How Much Impact Can Be Made in a Week? Designing Effective International Service Learning Projects for Computing

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ABSTRACT

Service learning has been gaining attention in recent years. It has been established as an effective method to teach students a variety of concepts that are not easily taught in the classroom, and much effort has gone into making service learning accessible and relevant to computer science students. This paper investigates a popular mode of computing-related service learning – offshore projects that seek to introduce information and computing technologies (ICTs) into a beneficiary population. Based on multiple years of experience working with ICTs in service learning, the authors examine the impact on students and beneficiaries through several critical questions, and draw conclusions and recommendations on good practices for designing offshore service learning projects for computing students.

Categories and Subject Descriptors

K.3.2. [**Computers and Education**]: Computer and Information Sciences Education; K.4. [**Computers and Society**]: General

General Terms

Design, Human Factors.

Keywords

service-learning; international projects

1. INTRODUCTION

Service learning has been gaining much attention as an effective way to teach students about concepts, such as social responsibility and empathy, which are not easily covered in the classroom. In addition, offshore service learning projects, which are defined as projects that require the students to leave their home communities and be immersed into a different environment for an extended length of time, are also gaining in popularity. Similar to exchange studies or semester abroad, they offer very rich learning opportunities that tie together service to the community with a cross-cultural experience of new languages, culture, food and people. Many of these activities have resulted in much benefit to the local communities as well as substantive learning gains from the participants.

Benefits aside, however, the increase in such activities has inevitably led to some backlash and soul-searching about their impact upon the local community, or the non-profit organizations (NGOs) that usually are involved with sponsoring or organizing these projects. In a general service-learning context, Blouin and Perry [3] examined the impact of service learning on the community partners. Grusky [10] and Crabtree [5] present in-depth analyses of the impact and consequences of international service learning. From the Computing front, Connolly [6] argues that many computing-related service learning activities often over-focus on the students' discipline learning gains at the expense of addressing real needs and facilitating real understanding of the target community. This topic surfaces regularly in popular literature as well, with many such reports pointing to physical as well as emotional disruption that such activities inflict upon the local community.

Given such disparate opinions, and the resources that inevitably need to be invested into offshore projects, this paper seeks to investigate the issue of how such projects could best be designed to maximize the potential of (1) producing the biggest positive impact on the target community, and (2) eliciting the maximum learning outcomes from the students.

2. BACKGROUND

At the Hong Kong Polytechnic University and the Department of Computing, there is a long tradition of organizing ICT-related service learning projects that bring students to serve underprivileged communities. The majority of students serve the local community, but a growing number are involved in offshore projects. Since 2005, our students have contributed over 13,000 man-hours of service in 14 ICT-related offshore service learning projects in China, Cambodia, Rwanda and Myanmar.

There are two main "models" when it comes to offshore service projects. The first model involves small teams of experienced, or highly trained, individuals, often for longer periods of time, such as several weeks or even months. A second model brings larger teams of relatively inexperienced members, often for shorter periods of time, such as a week or two weeks.

The model discussed in this paper is the latter. Many of our students are first-generation college students from working class backgrounds, and a good number have never travelled away from home on vacation or study abroad prior to arriving at university. In order to not disadvantage these students relative to their more affluent peers, our philosophy is "attitude before ability" – meaning

SIGCSE '15, March 4–7, 2015, Kansas City, MO, USA.

http://dx.doi.org/10.1145/2676723.2677267

that any student with a proper attitude (willingness to learn, willingness to be a team player, willingness to "pull their own weight") would be accepted. (The college generously sponsors a significant part of their expenses.) Our teams almost wholly comprise of undergraduate students in their first and second years. This oftentimes means inexperienced students who have not yet acquired much expertise, and most of their knowledge is confined to in-class theoretical concepts, untested by real-world constraints. Since Hong Kong is relatively ethnically homogeneous, this also means that most of our students have no prior experience interacting on a peer level with people of a different ethnicity.

