

Using a Recycled Container to Setup a Community Learning Centre in Rural Cambodia – A Case Study

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Abstract— The use of Information and Communication Technology (ICT) in K-12 education has been gaining attention in recent years. With using appropriate technology, not only can it allow people to have equal opportunity in education, but also improve the quality of teaching and learning. However, this is difficult in developing countries due to the lack of resources, infrastructure, support from the local community, skills, culture and policy. In 2014, according to World DataBank indicators, over half of the population in East Asia & Pacific region were not able to access the Internet. In Cambodia, this figure drops to less than one-tenth.

This paper investigates complementing education in developing countries through appropriate technology and a sustainable model that maximizes short-term efforts from foreign teams. We present a case study in Cambodia whereby a zero-carbon community learning centre was designed and installed for a rural community. The first phase deployment involved a recycled twenty-foot container, furnished with solar panels, computer devices, Internet hotspot, books and toys. A sustainable model was developed through engaging local community leaders and empowering resident university students. Follow-up evaluations suggest that community ownership and buy-in are critical for success. We present design principles, implementation methods, evaluations from the experience, feedback from stakeholders, and lessons learnt.

Keywords— ICT4D; Education; Service-Learning

I. INTRODUCTION

Information and Communication Technology (ICT) in education has been gaining attention in recent years, especially in the area of K-12 education [1]. Previous efforts include using computers and the Internet to enhance the learning experiences as in computer-aided learning, or moving course content into the digital realm as in eLearning or flipped classrooms.

There has been much previous work on the impact of ICT in education. A multitude of studies have shown that an appropriate use of ICT can contribute to universal access to education and improve the quality of teaching and learning [2,3]. These findings are especially promising for developing countries and remote locations, which often suffer from large student-teacher ratios and poorly paid and trained teachers. However, ICT in education is still in its infancy in developing

countries due to certain barriers [4], such as lack of resources, infrastructure [5], support from the local community [6], funding, knowledge and skills as well as culture and policy [7]. In 2014, according to world development indicators from World DataBank, only 9% of the population in Cambodia has Internet access, and the vast majority of these users are concentrated in the urban areas [8]. In comparison, developed countries often have an average accessibility rate of 80% [8].

This project seeks to investigate how education in developing countries may be supported through appropriate ICT technology. Shown in Figure 1, A zero-carbon community learning centre was designed and implemented in a rural Cambodia in two-phase approach, from April 2015 to December 2016. This case study outlines the design principles, implementation methods and lessons learnt.



Fig. 1 Children were having lessons in the Community Learning Center

II. PROJECT DESIGN

The objective of the community learning centre is to provide an informal learning space for village children and youths, both to supplement their regular school education, as well as to serve as a resource for continued education and self-guided study.

The context of the site is a semi-rural area in Cambodia, outside of the capital city of Phnom Penh. The majority of the residents in the area rely on farming for a living, a number of

the younger residents have also departed to work in factories in the city or abroad. There are a fair number of children in the community; the other young people resident in the community are unemployed or still attending school.

In terms of infrastructure, the site is on the main electrical grid and therefore electricity is available, though still expensive and unreliable, with frequent blackouts and brownouts. Running water is not available and water has to be collected (mainly during the summer rainy season) or bought from the city. There is no land-line phone service, and the cellular coverage is spotty, and 4G phones usually drop to 3G service or even 2G/LTE.

The project team has had a long-running relationship with the community and has involved the community in service and income-generating projects in the past. These projects include free health care and vision screening services, sellable craft production workshop and support, and community homestay upgrades and consultancies.

TABLE I. DESIGN PRINCIPLES OF THE COMMUNITY LEARNING CENTRE

Priority	Principle	Description
High	Energy-Neutral	The centre needs to be energy-neutral – i.e. self-reliant with respect to electricity, rather than depending on the main electrical grid supply.
High	Community Involvement	The ultimate ownership of the centre should be the community. To that end, the community should be actively involved in the planning, execution and maintenance of the centre.
Medium	Self-contained Content	The centre should contain local copies of educational and/or informational content that would be of interest to the community, rather than relying on the Internet.
Medium	Scalable	For gradual diffusion and incremental deployment, the solution should be scalable so that it can be easily expanded in size and scope.
Low	Replicable	To benefit other similar contexts and narrow the digital divide, it should also preferably be repeatable at other similar locations.

