Introducing Innovation in Education

International Development Design Summit 2014, Sponsored by IDIN at MIT D-Lab

Problem Abstract

Last year in Orkolili Secondary School, 88% of the students left the school system before Form V (the equivalent of junior year of High School in the United States). The students fail to pass the National Examination, which is conducted after Form IV, and are suddenly faced with the real world. The current education system does not equip them with skills to obtain a job or start something on their own. As a result the economic impact of the Tanzanian educational system in this group of students is marginalized due to high rate of unemployment and lower annual income.

The focus of our project is to improve the economic well-being of the community by developing a hands on curriculum that could be introduced in the local schools. The curriculum will focus on building real life skills of the students while trying to introduce the idea of innovative thinking.

Context

Background

Orkolili is part of the Kilimanjaro ward at the base of Mt. Kilimanjaro in Tanzania. The Ward has approximately 12,000 people of which roughly 50% are children. Maasai community makes up the majority of the total population.

Community Description

The economic base of the community is agriculture with the primary crops being maize, sunflower, and sorghum. Their livestock includes chickens, goats and cows, though the cows are primarily for milk and trade, and not for meat. The Maasai see cattle as a symbol of wealth, so they do not kill the cows as that would diminish their wealth. During the dry summer season, the land is barren and the cattle suffer from lack of fodder and are severely malnourished. This results in many of the animals dying from disease caused by lack of food. The area has more than 40% of its population living below the poverty line and has experienced very little growth in income in the last 10 years.

The culture is very patriarchal and a household is made up of one male with several wives and the combined children. It may also include the son's and their families. The majority of the work is completed by the women and the children with the head of the household providing oversight.

There is no running water or electricity in most of the homes. The homes are both traditional wood and dung huts, and cinderblock construction. Fuel wood is the main source of cooking fuel for the families, who use the traditional three stone cook stoves.

The team worked with a local school in the village of Ormolili to gain a better understanding of the education system in the entire community.

Community Meeting in Orkolili

Problem Framing Statement

Before explaining the problem statement, we wanted to outline the current education system followed in the schools in Orkolili.