3. Computing in Service Learning

Computers, in various shapes and forms, have become almost indispensible for many types of services. For many young people in first world countries, it is difficult to imagine life without the computers or the Internet. Computing devices govern and manage almost all facets and transactions in daily life, including social communication and networking, which have taken on dramatically different formats. Even in developing countries, commerce and communications are slowly becoming more and more dependent on ICT, and computing is a popular discipline of study in many such countries. Since computing devices are low in both size and cost, transportation and installation is convenient and feasible. Therefore, it is not surprising that computing-related service learning has become quite popular. As an example, there are many projects, such as computing outreach efforts, which aim to bridge the digital divide or to facilitate digital inclusion.

From the learning standpoint, when students go on projects in developing communities, there is a wide gap between the level of availability of ICT in the resource-rich society where they come from, and the community that they are serving. Concepts such as the digital divide and the inconveniences, or even inequities, that arise as a result, are obvious to even the casual observer. At a deeper level, issues such as information ethics, education and privacy have to be addressed and examined. The impact of ICT upon daily life leads to differences in expectations, working style and even culture and self-expression between the service team and their beneficiaries. For example, the convenience brought about by ICT services and the greater (and faster) availability of information usually results in a faster pace of life, and hence a different sense of time and punctuality, which pervades into other aspects such as individuality and even commitment. All of these are issues that need to be addressed during the planning and execution of the service project. At the same time, they afford many valuable opportunities for learning and reflection.

4. Critical Questions in Designing an Computing-Related Service Project

Computing-related service projects usually fall into one of two broad types. Design-based projects have the objective of providing technology-based solutions for needy communities. Examples are designing and installing computer labs; constructing websites; or developing content management systems. Instructional-nature projects aim to provide training in various ICT-related topics. These include "computing outreach" workshops that teach innovative technology or computer literacy. (A third type of ICT-related project – the "ICT for development" (ICT4D) project – is not covered in this paper.)

Similarly, all projects can be divided into three phases. The participants usually need to spend time and effort in preparation.

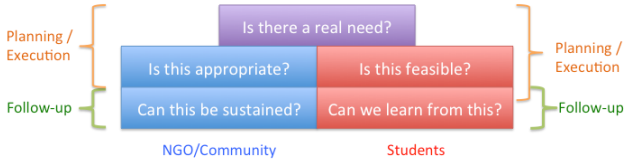

Figure 1: Critical Questions for Designing Computing-related Service Learning Projects

For example, projects that involve development, such as design and development of webpages and content management systems, obviously will require much effort before the product can be deployed, and infrastructure installation projects often require substantive research into the local context before decisions on hardware can be made. Even instructional-nature projects require participants to design lesson plans and teaching content, and often, also assembling supporting software.

The execution phase starts once the team gets onto the ground and the designed plans are put into motion. Depending on the complexity of the project and the conditions at the site, this phase often involves adaptations and modifications of the original plan

The follow up phase begins after the team leaves the site and can last for an extended period of time. This phase mainly involves the local communities who have to take charge of the project deliverables and continue with the services. Many ICT-related projects also require support from the team after their departure.

Finally, all projects involve at least two or three parties. The students travel to the site as service providers. The local community receives the service or the deliverables. The project is oftentimes facilitated by a non-government organization (NGO).

Based on our own experiences and studies of literature, we formulated a sequence of four critical questions to be addressed in the design of international ICT-related service learning projects.

1. To start with, is there really a need for an overseas team, travelling to the site, to address the problem identified?
2. Assuming that the need for the trip is real, is the proposed method sound – in terms of addressing the need? That is: is it appropriate for the community? And is it really feasible, given that it is students who will be carrying this out?
3. Assuming that the method is sound, is the solution sustainable? Or it is only a short-term or a once-off solution?
4. For true service-learning, there must be balance between the community service and the educational objectives. Are there real benefits to the students participating in the project?

Figure 1 shows the relationship between the project phases, the parties, and the critical questions. The following sub-sections will discuss each question in more detail, illustrating with real cases.

Finally, the ethical aspects of the project must be addressed. We are putting them into a separate section to ensure that they receive the attention deserved.

4.1 Do they actually need a visiting team for this service?

A critical question to ask of any project – ICT or not – is whether the nature of the project really requires an overseas team. Much has been made about the "contributions" of overseas teams who arrive with little or no preparation and undertake tasks that could easily have been performed by local residents. Is it really a

learning experience, or worse, a tour, disguised as service-learning? Each of these activities can be legitimate in their own right, but they should be identified as such properly.