Based on previous experiences, and the context of the community, we collated a preliminary list of principles that would inform the design of the centre (Table I). The rationale for the principles are given as follows:

- **Energy-neutral:** The location of the centre is a rural area in which mains electricity is available but unreliable and expensive. For reliability, and also to avoid creating a financial burden to the local community (which would discourage them from using the centre), we opted for an energy-neutral solution in which the centre would generate and supply its own energy.
- **Community Involvement:** From our experience, and from previous work, installations that do not have

community ownership do not usually last past the initial excitement and enthusiasm. This is especially true for installations involving education and ICTs [9], which do not immediately impact the livelihood of the community. There is also evidence suggesting that an often-used model which involves constructing these learning centres inside schools often turns out to be less effective as the schools and teachers do not usually have incentive to make the centre accessible to individuals outside of the school, or outside of school hours. Therefore, involvement from the community is critical, from the planning to the long-term maintenance.

- **Self-contained content:** In most rural areas in developing countries, cell coverage is limited and Internet access, even when available, is expensive and difficult. To encourage children and young people to use the computers, access to content must be quick and painless. Therefore, it is desirable that the centre must be pre-loaded with as much of the content that we wish to distribute as possible.
- **Scalable:** Previous work has noted that in many poor, developing areas, the poverty-reducing potential of education and ICTs are not obvious, and many initiatives are best introduced gradually. Therefore, an ideal solution should be scalable [10] – i.e. it can be incrementally improved and expanded upon, whether in size, functionality, or scope.
- **Replicable:** To maximize the impact of our efforts in narrowing the gap of the digital divide in developing countries, it is best if the solution can be taken from one setting and incorporated in other settings. This means that the design must be heterogeneous and easily replicable to other similar settings.

III. IMPLEMENTATION

We took a two-phase approach this project, with clearly defined deliverables for each phase.

The first phase took place in December 2015 in which a small team of researchers from a university in Hong Kong explored the idea of a community learning centre. Together with the community residents, leaders and volunteers from a local NGO, our team identified an area located in the centre of the village. Also, the described design principles were solidified and a commitment from the local community to help implement and maintain the centre.

After the research team was returned, the discussions from the first phase were followed up by approximately 5 months of fundraising, fact-finding, sourcing and planning. The gift of a piece of land from a community leader demonstrated the commitment on the part of the community and informed the spatial parameters of the centre.

The final design of the centre centered around a 20-foot shipping container. The decision to use a container was made for reasons of cost and ease of implementation. Compared with constructing a new building, this was much quicker and

the structural integrity of the container ensured the safety of the users and the security of the equipment. In addition, this ensured a highly scalable design as additional units could be easily incorporated when needed. These types of shipping containers are also widely available in the target country, making this an environmentally responsible solution.

The planning stage was followed by the second phase of implementation in August 2015. This phase involved a team of 1 instructor and 16 students from a university in Hong Kong who spent 6 days in the community.

TABLE II. IMPLEMENTATION SCHEDULE

Period	Tasks
Dec 2014	1st Phase: Research and Development <ul style="list-style-type: none"> - Collect user requirement & expectation - Solidify design principles - Identify the location of the learning centre
Jan – May 2015	Fundraising, Fact-finding, Sourcing and Planning
Aug 2015	2nd Phase: Implementation & Training <ul style="list-style-type: none"> - Setup the rooftop photovoltaic generator - Install appliances, e.g. LED and USB devices - Install computer devices - Put-up books and toys - Renovate and decorate the interior and exterior - Provide training to local volunteers - Setup scholarship scheme
Sep – Dec 2015	Follow-up, Reflection and Evaluation
Dec 2015	Post-trip and Collect User Feedback

Apart from the installation of the container itself, the deployment involved the following aspects:

A. Interior wiring and Rooftop Photovoltaic Generator

To fulfill the “energy-neutral” requirement the centre had to generate and supply its own energy. A standard photovoltaic solution consisting of 17 solar panels (210W), two solar controllers and two lead-acid batteries (120Ah and 45Ah) were installed to provide the centre with the needed electricity.

