

FabLab In The Nigerian Innovation Space

By Babasile Daniel Oladele-Emmanuel

Summary of GreenLab Microfactory's first workshop in cooperation with the OpenLab Hamburg, Laboratorium Fertigungstechnik (LaFT), and Helmut Schmidt University

April 20 – 22, 2017

Funding

This project was solely funded by the Helmut Schmidt University, Hamburg, Germany.



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<u>Take Away</u>

After 3 days, younger participants were able to learn and explain 3D technology, AutoCAD and Solar panel technology Participants between the ages 8 - 13 were able to grasp the concept of 3D printing, the difference compared to Traditional manufacturing, understand how FreeCAD functions and successfully explain their learnings to high school students between the ages 14 - 16 despite being newly introduced to the concept.

People in developing countries have a hunger for practical knowledge with theoretical knowledge. The combination of both enabled participants to understand, apply and develop solutions to their problems. This suggests classroom based learning without practical experience may hinder the successfulness of individuals in a country such as Nigeria.

The older participants were able to learn and apply knowledge successfully construction a functioning Solar Panel

GreenLab is a social innovation promoting the provision of novel solutions to Nigeria's innovation sphere that are more effective, efficient, sustainable and just than current solutions

A population over 200 million looking for new and consistently stable returns through transformation of current operations.

Projects to improve innovation have been established in the country such as coworking spaces When brought together to work on topics that improved the social situation of a person's life for example developing a means of generating electricity for one's self utilisiing abundant resources such as the sun, interest in innovation among individuals increased dramatically with increased likelihood of individuals moving on to create something useful for themselves and others hence becoming prosumers (Producers & Consumers)

<u>Relevance</u>

What you will Learn

In this summary you will discover the potential innovation growth found in the Nigerian hemisphere through the investment and focus on the number one renewable and most useful resource "Human Capital". GreenLab endeavors to be a social innovation in the Nigerian innovation sphere providing novel solutions to Nigeria's Social Problems that are more effective, efficient, sustainable and just than current solutions. Ajumose, name of the first free 3D printer and Solar panel construction workshop coordinated in Ibadan, in the Yoruba language means Collaboration, teamwork, co-working or cooperation. This report shows the potential available when cultivating early the grassroots of the country, the young generation.

Introduction

Nigeria, an oil producing nation, has a population of over 200 million people, today still heavily reliant on importation rather than exportation. Oil is the nation's greatest export, however with fluctuating prices according to supply and demand, corruption, high importation prices, mediocre wages and a future set to decrease the usage of oil globally in leading economies, Nigeria has a great challenge ahead of them being the need to generate income that guarantees consistent or at least stable returns, through the transformation from a country reliant heavily on foreigners to a country self-sustaining and benefiting foreigners.

This mindset has already been picked up by many Nigerians who feel in one and accord that operations in Nigeria need to change if the country is to remain relevant in the future. As a result many projects have been established (such as co-working spaces, government funded and privately spurred innovation incubator, M.A.D initiatives and several other social innovation initiatives) aiming to solve some of the social issues found in Nigeria. In order to achieve such aspirations, there is a need to encourage the growth of ideas, trust,

Innovation is critical to providing advances in such crucial human endeavors such as medicine, agriculture and education.

GreenLab a digital Microfactory aims to encourage the utilization of dormant, recycled and abundant eco-friendly materials and resources in rural areas, and to encourage innovation and sustainable development.

Valuing the importance of "Human Capital"

Ajumose: first free 3D printer and Solar Panel construction workshop coordinated in Ibadan.

Disruption to the traditional ways of manufacturing

Creating Prosumers (Consumers who are Producers) DIY & DIWO

Engaging the young while there is the opportunity collaboration and cooperation between Nigerians, as these attributes help promote them to a point of self-sustainability and order in life.

Highlighting the words of Schillings (2008) "Innovation is a beautiful thing. It is a force with both aesthetic and pragmatic appeal: It unleashes our creative spirit, opening our minds to hitherto undreamed of possibilities, while simultaneously accelerating economic growth and providing advances in such crucial human endeavors such as medicine, agriculture and education."

The GreenLab Microfactory

With this in mind, the GreenLab Microfactory was established to help solve head on the issues seen in Nigeria. GreenLab Microfactory is a digital fabrication laboratory (FabLab) with keen focus on fostering social innovation/engineering/entrepreneurship in Nigeria. GreenLab aims to encourage the utilization of dormant, recycled and abundant eco-friendly materials and resources in rural areas, and to encourage innovation and sustainable development. The FabLab looks to utilize and further develop the one resource abundantly available and key to the successfulness of change in Nigeria 'Human Capital' through social innovation initiatives.

Social innovation is a novel solution to a social problem that is more effective, efficient, sustainable or just, than current solutions. The value created accrues primarily to society rather than to private individuals. It is through this desire that GreenLab, a social innovation, created its first event Ajumose.