This applies to computing-related projects as well. It is common to see teams going to offshore locations to teach classes on Office software or email. These types of services are very popular mainly because they make use of skill-sets that the participants already possess, and thus do not require much preparation. However, people possessing the same types of skills (basic computer operations, email, Office software) are often easily found in the target population. Given the amount of funds that are involved in bringing the service teams to the offshore location, it would seem to make sense to "set the bar higher", as it were, and bring in new concepts/skills that are not commonly available in the local population. This is also congruent with the philosophy of reciprocity [12], with a mutually and *equally* beneficial relationship to both sides.

In our experience, some of the most effective services of an instructional nature involve the use of educational technology in creative hands-on learning. These projects serve as an interesting and exciting introduction to many concepts in digital literacy, and they also have the side effect of arousing the beneficiaries' interest in technology and studying. The latter is not to be overlooked, for in many poor communities, staying in school does have a real opportunity cost in terms of lost income.

There is much literature documenting successful cases of teaching technology to underrepresented groups, such as multimedia computing to disabled children [9], robotics for blind children [14] and wearable computing for low-income children [13], among others. Obviously, there is a resource gap and some of the more expensive equipment (such as Lego robots) would not be appropriate in developing countries. However, many applications of creative technology do not require expensive equipment.

We describe one example for illustration. A primary school in rural China had received a donation of computers. Since they wanted to introduce computer classes, they asked for training in Office software for their teachers, who would in turn teach it to the children. After discussion with the school authorities, the authors made a counterproposal – the service team would teach the children directly, with the teachers present to assist in classroom management, and digital storytelling would be used as a vehicle for teaching computer literacy.

In preparation for the service, the students researched the concepts and methods behind digital storytelling. Micro-movie production was finally chosen, as it requires a diversity of computer operations (e.g. basic operations, file manipulation, etc). It also encourages artistic creativity and self-expression. To familiarize themselves with the software and to help with time allocation and planning, the students produced several movies and drew from the experience to design a comprehensive lesson plan that covered topics from storyboarding to shooting to subtitling and rendering.

The project was executed over one workweek (5 full days). Some adaptations were made on site to accommodate the interests of the children – for example, some wanted to incorporate scenes from movies or TV shows or famous artworks into their own micro-movies, and so the lesson plan was modified to introduce information search and downloading images from the Internet. Some of the processes (such as movie rendering) were deemed to be too boring, so they were removed from the schedule.

The workshop familiarized the children and their teachers with certain aspects of multimedia production, which were worked into their regular classes after the team left. For example, some of the teachers incorporated multimedia content and project work into their teaching, which had previously relied mainly on rote learning and memorization. In addition, after the short introduction to the Internet and information searching, the children and teachers started exploring the Internet on their own. One year after the workshop, observers on a followup visit reported the use of Google Maps in General Studies lessons!

In general, for instructional-based projects, we have found that project-based learning usually produces better results than teaching specific skills or concepts. First, it is easier to motivate a project within a short period of time than a particular topic or concept. In addition, projects often involve a diversity of skills and topics, each of which would be difficult and tedious to teach and motivate on their own. Project-based learning has also been shown to promote self-learning and life-long learning in engineering and computing [11][17], which is appropriate for short workshops that serve as an introduction into a broader field that the recipients will have to learn to explore on their own.

4.2 Is the service appropriate? Can it be feasibly carried out?

ICT-related projects have to adapt to the available resources and constraints of the service environment, which are beyond the control of the service team. Some constraints are infrastructural, such as the availability of electricity, Internet, or spare parts. More often, however, the constraints relate to human and societal factors, such as the readiness of the target beneficiaries for the deliverables. Put together, these constraints often make conventional ICT solutions inappropriate and require creative thinking to come up with a workable solution.

We illustrate with an example from our experience. An NGO in Cambodia wanted to expand their services. Their vision was to bring computing literacy to children living in rural communities just outside the city. The challenge was that the communities did not have electricity supply, and while they could have constructed a computer lab in the community center, they were not confident about ensuring the security of the equipment.