All solar panel were connected to two controllers and each controller was connected to one battery. Since we needed to powered-up the pre-installed ventilation fans, an 700W DC (direct current) to AC (alternating current) inverter was connected to the 120Ah battery. Apart from that, as we did not plan for heavy-energy appliances (e.g. air-conditioners) in the container, we chose to take a 12V DC (direct current) approach to conserve energy and minimize energy wastage. The appliances in the centre therefore included LED lights for illumination, computer fans for ventilation and cooling, 3G router for the Internet and the computing devices were modified to run directly off DC power. In usual practice, given the amount of sunlight in Cambodia, the centre can run for 8-10 hours every day before the battery level gets too low for continued operation.

B. Installation of computing devices and resources

When the idea of a community learning centre was first explored, the young people in the community expressed a wish to have a space where they could properly access the Internet and improve their computer literacy skills.

To that end, 3 donated laptops were installed into the learning centre. Since wired Internet (or even phone) access was not available at the site, Internet access was provided via a portable battery powered 3G wireless router. This router equipped with 5200mAh internal battery which was able to operate 16-17 hours after fully charged. However, even though 4G access was theoretically available at the site, in practice the speed often dropped to 3G or even 2G or LTE. Therefore, a server was set up with an offlined copy of Wikipedia, Khan Academy, e-books and educational games. Appropriate shortcuts were placed on the desktops so that these offline resources could be easily found and located.



Fig. 2 Delivery of the second-hand 20-foot shipping container

C. Physical books and toys

Even though the learning centre was primarily aimed to be an ICT solution, it was obvious that the children of the community would perhaps find the computing devices and content too difficult and too far beyond their reach. As a result, the centre was also equipped with a library of physical books and toys. The objective was to make the centre a comfortable, safe place for the children and to avoid intimidating them with the computing devices. The hope was that the children would make coming to the centre a regular habit, and through that process would be emboldened to try the computing devices.

D. Renovation and Decoration of the Interior and Exterior

In the same way as the physical books and toys are intended to create a friendly, welcoming environment for the children, the rather sterile façade of the container also needed to be renovated. As a result, a mural was designed for the outside of the container, and the interior walls and ceiling were also painted. The goal was to create a warm impression that would both blend in with the overall environment of the village as well as stand out and attract attention.

E. Workshops, Reading Sessions and Playgroup for Regular Users

In order to bootstrap the learning centre, 2 workshops were organized for the community residents on the usage of the community learning centre. These workshops were 2 hours long and targeted at covering the usage of the computing resources on a user level. For example, how to access to the computer resources, the basic operation of the computers and how to search information over the Internet. These workshops were attended by 30 people. Apart from the workshops, reading sessions and playgroup were also organized. For each reading session, it involved 3-4 teammates and each of them was assigned to have the storytelling with a group of 3-5 kids. Also, 2 sessions of 3-hour playgroup were conducted. During the playground, kids were allowed to borrow the educational games and play under our teammates instructions. Therefore, kids were able to learnt how to play the games.



Fig. 3 Books and toys were equipped in the centre

F. Training Volunteers for Upkeep and Maintenance

In addition to the user-level workshops, a 2-day training workshop (10 hours) was conducted with adopting a focus group discussion approach. During the workshops, we focused on three aspects:

- Operation and maintenance of the learning centre: The standard operation procedure of borrowing and returning books and toys were discussed. For each month end, local volunteers would do the stocking checking to see if there any equipment, books or toys were broken or loss. Then, together with the local volunteers, we worked out the template of the

operation documents, such as class attendance sheet and stock logging sheet.

- Teaching and learning of the children: Since the volunteers did not have any training on teaching before, our team organized a 2-hour workshops on developing a lesson plan followed by another 2-hour discussion on essential elements within a lesson.
- Personal development on volunteering in the learning centre: Apart from bring impacts to the children, motivating the local youths to serve the community was another mission of our team. Therefore, through evaluation and reflection, we believed that the youths could identify the benefits of the service not only improving the education level of the children, but also develop their own personality and empathy towards others. During the evening, we divided the local volunteers into smaller teams of 5 people, and we discussed the project at operational level and shared our personal feeling.