A. Level I to VII – Primary School
B. Form I to IV – Secondary School

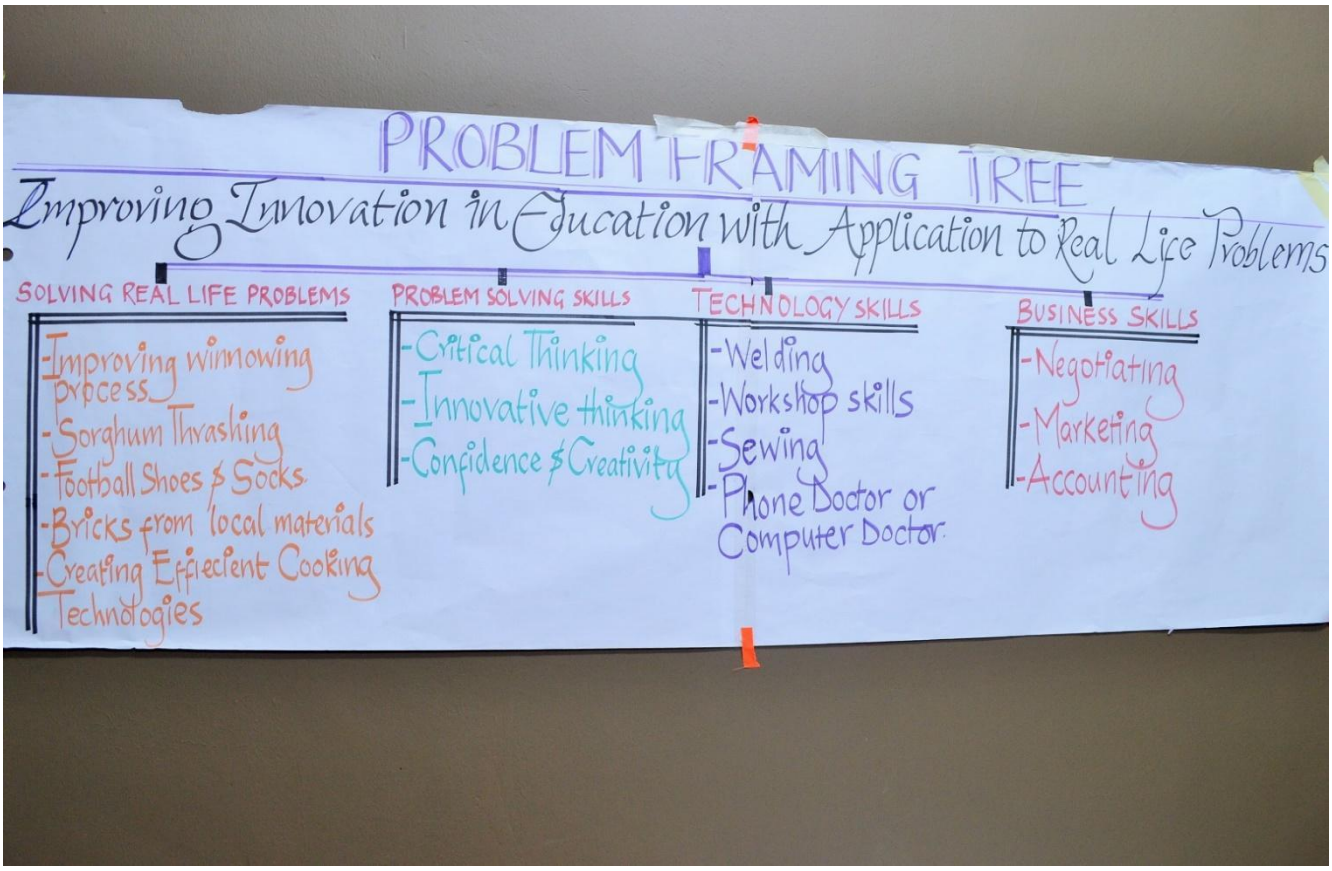
Government Examination

C. Form V to VI – Secondary School
D. University

About 88% of the students drop out of school after form IV as most of them do not clear the National Examination held by the Government. These students do not have the appropriate life skills to immediately find a job or start something on their own.

Design Process

Problem Framing Tree



Problem Framing Tree prepared by the team after coming back from the community

Value Proposition

The customers for the project are

Students

School

Introducing real life skills in the education curriculum will assist students to gain important skills, which will help them to be more employable than before. The build-its, which are an

integral part of the hands on curriculum also focus on building critical thinking and soft skills, eventually used to solve problems faced by the community in daily lives.

Team teaching the students of Orkolili Secondary School how to prepare charcoal from agricultural waste

Summary of Design Process

The team started the design process by identifying the key stakeholders in the project. Post initial discussion and research, we visited the community to work with the stakeholders and get a better understanding of the project.

We followed the AOT (Ask, Observe, and Try) methodology in the community. Meetings were organized with several groups within the communities, including women's group to get a broader perspective. We also visited two schools – Orkolili Primary School and Orkolili Secondary School. We spent majority of our time at Orkolili Secondary School, because of the inclination of the local school leader to adopt the project and implement it. With her support, we could spend time attending lectures, laboratory sessions and meeting both students and teachers in person.

During our initial meetings both in the school and in the community, we demonstrated couple of build its, which we thought were of use to the people. We built a maize sheller and observed the

keen interest of the people in the product. This helped us to get the members to open up with the team and also to observe their response to a product, which was useful to them.

Team performing the corn sheller build it in the community meeting

During our stay in the community we came across following problems either through our observation or informed by the stakeholders -

1. Cleaning the chaffs from the sunflower seeds - Observed
2. Lack of football shoes - Informed
3. Women using 3 stone cook stoves - Observed
4. Lack of Cooking fuel - Informed
5. Sorghum threshing - Observed

Team trying out the conventional process of cleaning sunflower seeds from the chaffs

After coming back from the community, all of us took turns in identifying the problems, we observed during our stay. Another topic of discussion, was the delivery mechanism – how do we implement innovation in education?

All the members of the team listing out the problems they felt in the community

After a series of discussion within the team, we decided that we wanted to provide local school leaders with an innovation tool- kit that will equip them with all the necessary information and technical know-how to implement the project in the school. The innovation tool- kit will consist of

1. Curriculum – List of Build-its and how to make them. Each Build involves a bunch of skills that the students will pick up in the course of building the final product. This final product will be used by the students to make their lives simpler. The curriculum will be modular and single – sourced to help instructors to pick up any module, which is independent of the other.