Given the constraints, it was quickly determined that a conventional computer laboratory would not be a feasible solution. After a lot of discussion, an alternate solution was devised. The final solution drew inspiration from the "bookmobile libraries" that serve underprivileged communities in the US. A Raspberry Pi single-board computer was used as a server hosting e-Learning resources such as electronic books, with the operating system and data on an SD card. A mobile router created a local area network, and the computing devices were smartphones and tablets. The setup fits into a suitcase and was outfitted with enough batteries to run for up to 6 hours on one overnight charge. The idea is that the "lab" would be charged up in the city, and transported into the rural community for regular sessions.

During the execution phase, the project team conducted intensive training for the NGO staff, and also organized workshops in computer literacy for rural schoolchildren, using digital storytelling as an illustration, in collaboration and with the assistance of the local NGO staff. While the most obvious objective of the workshops was to teach the children computer literacy, they also served as demonstration classes to familiarize the NGO staff with the new equipment, and to give them an idea

of how this equipment could be used in their services. The NGO staff continued with the services after the team departed. A follow-up visit a year later found that inevitably, the nature of the services had undergone some evolution as the mission of the NGO adapted to the changing needs of the community. The lab was still in regular use, but the target had shifted from rural children to urban street children, so arguably the portability was not needed, but the comments from the NGO were that the reliability of the devices made them easy and convenient to use, and therefore allowed them to run sessions more regularly.

In a similar manner, many service proposals, if scrutinized carefully, may turn out to be too risky, or even infeasible. As engineers or computer scientists, practitioners of ICT-related projects tend to look towards the technical aspects when considering feasibility challenges. However, many challenges come from the human or societal aspect, which (in a way) are harder to address than technical challenges.

4.3 Can the deliverables be sustained/maintained?

Sustainability is a key concern in all service projects. Due to the (usually) short duration and the gap (both in distance as well as cultural habits) between the service team and the target beneficiaries, offshore service learning projects are often criticized as being unsustainable.

ICT-related projects face an especial challenge in this aspect. Most technology solutions need to be maintained, and the maintenance process usually requires a minimum of technological know-how. For example, a software package or a web page that was developed for an NGO will often need debugging, or updating, which is often extremely difficult, if not impossible, for local individuals. The short-term nature of service learning projects worsens the situation, as it is often difficult to find volunteers who are willing to continue to help after the project.

Even hardware and infrastructure installations require maintenance and upkeep. For example, any computer that is connected to the Internet or has the capability to accept a USB flash drive will require periodic anti-virus scans. Since many anti-virus software packages are configured to run the scanning process at start-up or when a new USB drive is inserted, this may seem like an automatic, pain-free process. However, anti-virus software needs to be updated regularly, and many such software packages need user confirmation before the new signatures are incorporated into the package. Adding to the problem is that when a virus is discovered, the software usually gives the user a list of options, which is often couched in technical jargon and almost unintelligible to non-computer-literate people.

An example can be found from the authors' own experiences in a rural school in China. The project involved installing a network of computers for students and staff at the school. The project also included training in computer literacy and maintenance for the staff at the school, including anti-virus scanning and removal. About a month after the project, however, the computers started to malfunction. Frequent crashes and application lock-ups were experienced, and some computers had trouble accessing the Internet. It was determined that the computers had become infected with a variety of viruses and Trojans, and despite several video-conferencing sessions that attempted to troubleshoot and solve the problem online, the situation deteriorated and the machines soon became unusable.

A follow-up project was organized at short notice to fix the problems. After much discussion and debate, it was decided to take a draconian approach to the problem. "Reborn cards" were installed into the computers, which essentially restored the computers to the same starting state upon each reboot. The training was then modified to incorporate the use of USB flash drives for file storage and frequent reboots of the computer (especially before/after any insertion of USB drives.) The result of the changes was that computer-related problems dropped dramatically: over the 12 months after the follow-on project, only one support request was made when a new piece of software had to be installed into the machine.

This solution, which would probably *not* be acceptable in most contexts in first-world countries, illustrates one of the biggest challenges for ICT-related projects – that of follow-up and maintainability, and the trade-off between flexibility and predictability. Such a solution would be seen (and was seen at the time) as being a waste of computing resources, (since the hard drive becomes unavailable for long-term storage), and adding unnecessary steps to what would normally be a simple process of opening a file stored on a flash drive. For our particular context, however, it made the computers more predictable, more reliable, and therefore, *more* user-friendly. We suspect that a similar situation exists for many other contexts in developing countries.