<u>Ajumose</u>

Ajumose was the perfect beginning for GreenLab's endeavor to start solving the social issues found in Nigeria – exploring how and what people think when it comes to the concept of FabLab. Ajumose in the Yoruba language means Collaboration, teamwork, co-working or cooperation. The event was the first free 3D printer and Solar panel construction workshop coordinated in Ibadan.

Disrupting traditional ways of organizing events and workshops, the aim of the workshop focused on the advance and support of the "Grassroots" economy of the country, the young generation where change is most likely to be created and implemented if provided with the right stimulus for growth. The event funded by LaFT OpenLab Hamburg, looked at typical Nigerian needs with the element of also introducing innovation.

Solar panel has fast seen its introduction into the African nation with many individuals using it to achieve their daily energy needs. However the use of Solar panels has created a community of consumers and not prosumers (Consumer who produce). Whilst many can comfortably use a solar panel to achieve their needs, the majority have no real working knowledge of how to build a solar panel, yet alone interest in how to build it. This nonchalance benefits manufactures and Sales as they continue to gain profit off the dependency of consumers. Ajumose set to disrupt this situation, planting seeds into participant's heads, encouraging them to think about the concept of creating products, namely a solar panel in this case, themselves.

Over 3 days, Ajumose the event set out to encourage participants using the terms Do It who are DIY & Over 3 days, Ajumose the event set out to encourage participants using the terms Do It Yourself (DIY) and Do it with others (DIWO). The following is an abstract of the event taken from the full report and includes a summary of the workshop, results & outcomes, limitations and SWOT analysis.

The workshop

The number of participants were a little close to 80 with backgrounds ranging between elementary education (+/- 40), high school students (+/-20), tertiary students (7), traders (5), teachers (4), artisians (car mechanic and photographer) (2), engineers (3), and Financial managers or accountants (3). The youngest participant was aged 4, while the oldest was 69

80 Participants from a variety of backgrounds

In order to gauge the level of understanding about 3D print technology among the participants, a short quiz was conducted. The results of this quiz proved the lack of exposure that participants had regarding 3D printing technologies. A similar quiz was conducted on solar panel technologies. Whilst many were able to explain what a solar panel does, they were unable to explain how it works or the technology behind it. This was a huge relief, as it confirmed the obvious speculations; lack of infrastructural development in Nigeria was mostly responsible for the laggard innovative cycle.

An explanation of the objective of the workshop, FabLab concepts, equipment and sponsors was delivered before creating structure to the event over the 3 day plan. Groups were split into three groups. Due to the technicality, fragility of the components and the complexity of the activities, Group 1 comprised of participants below the age of 13, to be taught both theoretical and practical knowledge about FabLab, Open Source, Arduino, Computer Aided design (CAD) modelling and 3D printing.

Group 2 comprising of participants 13 years and over were assigned to construct the RepRap 3D printer. Armed with a manual, the unassembled components of the 3D printer and the tools to construct the device, the team set out to read, learn and apply knowledge gained in order to construct a functioning 3D printer.

Group 3, comprised of participants above 13 years of age, were assigned responsibility to assemble the solar panel intended for the generation of electricity to power the 3D printer. Utilizing available resources in the form of an instructional example, YouTube video links, technical and practical skills, the group, using available provided materials; solar flux, soldering lead, strips of tabbing wires and 40 silicon solar cells, began to construct the solar panel.

Although at first seemingly straightforward, each group came across challenges, encouraging them to create solutions to solves their problems. It is through these challenges and finding solutions that Ajumose really began to deliver the intended outcome of the event.

Results & Outcomes

By end of Day 1, leaps and strides had been made. Under 13's could explain a variety of technologies, over 13's had successful constructed the 3D printer frame and assembled 10 solar panel cells.

When met with the challenge of unidentifiable equipmen, group 2 thought out of the box utilizing any alternative or additional resources they had By the end of <u>Day 1</u>, group 1 was successfully able to explain the concept of FabLab, 3D printing and the difference between 3D printing and traditional manufacturing. Group 2 had successfully constructed the 3D printer frame and Group 3, after learning through trial and error, had successfully created 10 individual solar panels cells towards the overall end frame. Due to Sun set taking place at 7pm in Nigeria, the outcomes of day 1 showed the amazing possibilities and advancements made, taking into consideration that all participants previously had limited or no knowledge about 3D printing or solar cell technology.

Day 2 saw group 1 working with CAD 3D model designs where participants were taught CAD, given information about the software and explained the difference between commercial CAD software and the open source version FreeCAD. By the end of the day, students were able to explain how FreeCAD software worked, however due to limited availability of laptops were unable to personally handle the software themselves.

Group 2 were forced to think beyond the limits in which they had assumed themselves to be constrained to when it was noted that some of the 3D components were unidentifiable and misaligned with the user manual detailing how to assemble the 3D printer. Despite this setback, with motivational words reminding them that limit exists only if you place on oneself, the group was able to utilise available manufacturing documentation with the manual to cross reference the correct items needed to assemble the 3D printer accordingly.