2. Support Manual for instructors

3. Local materials required to build the tool kit

The innovation tool kit will consist of the products built by past IDDS members and which are relevant to the problems faced by the community. Along with the innovation tool kit, we also wanted to design solutions to a local problem faced by the community, which has not been designed before. IDDS is about building products, which have not been built before and we also

wanted to challenge our technological acumen. We decided to focus on the winnowing process to clean the sunflower seeds from the chaff.

Once we narrowed down the scope of work, we initiated prototyping, experimenting and building our prototype along with the local people in the community as part of the co-creation process. We built our prototype in Orkolili Secondary School. This helped us to get constant feedback from the users and we realized that we progressed much faster during the co-creation process than when we were trying to do it by ourselves. It also ensured that we assumed less and asked more questions to the users of the product. Even though we started building the prototype to address the problem of only cleaning the sunflower seeds from the chaffs, the final product included both threshing of the seeds from the sunflower cake and also cleaning of seeds. The fact that we looked at the problem from various perspectives and went back to the beginning of the process, helped us to build a much better solution.

Co-creation: team building the prototype in Orkolili Secondary School

Analysis and Experimentation

In designing the sunflower winnowing machine, we started with using big bowls, which had perforations to clean the chaffs from the seeds, but due to the difference in the size of chaffs (both bigger and smaller than the seeds) we could not effectively use a single container to filter the chaffs and seeds. Next, while trying to drop the sunflower seeds from top and keeping a

bucket at the bottom, we did not receive positive results as the seeds also fell on the ground away from the container on the ground due to the wind pressure.

Then, we saw a chicken mesh at one of the Maize flour shop, used to clean the maize seeds. We brought some sunflower cakes to test on the mesh by rubbing it against the mesh, and even though it worked to remove the seeds from the cakes, it was more tiresome than the usual hitting process. We, experimented the same process on a mesh with bigger holes and this time the process was much faster than the earlier process. Using this as the starting point, we created another layer of mesh at the bottom to collect the seeds and also filter out the smaller chaffs, which did not get blown away by the wind. The bottom mesh has smaller holes than the upper mesh to not let the seeds fall down.

Trying out meshes of different sized holes

Team working with the local community members

Prototype version I

Technology/ Final Prototype

Design Requirements

During the second visit to the community, we built a prototype and demonstrated it to various stakeholders. We not only demonstrated the product, but also let them use the product as it would help them to give a much better feedback.

The existing process involved hitting the sunflower cake with a stick to remove the seeds. After that the seeds were dropped on the ground from a height, using wind pressure to blow away the chaffs. The latter process was repeated two to three times to clean the seeds from the chaffs.

The new solution involved rubbing the sunflower cake on a chicken mesh to extract the seeds. The seeds that fell through the mesh would be accumulated at the bottom mesh, which had small holes as compared to the upper mesh, ensuring that seeds are collected and the smaller chaffs filter out. An optional fan was provided to improve the process as it supplements existing wind.

These were the design requirements pointed out by the users:

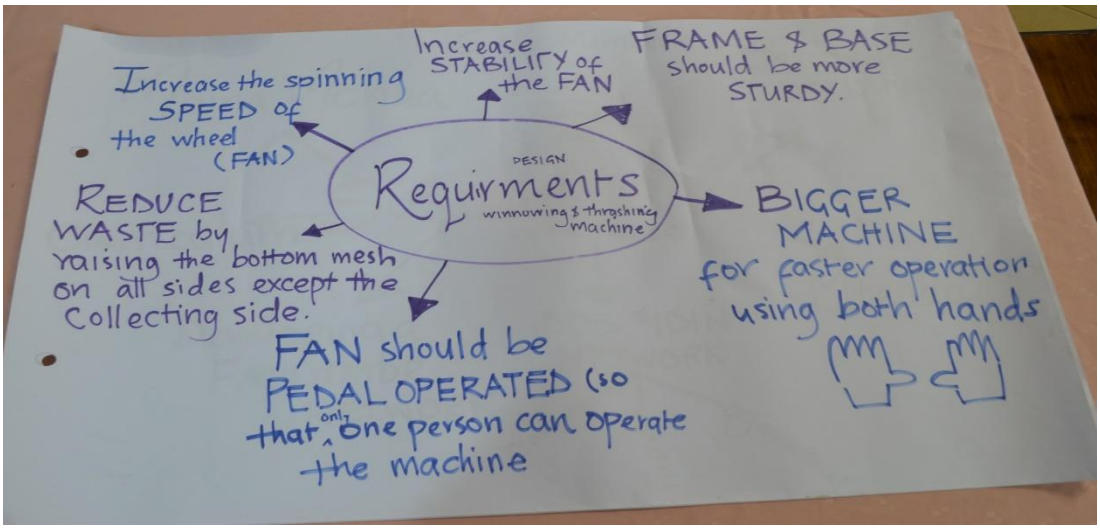
The frame should be bigger so that the operator can thresh two sunflower cakes simultaneously