The problem of maintenance and upkeep poses an especially big challenge when older models of computing equipment are involved, for example, when used computers are donated to developing countries. In general, older equipment requires more maintenance, and the rapid pace of change in technology also makes it difficult to find spare parts for replacement or to identify people with the needed know-how. Indeed, with the introduction of the tablet computer and the rapidly declining prices, even for new units, we feel that it is worth considering using these new technologies for computing setups in service contexts.

4.4 Does this provide learning opportunities for our students?

Service learning puts equal focus on both service to the community and learning gains by the students [8]. It has often been argued that just simply placing students in the community or putting them to work on real projects already affords learning gains. However, in the continuum of service-based activities, such statements are probably more appropriately applied to volunteerism, community service or service-based internships, than to service learning, which should include directed learning of societal issues in addition to service to the community.

In this sense, it can be argued that many developmental or infrastructural installation projects are lacking in the learning aspect. Putting it another way, the tasks that are carried out in these projects are oftentimes very similar in nature to tasks that would be carried out in a corporate setting in the developed world, the only differences coming from infrastructural factors such as electricity supply or fast broadband access. These are illustrations of the digital divide, and students may well have to adjust their plans or design their solutions around these constraints, but they do not afford students the opportunity to observe the impact upon the users, or the underprivileged that they have come to serve.

We illustrate with an example from our own experience. An NGO in China accepts donations of used computers, which are then donated to poor children living in rural regions. Since many of the computers that they receive are not working properly, they proposed a service project to take place at their headquarters in Beijing (the

capital of China), where students would fix up the old computers, which would then be delivered to the beneficiaries.

This project, if carried out (we did not accept the proposal) would have provided a useful service, but at the cost of very little learning gain for our students. Ensconced in an office setting in a world-class city and fixing up old computers would not have offered them any insights into the impact of ICT upon the underprivileged (beyond an abstract grasp of the concept of the digital divide by realising that children in rural areas use computers that would be considered trash by urbanites). Indeed, this project arguably provides little in the way of *discipline-specific* gains. Given the rate of change of technology, many of the techniques that apply to fixing up old computers are not applicable in the newer generation of machines. Unless the students intend to take a job in a low-resource setting, they would likely never need to use those sorts of skills again.

Another example is a software development project that was carried out for an NGO in Cambodia. The NGO shelters abused children, and they wanted a database system to keep track of the children's medical records, such as doctors' visits, diagnoses, etc.

A team of students took on this project, with supervision and guidance from faculty members experienced in software management and development. The bulk of the development took place in Hong Kong, and the team travelled to Cambodia for deployment and training of the local NGO staff. It was expected that the system would be deployed without much problems. Upon reaching the site, however, a myriad of challenges such as differences between the stated user requirements and the expectations, inconsistencies between the existing data that had to be imported into the system, etc, caused so many problems that the team was forced to spend the entire time in Cambodia debugging the system. In essence, their project had turned into what could have been amounted to a term project in a database class, albeit with a real user and in an exotic location!

While one could say that the aforementioned problems could have been prevented with enough foresight and user testing, it is a fact that ICT system development is complex and difficult, even in professional settings, where a large majority of IT projects either fail, or go over-budget and fall behind schedule [4]. It is therefore debatable whether projects of this nature are truly feasible, especially given that most students on service learning projects are likely to be inexperienced.

This is not to say that all developmental projects should be avoided in service learning. Indeed, projects of a design nature do provide a much-needed service to many NGOs that provide valuable service to needy communities. However, the risks and feasibility must be thoroughly analysed before taking on the project. It would also certainly not be desirable for the *entire* project to be of this nature. For example, an installation of a computer laboratory could very feasibly be combined with workshops in computer maintenance and information literacy, either for the NGO staff or even for members of the community that they are serving. Such a combination would highlight examples of the realities and impact of the digital divide, together with potential solutions, that could be elaborated on later in reflection and discussion sessions.

5. Do Some Good — and Minimize the Harm

The focus of this paper is on the design of ICT-related service projects, but no such paper would be complete without a discussion of at least some of the associated ethical issues. On one hand, carrying out service projects without due consideration of the ethical implications is simply irresponsible. On the other hand, tackling ethical issues encountered in the middle of service makes the issues come alive and relevant to the students. It is much more effective compared to a discussion in the calm of the classroom.

