*CHAPTER 11*

# COMMUNITY SERVICE LEARNING AS AN INCLUSIVE EDUCATIONAL MODEL IN THE LIGHT OF COMPLEX REALITIES

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Key words: Community Service Learning, information systems engineering, ICT for development, local context user-centred approach, sustainability.

## Abstract

An educational method that prepares the student to face the real-world complex realities in solidarity and equity is found in the pedagogy and is known as Community Service Learning (CSL). This pedagogy combines academic learning with real-world community service tasks. In CSL students actively participate in innovation projects, collaborating with communities in order to meet their needs within the complex reality of their multi-faceted environment. In this article, we discuss CSL as a pedagogical model for inclusive education in the academic curriculum in information and communication technologies. This model has two objectives: (i) to train students in socio-technical development methods, making them aware of their social and civic responsibility to face complex realities of the real world; (ii) to develop inclusive technologies that serve the needs of underprivileged communities and connect them to the computerized society. We exemplify this by discussing the design, experiences, results and evaluation of CSL postgraduate courses in Information Sciences ("ICT4D In The Field") in rural areas of Sarawak, Malaysia.

## Community Service Learning and ICTs

The inclusion of people and communities from less privileged regions to the digitally connected and computerized world is a social responsibility that touches higher education in order to move towards a more inclusive and equitable society. One way to realize this responsibility is in the training of professionals and academics in the area of Information and Communication Technologies (ICTs) such that they are capable of developing technologies that are properly adapted to the needs of underprivileged communities and their low-resource contexts. For this type of education, Community Service Learning (CSL) is a pedagogy that offers an appropriate methodology (Duffy *et al.*, 2000). In the CSL pedagogical model, students actively collaborate with local communities in social innovation projects in order to respond to some aspect of their needs.

We discuss a novel type of teaching based on the CSL idea, in the area of education in Computer Science and ICTs, in particular Information Systems (IS) engineering. In this type of education, students at the postgraduate level learn and develop through co-creation, design and implementation of ICT services focused on providing value to less privileged communities in a thoroughly collaborative fashion.

As a real-life case we present a course organized jointly by the Vrije Universiteit Amsterdam (VUA) and the Universiti Malaysia Sarawak (UNIMAS) in Sarawak, Malaysia, for students of computer science, information science and artificial intelligence (case materials coming from Bon *et al.*, 2019). The design of this course, its theoretical framework, the experiences of the courses organized in Sarawak, Malaysia, in June 2018 and 2019, student results and evaluation are discussed in this Chapter.

## Technologies for inclusion

In recent years a large number of projects, usually financed by states or international agencies, in the field of ICT for socio-economic development, have been considered failures (Group, 2011). The failure of these projects is generally attributed to a lack of adaptation of these technologies to the real needs of local users and their context (*e.g.*, Bon, 2019). In terms of social inclusion, the design of adapted technologies is essential for their success (Waugaman, 2016). In communities with low levels of education and limited resources in terms of economic development and infrastructure, adapted ICTs may lead to greater inclusion. For this reason, attention must be given to the collaborative design and development of ICTs so that they are

relevant and meaningful to their users in those communities in low-resource contexts (Bon *et al.*, 2016).

However, the design and development of ICTs in low-resource environments is a challenge, for several reasons (de Boer *et al.*, 2012): low-resource contexts may be variously characterized by lack of infrastructure (physical, digital, energy), high illiteracy rates, low purchasing power or a variety of complex adverse social, economic, cultural and environmental factors (Gyan, 2016).

In the area of innovative ICT systems engineering (in the connected and highly computerized world), new socio-technical methodologies have been developed in recent years, with greater focus on the user and his needs (*e.g.*, Doerflinger *et al.*, 2013). These methodologies allow the development of information systems more adapted to local needs and environments (Ferrario *et al.*, 2014), thus respecting the autonomy of their users.