The base of the machine should be sturdier

The fan in the prototype was hand operated, which meant two people would be required to complete the operation. One would be needed to rub the sunflower seeds on the mesh, while other would be needed to rotate the handle of the fan. The fan should also be faster.

To create boundaries on lower mesh so that the sunflower seeds do not fall off

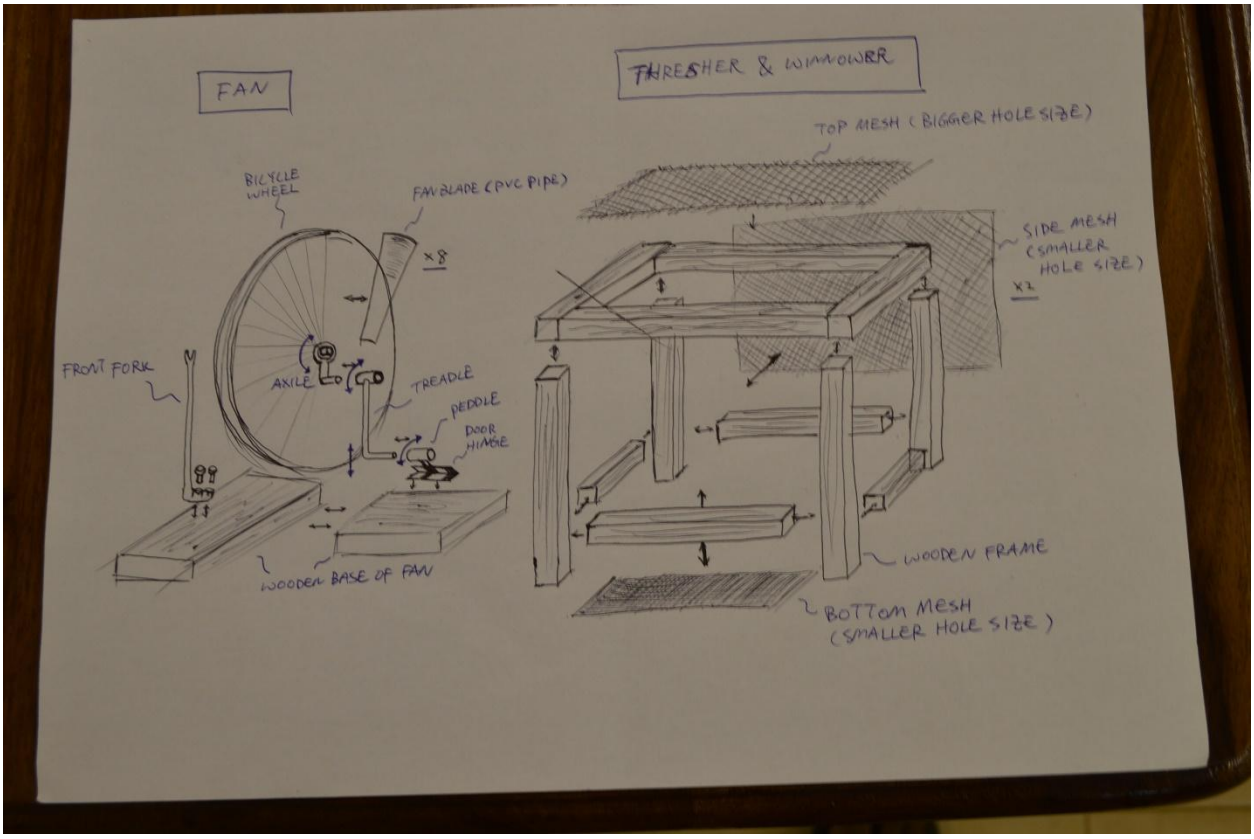
The fan should be more stable than the current one



Design requirements pointed out by the customers of the product

Women in the community trying out the machine

How it Works (Exploded View, Pictures with Captions, videos, step by step instructions etc.)



