1b,1c	1b,4,5
A12	1 to 1	1 to 1	No Data	0	S	EK	100		E	E	1a	2b, 3
A21M	1 to 1	1 to 1	1	0	S	E	72		S	E	1a,2a,3d	1b,6,7
A22M	1 to 1	~2 to 1	3	0	T	E	~100		I	S	3e	1d,2a,6
A23M	1 to 1	No Data	No Data	No Data	S	KE	95		I	S	3e	1b
A25M	1 to 1	1 to 1	No Data	No Data	S	EK	100		E	E	4b	3
A27	1 to 1	1 to 1	'Old'	0	T	KE	~85		E	E	3b,3d	1b,2b
Specialized, Private Schools (Managers, Teachers)												
A02	~6 to 1	1 to 1	No Data	0	<1 Day	EK	90		E	E	1b, 1c	1d
A03	1 to 1	1 to 1	No Data	33	<1 Day	D	90		S	S	2a	2a
A04	2-20 to 1	3 to 1	No Data	0	<1 Day	KE	90		I	I	3b,3c,3d,3e	1d,2a,5
A07	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat	Repeat		E	S	No Data	4
A13	Repeat	Pool, Shifts	No Data	No Data	T	E	Repeat		E	I	3a,3b,3c,4b	1a,1b
A16G	6 to 1	1 to 1	No Data	0	Repeat	Repeat	~100		E	E	1a	6
A17G	7 to 1	1 to 1	No Data	0	Repeat	Repeat	~100		E	E	1a	6
A20	1-25 to 1	1 to 1	mostly 1	No Data	Repeat	EK	~100		S	S	1a, 1b	2a
A24M	No Data	1 to 1	3		S, T	EK	100		E	E	2a	1a,3
A28	15 to 1	1 to 1	5	0	T	E	100		S	E	1b,2a	7
Post-Secondary Institutions (Department Staff, Teachers)												
B19	10-15 to 1, undergrad up to 80 to 1	1 to 1 (class); 5 to 1, pool	2	0	T	E	~70 (undergrad), 100		I	I	3e	6
B29	15 to 1	1 to 1	2	0	No Data	E	100		S	E	1b	3
B26M	15 to 1	No Data	No Data	0	T	E	100		E	E	2b,3a,3d,3e	3
Students (current)												
A05	Fine	Own				Fine		S	E	E	2a	None
A06	Fine	Own				Fine		R	E	S	2a	None
A14G	Fine	No Data				Fine		I	I	E	3e	8
A15G	Fine	Pool, Shifts				Prefers French		R	E	S	2a	8
ICT Education Related NGOs												
C18	No Data	No Data	No Data	No Data	No Data	D	No Data		I	S	2c, 3b	3
C30	No Data	No Data	No Data	No Data	No Data	K	No Data		E	E	1a,2a,3e,4a	1a

C.3 Other Data Collected

Classification of Advantages

Set	Advantage	Ref No.	n
A	Practice	A02, A03, A04, A09, A20, A22M, A23M, A25M, B26M, A28	10
B	'Practical Skills', Specialization	A02, A04, A07, A08, A10, A13, A20, A21M, A23M, A27	10
C	'Too much theory in schools'	A02, A07, A08, A11, 22M, 25M	6
D	Flexibility (time or payment structure), personalization	A04, A08, A20, A21M, A24M	5
E	Short course, short timing	A13, A24M, A27	3
F	Certification, Partnership	B19, A28, B29	3
G	Low Prices	A27, B29	2
A U B U C	Practicality vs Schools	A02, A03, A04, A07, A08, A09, A10, A11, A13, A20, A21M, A22M, A23M, A24M, A25M, B26M, A27, A28	18
B U F	Employability	A02, A04, A07, A08, A10, A13, B19, A20, A21M, A23M, A27, A28, B29	13
D U E U G	Low Cost to Time and Money	A04, A08, A13, A20, A21M, A24M, A27, B29	8
Universal			23