However, in order to bring these methodologies to the service of underprivileged communities in low-resource environments, a new generation of professionals with socio-technical skills and knowledge and an active citizenship attitude is needed. Technical curricula in higher education need to train professionals with these skills (Lago and de Boer, 2019). Engineering technical training such as computer science, artificial intelligence and information science is traditionally focused on the developed and "connected" world (the Global North or more precisely North-West) . In the Netherlands, for example, active citizenship and social awareness are not yet part of these education spaces. Social inclusion policies demand an innovative education, combining the technological with the social, and training professionals with a reflective attitude. This is a practical and reflective education, centred on the users, their objectives and community, in ICTs for Community Development.

## Reflective social theoretical frameworks

For the design and implementation of a practical and reflective education in the area of ICTs for Development, focused on the users and their community, a framework is presented that combines service learning (Bringle and Hatcher, 1996) with a theoretical framework that comes from socio-technical action research, called "ICT4D 3.0". (Bon et al., 2016; Bon, 2019). ICT4D 3.0 is based on the participatory action research (PAR) methodology and philosophy, see for example (Freire, 1970/2005; Fals Borda, 1979). To guide the course design, we have formulated some principles that support an inclusive approach to teaching, learning, and research, see Table 1.

Table 1: Principles guiding Participatory Action Research (Bon and Akkermans, 2019)

| No. | Principle |
|---|---|
| 1. | Principle of **Critical Investigation** of Concrete Situations (field, professional practice); |
| 2. | Principle of **Value**: Developing/Taking a Value Position (democracy, emancipation, autonomy, social and economic betterment) |
| 3. | Principle of stakeholder **Collaboration** (involving Co-Investigation, Co-Design, Co-Creation, whereby goals and interests as seen by stakeholders themselves are central) |
| 4. | Principle of **Dialogue** (between multiple actors and stakeholders (to be) involved) |
| 5. | Principle of **Action**: Discovery and subsequent Realizing Change for the Better |
| 6. | Principle of **Reflection** and continuous Learning in Action |

## Community service learning as educational theoretical framework

Community service learning (CSL) is an educational model designed to connect theory and practice in order to solve challenging social problems by training students for a life as responsible citizens (Duffy et al., 2000; Bringle and Hatcher, 1996)). CSL uses an experiential learning methodology that integrates meaningful community service with instruction and reflection to enrich the learning experience, assume civic responsibility, foster civic engagement, and strengthen communities for the common good (Lopez et al., 2015). CSL combines two interrelated objectives: (i) an educational objective based on learning through practice and reflection (ii) a social objective set in the service of the community.

## ICT4D 3.0 as a theoretical framework for socio-technical design

For the sociotechnical education, a theoretical framework has been developed, called ICT4D 3.0 (Bon et al., 2016; Bon, 2019). This framework has similarities with CSL, offering methods that contribute to inclusion, innovation (Von Hippel, 2005), and socio-technical development. These include agile and user-centred methods (Gottesdiener, 2003; Dingsøyr et al., 2012). The ICT4D 3.0 framework consists of five cyclic stages that cover the full life cycle of information systems development: (i) context analysis, (ii) needs assessment, (iii) analysis of use cases and requirements, (iv) sustainability assessment, (v) engineering, development, evaluation (Bon, 2019).

**Context analysis.** Consists of obtaining knowledge about a real-world environment. Socio-technical engineers (in this case students) must dedicate sufficient time to familiarize

themselves with less privileged environments, of low resources, with their limitations and their demands. Conversely, potential users need to achieve a certain level of knowledge of what ICTs can bring them in terms of benefits.

**Analysis of community objectives and needs.** The ultimate goal of any socio-technical engineering is to develop services that meet the needs of its users. Therefore, explicit attention has to be paid to local needs. In general, users with little ICT experience are not aware of what kind of needs can be met by ICT-enabled services. Demonstrations of successful ICT prototype services can contribute to this knowledge.

**Requirements analysis.** Once the needs of the users in terms of information and communication have been identified, and the most viable ideas have been selected, the requirements analysis must be carried out. In order to validate the requirements, prototypes or designs are prepared and tested to the users.