Exploded view of the Machine

Functionality Description of the technology

The technology substitutes the existing sunflower threshing and cleaning process.

The new technology has two layers of mesh with 70 cms gap in between. The top mesh is used to extract sunflower seeds from the cake, while the bottom layer, which has smaller holes is used to collect the seeds. The gap in between is used to blow away the lighter chaff using the pressure of wind. The smaller chaffs could also pass through the second layer of mesh at the bottom. An optional fan is provided to supplement the wind pressure and improve the efficiency of the process. The fan is pedal operated and a single person can operate both the machine and the fan.

Prototype version two

Performance

The current machine can be used with wet sunflower cakes as well to remove the seeds as compared to the existing one which first needs to be dried.

The current machine serves the purpose of both threshing and cleaning as opposed to the existing process, which takes much more time.

The build its and the education curriculum will teach students real life skills and improve critical thinking, helping them to develop skills for employment. The curriculum still has to be tested with students to find out the actual outcome.

Bill of Materials

The current prototype is designed for threshing two sunflower cakes at the same time and hence has a bigger base. The entire set up costs us 35,000 Tanzanian Shillings. If one wants to include the manual fan, it costs another 25,000 Tanzanian Shillings. The electric fan, which can also be set up to the body of the machine costs 28,000 Tanzanian Shillings.

Self- assess using four lenses (financial, technical, social/ cultural, environmental sustainability)

Financial

The cost of building the winnower was about 20 USD for the team. The local farmers felt that the cost was on the higher side and team needs to build a cheaper solution for the problem.

The team is working on the education curriculum for the local school. We will know about the financial sustainability of introducing innovation in the curriculum, once it is completed and implemented in the school.

Technical

The improved technology of the sunflower machine was appreciated by the farmers as it was durable and made out of local material. The farmers were already talking about building it for their own use next year as it is simple to manufacture.

The build-its in the education curriculum could be challenging to implement in the local school. We might have to work with local partners to help the school on the technology front.

Cultural/ Social Sustainability

The solution has been designed keeping in mind the local needs of the people in the community. The focus of the project was to introduce innovation in education by solving real life problems faced by the broader community.

Environmental Sustainability

The winnower is made out of recycled wood and metal pieces and does not create any hazardous waste harmful to the environment.

Lessons Learned

Community engagement

The community was engaged continuously during the building process. This helped us to constantly receive their feedback on the prototype. Another important aspect was that we did not have to assume anything and we could always ask them for any doubts that we had about the existing process and the changes that we wanted to incorporate.