G. Identifying Volunteers and Setting up a Scholarship Scheme

For the long-term upkeep and the sustainability of the community centre, it was important that the local community be involved and own the centre. Therefore, we set up a scholarship scheme that would provide 3 “half-scholarships”, covering about 50% of the tuition of a normal university student. 3 young people from the community were interviewed and selected to be the recipients of these scholarships. As part of the scholarship, they were required to reciprocally organize and conduct a 3-hour session in the learning centre every week. For the purposes of accountability, they were also required to report their activities and the attendance figures every month.

H. Setting up of an online platform for experience sharing

For the local university students, volunteering was new to them and they had not previously had any experience with organizing or coordinating activities. In order to provide them with emotional support as well as technical know-how, an online platform was set up to allow them to share their experiences and reflections with the project team, as well as to post questions and to ask for help if technical support was needed. To ensure that regular reflection was taking place, the students were also required to post a reflection once a month.

IV. FURTHER DEVELOPMENTS

After the second phase deployment, the project team kept in regular touch with the community leaders, and a return visit was paid to the community in December 2015.

From our observations, it appears that the learning centre has become a hub of social activity in the community. Since local young people were involved in managing the centre, the families were willing to allow their children to go to the centre. Our observations in December 2015, and figures collected by the community leaders show that on average, 44 people (24 kids, 10 youths and 10 adults and elderly) visit the centre on a

regular weekday, with children usually visiting in the morning to play with the toys and read the books, young people going in the afternoon to use the computers and Internet, adults of the community using the space around the centre to congregate and share news and information, and the elderly from the homestay program coming in to learn basic communication skills in English.

The workshops that were organized by the local scholarship students as part of the requirement also appear to be successful. These workshops were usually storytelling or reading sessions, targeted at children of elementary school age. Attendance figures show that on average, each workshop attracts around 35-40 children, with some coming from neighboring villages. Apart from the children workshops, the leader of the local village started a computer class on basic computer literacy, for example, MS office and browsing the Internet to the local youths. Also, English classes on communication skills were offered to the elderly from the homestay program to teach them fundamental conversation skills when welcoming foreigners to their homestay program.



Fig. 4 Storytelling workshops conducted by the local scholarship students

Finally, the community also proactively contributed to the equipment in the centre. Two months after the installation of the centre, the villagers initiated a fundraising campaign to purchase books and other resources. In total, over 50 books in Khmer (the local language) were bought or collected, and other teaching resources, such as school bags, stationery and colouring books were purchased.

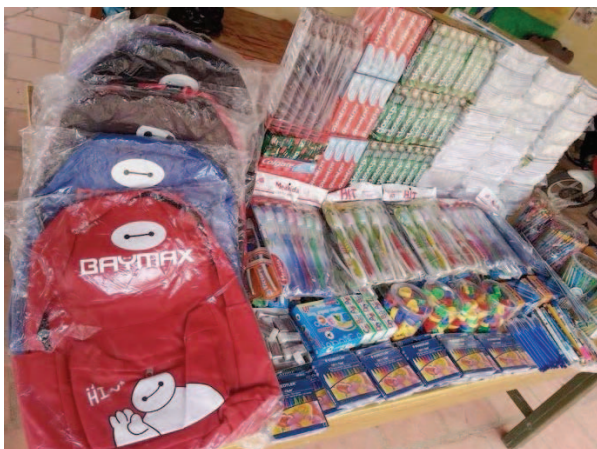


Fig. 5 Books and stationery donated by the villagers to the learning centre

Apart from the community development, an online portal (Facebook Group) was setup between our team and the local scholarship students. Photos, lesson contents and student attendance sheet were uploaded to the portal after each lesson. The scholarship students would share their observations, difficulties and problems they faced. Therefore, through this platform, our team could provide our suggestions and recommendations. For example, after six months of lessons, they reported that the children cannot focus on reading and writing classes, however, they were interested in books containing vocabulary, song, drawing, story, and games. This observation provided the direction for our team on how to further provide support and solicit donations for supplies.