**The construction and development of the ICT system.** The results of the requirements assessment are used to develop technically, but iteratively and adaptively an ICT system. In this phase there is also intensive collaboration with users representing the community. A prototype is considered ready, when it has been accepted for development and production, according to the users.

**The sustainability of ICTs in the local ecosystem.** Many services enabled for less privileged environments fail due to the lack of an economic model. Maintaining ICT systems involves costs and resource use. The question is always: who will be responsible for the costs at the end of the construction process? In ICT projects for social development, there is usually a donor (e.g. national government, World Bank, etc.) that pays for the initial investment. However, at a certain point in time, the funding ends and then the service loses its financial basis. There are different economic models that merit consideration, but in any case this analysis should be carried out in the initial phase of the process, preferably during the context analysis. ICT4D 3.0 employs the e$^3$value business network methodology for analysis of economic sustainability (Gordijn and Akkermans, 2003; Bon, 2019).

## Designing a postgraduate course: ICTs at the service of the community

Based on the above considerations, the course objectives are formulated as (i) to make the next generation of information scientists aware of the potential role of ICTs for the developing and

emerging world, with appreciation for the highly diverse and complex contexts (in contrast to a one-size-fits-all approach), social-cultural factors and human needs that must be addressed; (ii) to equip the students with relevant field research and development methods and skills to develop technologies in a (poor) rural/suburban community/developing region; (iii) to acquire and reflect on the experience of carrying out a full life-cycle of a real-world software development project in the field, thereby learning to be able to deal with unfamiliar and complex contexts, and engage with communities with their specific contextual constraints, needs and goals.

Admission to the course is subject to a selection procedure based on motivation and skills. To be admitted students must submit a motivation letter and have an interview. They are admitted based on a combination of technical (programming, modeling, requirements engineering) skills and social/communication skills. Moreover, a specific attitude is required as well: openness to other cultures and contexts, willingness to collaborate in an interdisciplinary team, a hands-on mentality, a social orientation and a reflective nature.

During the course students conduct context analysis, problem identification, problem conceptual design, technical design, information system engineering, testing and development. The whole process takes 4 weeks, on location, and is conducted in a way that meets the needs of the community.

The course includes lectures, field visits to communities (rural or suburban) where users live and work. Interviews and focus group discussions, user tests and feedback sessions are also part of the course. The formal process begins with lectures reviewing important topics: (i) use and context, use case and requirements analysis; (ii) conceptual design of information systems; (iii) selected technical aspects of ICT projects; (iv) values design and economic sustainability analysis; (v) guidelines and protocols for interviews and focus group discussions with local communities.

After the user group meetings and initial context analysis, students form teams of 4-6 people. Each team selects a relevant case for prototyping, testing with users, evaluation, improvement and development. Sustainability analysis and *value network* design are part of the task. Real-world context constraints and opportunities are taken into consideration. Students work in self-organizing (so-called *scrum*) teams, dividing tasks and working closely together. Users must be involved to make sure their needs and (business) requirements are met. The course involves reflection and open dialogue. The constraints and opportunities of the real world

context are taken into consideration. The students interact and receive daily feedback from the teachers. At the end of the course period, the student teams present their project results to users, local experts, the academic community and other interested parties during an official closing event and social ceremony.

Assessment of the student's result is based on four course deliverables, one of which is individual and three consist of group work: (i) a personal (individual) reflection about the course and the student's role in the process, and what he/she learned from it; each team delivers (ii) a working information system/app, tested and validated by key users, documented and available as Open Source (group work); (iii) a group presentation/pitch during the end conference; (iv) a full field report containing the following items:

- Context analysis;
- A justification of the project (short), in terms of social responsibility and user needs; why are we doing this? Who is the beneficiary? What is the real world problem context?
- Interviews with local stakeholders, typed out (not necessarily literal), containing all relevant information necessary to understand the information problem and stakeholders'operationaal goals at hand. This document must contain all user and business requirements, key points, important details etc.); it must be structured in such a way as to allow modeling the information in a formal or semi-formal way;
- A use case and information analysis report including a stakeholder analysis, a system architecture, information concepts (activity diagram, class diagram, user interaction diagram, deployment diagram), and a summary of all requirements;
- High level system design and user scenario;
- A sustainable value model with multiple scenarios (Gordijn & Akkermans 2003) for quantitative and qualitative assessment of sustainability of the proposed ICT solution;
- Report of user tests (of minimal two cycles of iterative testing and improvement);
- Results of test sessions; users evaluation reports.
- Pointers to the actual software and its documentation.