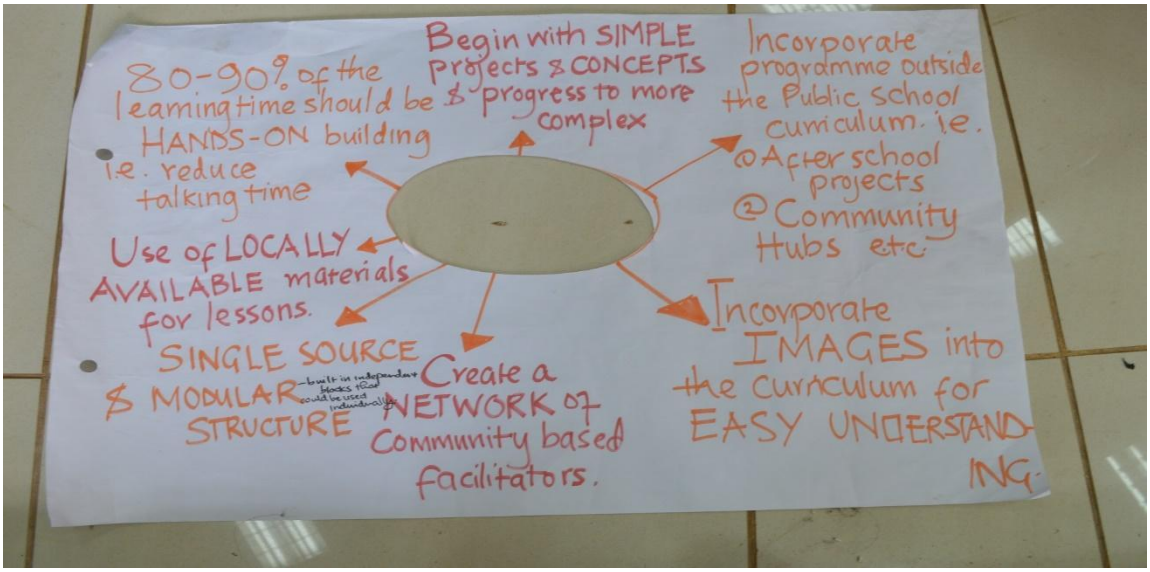
After we built the first prototype, we not only demonstrated it to various communities but also let them try the prototype to receive first hand user feedback. The various sections of the communities who tested the product were – Students, local leaders and the women groups

Meeting with the women's group

User Feedback

We received a positive feedback on the machine from the users. All the farmers, who tested the prototype were keen on using it in the next harvesting season. Being the first version of the product, they suggested some changes, which were included in the design requirement section.

For the education curriculum and innovation tool kit, we received feedback from the local school leaders. Following charts shows the feedback from them. With these feedback we will build the complete curriculum and experiment it with Orkolili Secondary School.



User feedback on the curriculum

Troubleshooting

The fan designed was not very sturdy and also did not create substantial wind to justify its cost.

The bottom mesh has to be supported with boundaries so that the sunflower seeds do not bounce off from the sides after falling on the lower mesh.

The same machine, with some modification and experimentation, can also be used to remove the maize seeds from Maize.

We will receive inputs on the education curriculum after it has been tried out in some of the schools.

Prototype version two

Next Steps/ Project Future

Reflection on project viability and other design opportunity

The project adds value to the entire community as real life skills and critical thinking are of immense importance in creating wealth in the future. Students, both who drop out of the school and who do not, are equipped with vocational skills that can help them to find a job much faster than the current process. Once the curriculum is implemented in the school, we will get a first -hand user feedback and can look at the suggested changes and other design opportunity.

The sunflower thresher and winnower, received positive feedback from the users of the product. The farmers in the village are very keen on building the same machine for their use in the next harvesting season. The same machine, with some modification can be used to extract

maize seeds as well. This is a design opportunity that the team will be working on in the future to be able to use the same machine for both the purposes.

Anticipated risks and challenges

The key challenge anticipated is that it has been difficult to develop a for-profit business model for an idea focused on education for the Bottom of the Pyramid. People will have to embrace the new curriculum and have the patience to see the value of innovation in professional life. Students who would be taught the new curriculum will take few years to enter into the job market and realize the importance of innovative thinking and real life skills learned in school. Thus the time to 'realize value' is longer and the business will have to sustain that period to receive some traction.

<table>
<tr><th>Problem</th><th>Solution</th><th>State your Value</th><th>Competitive Advantage</th><th>User and Customer Profile</th></tr>
<tr><td>Lack of Practical skills for students</td><td>Innovation Tool kit</td><td>Higher Employability Skills</td><td>Hands on Curriculum</td><td>Students in developing countries, who have a tendency to drop out before formal education</td></tr>
<tr><td>Lack of Soft Skills</td><td>The solution helps students to gain hands on skills, which can help them find jobs faster</td><td>Solving Local Community Problems</td><td>Modular</td><td>Local Schools addressing to similar students</td></tr>
<tr><td>Lack of Critical Thinking</td><td></td><td>Wealth Generation</td><td>Scalable</td><td></td></tr>
<tr><td></td><td>Important Metrics
Rise in Employment
Increas in Household income</td><td></td><td>Distribution Channels
Schools</td><td></td></tr>
<tr><td colspan="2">Costs
Cost yet to be determined for the innovation kit</td><td colspan="3">Revenues
Charge Schools for providing the curriculum