There is a lot of debate in the developed world about the benefits and harms brought about by ICT, especially where young people are concerned. There has been much study into the problems that are brought about by the pervasiveness of the Internet. Its affordability and its "always-on" nature has been blamed for a myriad of social ills, including loneliness and depression [7], a decreased ability to focus and commit [16], increased stress [15], increased social friction and polarization [2], and even addiction and other mental disorders [18].

In addition, many of the offshore sites involved in these ICT-related projects are situated in poor communities, many of which do not yet have access to the prerequisite infrastructural support (such as electricity), or even basic life necessities such as clean water and medical care.

Given these issues, one often cannot help but feel ambivalent about ICT-related service projects. Should we, from developed countries, introduce ICTs into developing communities where the medical and social infrastructure may not be in a state to deal with the associated ills that will invariably arrive? Similarly, would the resources invested into ICT projects be better spent on projects that bring life necessities to the community?

It is the authors' opinion that even with all the potential problems, well-thought-out ICT projects do more good than harm. Simply put, ICTs and the Internet *will* arrive at these communities, with or without our help. In all of the communities that we have worked with, people have *some* form of access to the Internet and communications, usually through mobile phones. Left to their own devices, these resources stay in the hands of the well-off in the communities. The service then is not necessarily introducing new resources, but perhaps simply "leveling the playing field".

This being said, the potential problems associated with computers and the Internet also suggests that whenever a service team introduces ICTs into a community, there is also a moral imperative to conduct training, not just in technical know-how, but also in the human, organisational and ethical issues associated with technology. This is even more critical if Internet access is included, as it introduces concerns with information privacy, security and ethics. These are complex issues to address and they usually do not surface until the technology has been in use for some time. We therefore believe that it is critical for project teams introducing new technology to build up a reciprocal relationship [1] or even a partnership with the beneficiary community. This provides additional support and training when the need arises, and sustainability in the project.

With respect to differing service natures, even though ICT is not traditionally considered a necessity of life, there is increasing awareness of the role that ICT plays in poverty alleviation, community empowerment and child development. Many of these efforts are classified as ICT4D (ICT for development), which is a huge topic that is outside the scope of this paper.

We believe that introducing ICTs brings benefits to education, even when the children/students are not the ones that have direct access to the computing devices. An example can be found from a recent experience installing the "Lab in a Suitcase" at a rural school in Rwanda. The lab server was equipped with, among other things, an

off-line copy of the Khan Academy[1], which contained videos illustrating teaching of different concepts in Mathematics.

Since the content was in English, the children were not able to understand the videos, and showed very little interest in the material. (They were more excited about photo-taking and video-making.) However, the local teachers were very appreciative. Even though the same language barrier existed for them (though to a lesser degree), they were extremely interested in the videos, spending a lot of time watching and rewatching certain sequences, and even comparing the content to their own textbooks. Follow-up studies will be made to ascertain the longitudinal impact of project, but it is clear that in this particular case, the introduction of ICTs has enabled access to new ways of teaching, and even new educational content, that was not previously available.

In other words, the consequences of ICT-based service learning projects must be carefully ascertained before embarking on the project. The reader may wonder why we state "minimize the harm" instead of the commonly-used "do no harm". The reason is that practically *all* efforts that have *any* impact on the community will have *some* negative consequences. The responsibility of the service provider is then to minimise this harm and provide support and follow-up to the community to address issues as they arise.

6. Conclusion

It is our belief that ICT facilitates service learning in a unique way. The low cost and small footprint of ICT equipment means that there is no need for much infrastructural support and heavy investment, as is the case for many engineering and construction-type projects. The pervasiveness of ICTs in daily life in the developed world means that the skill-sets required are possessed by a wide range of people — and these same skill-sets would also be useful to a wide diversity of people in the target population. Few other service types combine accessibility to the service provider and impact to the target population in the same manner.

Given this accessibility, it is therefore important to carefully consider all aspects of an ICT-based service learning project, in order to maximize the benefit to the target community while protecting them from potential harm, and to ensure opportunities for student learning. This paper has presented an investigation of the use of ICT in service learning, and analysed the impact of such services through four critical questions.

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