Group 3 learned fast regarding the fragility of the solar cells and hence having to put in place

Creating innovative solutions to challenges The social reach of the workshop encouraged altruistic support.

a proper and defined way of working which would reduce the waste and increase output and quality. Through observation from the previous day, participants were able to set in place a way of working that enabled them to achieve their desired outcome. Materials were however limited and the group were forced to search locally for resources (all materials used in the workshop were obtained via China or Germany). In a city like Ibadan, this proved challenging, however the <u>social reach</u> of the workshop meant that at one point a car mechanic attended the workshop and was able to accurately determine the exact need of the group, going one step further to supplying the material freely.

The particular act from the car mechanic showed how the future outcomes of the project inspired help from individuals without extra costs incurred. This act embodied the meaning of Ajumose, Collaboration, teamwork, co-working or cooperation.

Day 3 arrived almost too quickly as participants had begun to get accustomed to the workshop, the outcomes intended and their role in achieving the outcome. The groups all successfully reached an end success, with group 1 able to explain to high school students the concepts of 3D printing, FreeCAD and the difference between 3D printing and traditional manufacturing.

Group 2 discovered the limitations associated with external suppliers in that nonfunctioning parts of the 3D printer hampered the abilities to move forward with the completion of the 3D printer. The group was able to completely assemble the 3D printer and test successfully the X and Y axis; however the Z axis proved to be challenging where uneven rod diameters resulted in the movement in the Z direction constantly malfunctioning. Nevertheless, the group had successfully constructed a 3D printer.

The **greatest milestones** are seen with Group 3 who completed the solar panel construction, joining 15 cells in series to one another, leaving day 3 only to testing and tuning. By the end of Day 3, the group were able create a functioning Solar panel generating 6V electricity enough to directly power a small pocket torch.

Limitations

As discussed briefly in the outcomes section, there were a number of limitations which hindered, accelerated or encouraged the project. Below outlines some of the greatest limitations and the solutions developed to solve the problem.

- Limited knowledge due to inadequate access to internet services

To overcome this limitation, fortunately a number of instructional videos were downloaded previously. However should internet have been in abundance, there could have been the possibility to solve many issues quicker.

Epileptic Power Supply

GreenLab is envisioned to be self-sustaining, dependent to a large extent on renewable resources. However as the establishment of GreenLab is still in creation stage, there was a need to power a number of the tools utilized during the workshop with electric fuel utlising generators. In the short term, while this solution helped to move the workshop ahead, GreenLab is actively looking towards other options of generating electricity, hence the motivation for the workshop

<u>Availability of resources, tools and equipment</u>

As mentioned previously, a number of the resources, tools and equipment used during this workshop were acquired from Germany or China. Due to inadequate infrastructural development and technology advancements, some tools and basic resources were almost impossible to obtain during the workshop. It was through the expertise of some participants that enabled the workshop to source some of the much needed equipment, however going forward, resources will be a limitation which will need great attention

By the end of Day 3, the under 13s were teaching high school students and group 3 had successfully constructed a functioning solar panel producing 6W of energy, enough to power a pocket torch.

Imagine what could have been done with consistent internet access, uninterruptable power supply, abundance of resources, tools and equipment and more funding Limited Funds

The generosity of LaFT Open Lab Hamburg enabled a great proportion of the workshop to be achieved through the purchase of technologies which are not readily available in Nigeria. Sourcing these technologies in Nigeria proved a challenge and Limitation which going forward would need to be assessed.

Successes

Despite the limitations stated, Ajumose attested GreenLab microfactory's HIDES innovation strategy. The first phase, Hearten, enabled participants to learn about technology (3D printer and Solar panel) deepening their interest and expanding their knowledge of the technology by allowing them to personally assemble a 3D printer and Solar cell. According to Bosque (2013) *"FabLabs are more about the people than the machines"*. GreenLab also attest to the statement given above, that FabLabs are about knowledge acquisition and dissemination through participatory involvement of individuals which to some extent relies on having adequate access to technologies.

The success of Ajumose was left to the interpretation of the participants who were asked <u>"How the success of Ajumose should be measured".</u> Below are extracts from some of the participant response

In order to keep the momentum up... More workshops need to be established and more social innovation initiatives like GreenLab need to be cultivated.

By allowing

participants to

personally assemble a

interest and expanded their knowledge of

3D printer and Solar

Cell, participants

deepened their

the technology.

"I think it should be measured based on the items produced as well as the knowledge gained. Ive never seen young kids so vibrant, happy and willing to learn. Ajumose was a huge success! Looking forward to part 2..."

"Am really really speechless.... The success to me is measured on the 3 days fun packed workshop... From the seminar, to the practical's (creating of the solar panel and 3D printer) which was really an Ajumose work... the knowledge gained was awesome!!!! Less I forget, also the football match they also played to crown the closing of the workshop was really thrilling... I will really be on the move for the next workshop...."

Next Steps

The momentum, joy and passion gained from the Ajumose workshop has shown there is a need for practical and theoretical knowledge in technology if innovation is to grow within the country. A small experience such as Ajumose has already encouraged many to pay more attention and shape their lives differently.

GreenLab endeavors to keep up the momentum continuing with the next event <u>"1 Student 1</u> <u>Arduino"</u>