## "Co-creation of Inclusive ICTs" - a collaborative, inclusive course

The design of the course is adjusted and improved interactively, implementing it and evaluating it in the real situation. The course was run twice: first in June 2018 and again in 2019 at UNIMAS, in Sarawak, Malaysia. The initiative to establish a postgraduate course on "ICT for Community Development" between VU Amsterdam and UNIMAS started in 2015. In the same year, VU started the implementation of Community Service Learning in its curricula. Since 2013 an optional course (6 ECTS = one month full-time) of ICT for development is offered in the postgraduate curriculum at VU, in the masters of computer science, information science and artificial intelligence, but still without field work. Since 2009, VU has carried out an ICT4D research program, named W4RA (Web alliance for Regreening in Africa).

Since 1999 UNIMAS has been implementing ICT4D research through the eBario and Long Lamai projects: projects that aim to connect poor communities in remote areas of Sarawak (Songan et al., 2006). CSL was already part of UNIMAS' educational curriculum before the experience addressed in this article. In June 2018, a group of eleven graduate students in Computer Science, Information Science and Artificial Intelligence from the VU joined another group of ten UNIMAS Computer Science students in Sarawak, Malaysia, for a one-month field course based on the ICT4D project, coordinated by a joint team of VU/UNIMAS teachers. The course was held on the UNIMAS campus in Kuching, Sarawak, Malaysia. Students attended classes and did group work daily. Several field visits were made to a local community. The course was organized according to the ICT4D 3.0 framework, starting with a general context analysis. This then led to the definition of three student projects. In 2019 the course was repeated with a group of 15 students. Some of the projects are presented in this article.

**Context analysis:** The project started with a context analysis by the students in the presence of the teachers, in order to familiarize themselves with the local environment, the inhabitants of the community and try to understand their professional objectives and the existing ecosystems in this context. The group visited a banana plantation and a small banana processing factory, talked with the inhabitants of the suburban community (Kampung PJ, in the local language) and visited the local primary school. Focus group discussions and interviews with community members led to a list of possible project ideas. Three ICT projects were selected, based on the following criteria: (i) relevance to the community and (ii) technical feasibility for an ICT student project. Two student projects, EDUCOMX and Monkey Math Sarawak, are briefly described in the following paragraphs. Full field reports by the students are available on the W4RA website https://w4ra.org/student-papers/.

**Collaborative objective building:** Although the course consists of implementing an ICT project for the benefit of a community in a less privileged environment, at the start of the course, the project objective is not defined and not known to the students. The goal definition must be done in collaboration with the community. One of the biggest challenges for the students is to know how to analyze the new, unfamiliar context, how to detect real problems and to invent and build a solution together with the users, that ihas to be acceptable to them. Students make field visits, interviews and focus group discussions with users within the community context, in order to understand the local situation from the users' perspective.

## Student projects to design and build ICTs for basic education

During interviews with parents, teachers, and community children in June 2018 and again in June 2019, the ICT4D students learned that although English is a lingua franca in urban areas of Malaysia, in less privileged rural areas, English education in primary schools is of lower quality than in urban (private) schools. Since subjects such as science and mathematics are taught in English, the limited knowledge of this language makes it difficult to educate children in this rural community. The Malaysian government has decreed that the teaching of mathematics at the basic level should be in English. This is a disadvantage for children in rural communities, who will learn even less, when English becomes the language of instruction also for Math and Science.

**User needs analysis:** According to parents and teachers in a poor community, who were interviewed by the students, learning English is of key importance for children in this community. Since educational resources in public schools are not sufficient, alternative learning methods are sought. The students propose a mobile application (accessible by Smartphone) since most families in the kampung have a SmartPhone, despite the lack of Internet connection).