The local scholarship students were also required to share their personal reflection on the platform every two months. Their reflections provide an interesting insight into their mindset and vision for their own community and self-development. Analysis of their reflections suggests that the project not only brings benefit to the community, but also helped the volunteers to develop deeper understanding of social issues and enhances their sense of social responsibility towards their own community and cultivates their sense of empathy for people in need. It also empowers them to take ownership of their own community and proactively look for solutions. Below are two snapshots from their reflections (unedited for grammar and spelling):

“At the beginning, feeling the kids were very annoying, I did not know how to conduct the lessons and get along with them. However, when I stepped out my confront zone and knew them clearly, they are indeed lovely and clever. All of them could read and listen clearly what I taught! They were so clever and responsive during the lessons. I started to look after them and teach them as if they were my family. I wish I could stay with them until they grow up. I really want to see all of my kids having a bright future.” – Oct 2015, Samneang Long, Year 1, Plumbing System in Preah Kossamak Polytechnic Institute

“It is not a very long time since I have participated into this project and known all of you, however, this project has changed. It let me feel strong enough to work and know more about my own country. It was my first time to work in the learning centre that allow me know that I am not a young girl anymore. I should work for my society and take up more responsible to server and to teach the children.” – May 2016, Chhan Khemra, Year 2, International Relation in University of Cambodia

V. OBSERVATIONS AND LESSONS LEARNED

Thus far, the community learning centre has been successful. Upon evaluation and follow-up discussion, we have the following observations:

- The ownership of the project and community engagement determine the level of success. Since this initiative was primarily driven by the community, the local community had a stake in making the centre a success, as can be demonstrated by their willingness to take initiative to fundraise for additional equipment. Through involving the community partners or local

volunteers into the project, their ownership of the project can be increased. For example, in our project, NGO staff, villagers and volunteers were involved in project discussion, planning, resources sourcing, equipment preparation, project deployment, on-site training and maintenance. All parties shared their findings and progress on the online platform from the first phase, research and development, in December 2014 to second phase, implementation and training, in August 2015.

- It is important to have a venue or a forum for sharing and support, similar to the “communities of practice” in academia. This interaction not only provides tangible support such as technical know-how and ideas for workshops and activities, but also gives intangible support through encouragement and motivation. Usability was the primary concern when we set up the platform. It should be well-known in the local community and we cannot enforce our perception of using the portal on the local partners because of its functionalities or our culture. Besides, accessibility to necessary equipment or the Internet is another factor that should be taken into consideration. In our project, Facebook was chosen as main communication channel as the local partners could access Facebook through their mobile phone easily and had experience on using it. With using the online portal, ideas, suggestions and reflections were shared at the beginning of first phase until now.
- The effective use of ICT requires the availability of equipment, supplies of computers and their proper maintenance including other accessories. The laptops that were installed in the centre were second-hand devices donated by companies which were upgrading their own machines. After a month, 2 out of 3 were no longer working. Even though they could probably be fixed, the local community lacked the technical expertise to do so, and therefore, new machines were bought to replace them. Cost-effectiveness cannot take precedence over stability and functionality, especially in developing regions where inadequate knowledge exists to work around problems. Therefore, when it comes to donating computer devices or setting up a computer lab in developing countries, several factors should be taken into account. (a) Robustness of the computer devices; (b) Software licensing issue; (c) Maintenance; and (d) Support from the local community.
- Physical appearance is important. Since the centre was decorated to be attractive, it became a popular spot to visit and show off to visiting friends and relatives. This indirectly resulted in the centre and the surrounding environment becoming a focal point for the social activities of the community. Multidisciplinary members were gathered to achieve this purpose. For example, students with engineering background would install the solar system while members with design knowledge could support on the renovation and decoration of the learning centre. Our

team of 16 students came from engineering, health sciences, social sciences, business and design.

- The centre should be relevant to a wide range of users. The cellular Internet ended up offering not only a channel for the children to browse the Internet, but also act as a Internet cafe for the youths in the villages. In the evening, the young people would gather around the centre and surf the Internet, oftentimes collectively. Also, elderly living around always come to the centre to learn some basic English skills, which they will also bring along their grandchild. This allows the centre to serve as a focal point and hub, which facilitates the sharing of ideas, including new services that could be provided by the centre, and helps to cultivate the sense of ownership and social responsibility.

VI. FUTURE WORK

After the success of the first project, a similar follow-on project is being planned for the June 2016. This project will involve a larger team of 54 students and 15 staff members. The centre will also be larger, spanning across two wings (two 20-foot shipping containers), with a full computer library of 10 machines, solar panel system and a rainwater collection system.

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