Schools include the cost of the curriulum in their fees</td></tr>
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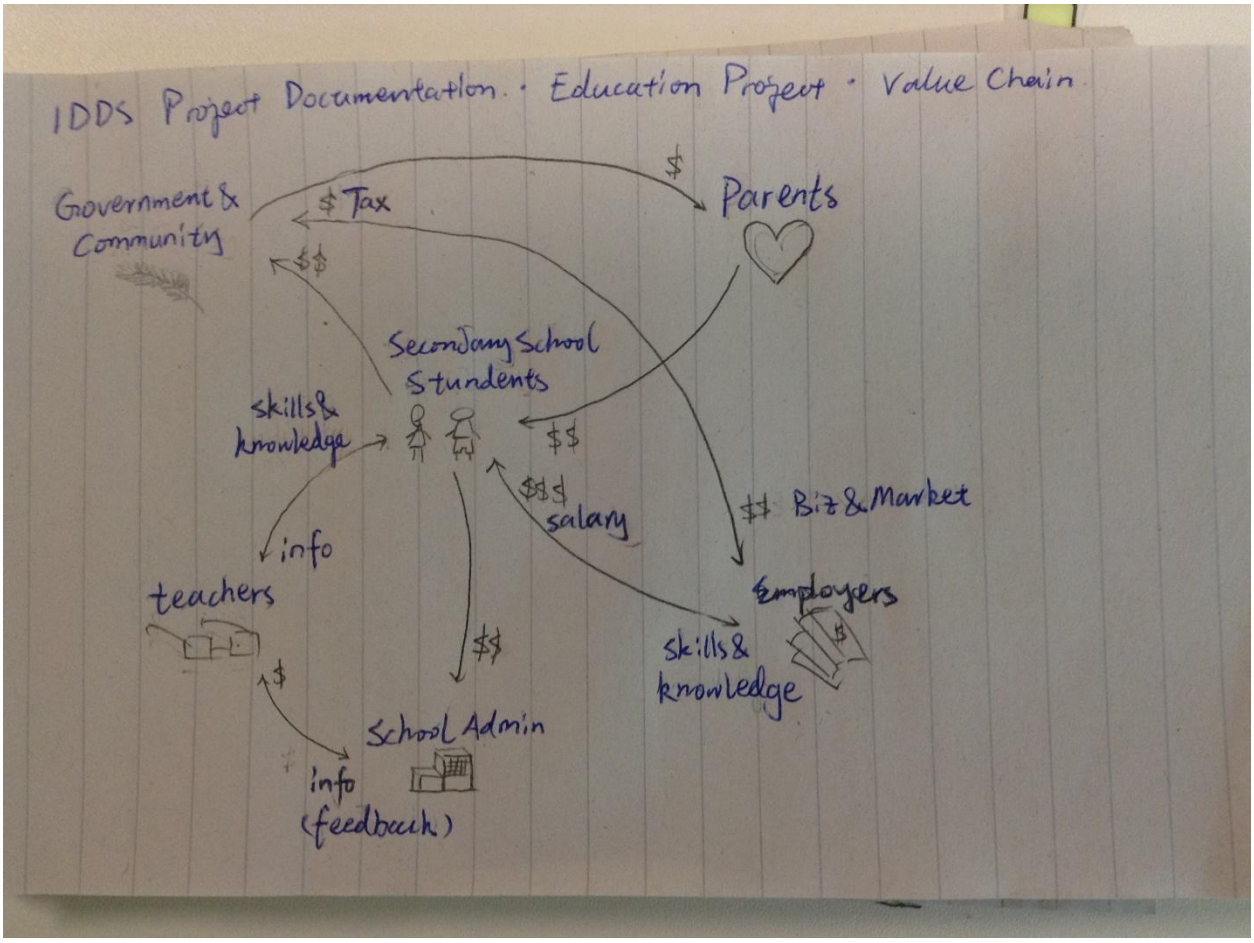
Value Chain (Visual, see design notebook for reference. Less than 250 words)


IDDS Project Documentation. · Education Project · Value Chain
Government & Community
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Parents
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Secondary School Students
skills & knowledge
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$$$ salary
$$ Biz & Market
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teachers
Employers
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$$
skills & knowledge
$
School Admin
info (feedback)