**Analysis of technical requirements:** The students decided to build a game for children to learn English, as a pilot mobile application to analyze is this would be useful and appealing for children. For the analysis of usage cases and requirements, students met a group of community children and ask them to draw their favorite superheroes and write down their hobbies and aspirations, as inspiration for the artwork to be used in the application reading material. The application was made attractive by adding gamification elements. For its educational elements the regular English learning methods from school were used. This process of use case and

requirements analysis is a key element of the context analysis and use case analysis, according to the ICT4D 3.0 framework. User interviews and stories are often decisive factors for the success of an application implemented in the community, and have to be collected and well analyzed by the students or developers.

**Construction, development, evaluation:** For the EDUCOMX application, existing gamification methods were used, to improve the children's English language proficiency, while playing. The design is playful and includes animations, sounds, funny colors and images. A scoring system is implemented. Users (children) can continue through chapters that look and feel like levels of play, which must be completed to continue to the next level. Status bars show each user's progress and scores.

**Evaluation**: The children's evaluation of the system was a central activity in this project. After a week of construction and laboratory testing, the first prototype tests were conducted at Kampung PJ with a group of 21 children between the ages of 10 and 12. The children were invited to play freely with the application, in the style of a Living Lab.

The children liked the concept of comics and began reading the texts aloud so that their English reading skills were audible. The questions at the end were a bit difficult for them. The students realized that there were too many pages before the test began, so after a few pages they had trouble concentrating on reading. The children seemed to enjoy unlocking new chapters and were motivated to answer the questions correctly. The process was such that they also began sharing answers with other children to help them unlock new chapters. Sound effects were also a motivating factor in answering the questions. In the process it was also noticed that the back button and logout button were in the wrong place on the screen and had to be moved to another place.

**Sustainability and reflection:** Two contextual issues influence design decisions: (i) connectivity and (ii) specificity. First, in rural areas there is no (consistent) Internet access, which makes online content not a design option. Second, existing digital learning platforms are not adapted to the local culture or to the specific wishes of end users (children). User testing was the core activity of this project and provided many new perspectives. Students learned how to make design decisions based on context and user requirements. Sustainability analysis revealed the need for further exploration of the use case. This will be followed up by UNIMAS, as this university has an educational systems development program to serve rural communities in this region.

**Second cycle of the student project in 2019.** In Sarawak, in the year 2019, a government decreed that primary education in mathematics and science would be changed to English, starting in January 2020. The teachers, interviewed by the students, explained the difficulties involved in this change, especially for schools in rural areas, where children and teachers have limited English proficiency. Interest in the prototype of the English learning game application, developed in the first year in 2018, has led to further development of the educational software project, by a student group in 2019. Five students (three from Amsterdam and two from Malaysia) resumed the development project, based on the knowledge and feedback obtained in 2018. An initial design was made for an educational game with which you learn to do basic calculations in English. The idea is that the children, playing with a playful application, learn the mathematical vocabulary in the English language. The second educational game was developed by one of the master students from VU during the April-June 2019 period, in which he did a more thorough context study in the local area.

**Project results:** At the end of the course the students presented their results in an informal ceremony in the Kampung Pinggan Jaya community and the following day in a formal conference at the university. In addition, personal reflection reports were presented, describing their own role during the project implementation process. The game was considered attractive by the children. Since children are not allowed to use Smartphone at school, the game was aimed to be used outside school hours. A (common) problem encountered was: how to keep the app alive after the end of the course. This problem was not solved. There was no responsible entity to keep the game alive.

**Second educational project: April 2019.** In 2019 the CSL project has been continued in the same environment in Sarawak. One of the students returned to the community to build a (second cycle) educational game for children in the community. He focused on the design of a game to teach children Math, in a game-like environment. While playing the game they also learn the English vocabulary for Math. The idea was to build on top of the experiences of the previous year, and make a system that is more robust, and that can be sustained after the project is finished.

**Challenges encountered during the project:** The development met with several challenges, based on three view-points: the user interface, the educational ecosystem, and the technical infrastructure. As it became clear to the students that telephones are prohibited in elementary schools, the educational game was designed to be used by the children as an (extracurricular) educational activity, i.e. outside official school hours. The application has been tested in several

sessions with students from two schools and evaluated by teachers. The difference of this game with other games is that it is Open Source. It can be found for free on the Internet. It has been specifically designed according to the local requirements of a community school in Sarawak.

**User interface:** Design of the game interface requires special care. Information (visual, written text, spoken text) is interpreted in different ways accross cultures. For example, icons used in the Netherlands may be interpreted differently in Malysia. Different cultural values and standards can hinder communication between the (Dutch) developer/student and the user (child, teacher, parent). For example a game background environment, or a cute animal in the game may be interpreted differently by the children or the parents. These cultural diffrences can affect acceptance of a game. It is the task of the student to design a game interface that is culturally accepted.

**Assessing the local education ecosystem:** Gamification for educational purposes is a challenge to make the game really interesting for children. Gamification it is a powerful strategy when implemented correctly. It can enhance an education program, and positively influence the behavior of students to achieve learning objectives. The challenge of the design is to make the game fits the educational requirements according to and mathematical learning methods. Moreover, embedding the project in an organizational context of primary education in Sarawak is also a considerable challenge. Teachers are not always convinced that a mathematical game will help the primary children to learn mathematics. Interviews with teachers are aimed to discuss their openness to this type of education support.

**Resources and infrastructure constraints:** For the development of a sustainable system, it must be taken into account that the technical environment in a poor rural community is less developed than in urban areas. Most rural areas in Sarawak do not have an internet connection and access to multiple digital devices. Selecting a proper device and environment to host the game which will fit in these constrains is important for the sustainability of the game.

**Designing, developing and testing:** During designing, developing, and testing of the application, several cycles (usually three) will be used to improve the application.

**Creating the gaming story iteratively, in cycles:** The first cycle is about understanding the target group as well as the context. Moreover, in this cycle, the student looks into which learning objectives are needed for the children and how these mathematical subjects can be structured in the game.

**Understanding the target audience and the context:** To fully adopt the content and technology to the local context, first research is carried out to understand the level of mathematics and the problems the children face during learning of mathematics. Moreover, it is investigated how the local technical environment is functioning. This is done during visits to the local community school. The main question regarding technical infrastructure is: which device fits the best for hosting the application, and how can this be maintained and kept available in a sustainable way.

**Defining learning objectives:** To define the learning objectives, the results of the focus groups is used to understand with which subject the children have difficulties. Moreover, interview(s) with teachers and literature study of mathematics help to define the learning objectives.

**Structuring the experience:** To test gaming experience two gaming designs are created to find out which type of game is most interesting for the children. Learning objectives and learning methods are discussed with a primary school teacher to understand how learning subjects are interrelated. Both games are tested as prototypes. The best method is chosen based on test sessions with the children and evaluation by the teachers.

**Identifying gamification elements with children:** To investigate which gaming elements are useful and interesting to keep the attention of the children, observation test sessions with a group of children are done at school, in which they can freely play with the game prototypes. This is done in group sessions, so that children can also interact with each other and learn from each other, as a social interaction event. During these gaming sessions, the student observes how the children use the apps, which gaming elements the children prefer or miss in the game, what goes well and what should be improved. These test sessions yield a large number of new requirements and essential gaming elements. This can also be discussed with primary school teacher for further fine tuning of the game design.

## Discussion

The discussed ICT4D In The Field course is to be evaluated in view of the CSL principles and those of participatory action research (PAR) that have been laid out in the beginning of this Chapter, and that underlie the ICT4D 3.0 framework (Bon, 2019) which has been used as the basis of the course.

The main questions regarding the educational goals of the course then are:

(i) Does the course achieve its goals of training students in socio-technical software development methodology, while making them aware of their social and civic responsibility to address the complex issues, needs and practical realities of the real world?

(ii) Did students learn how to develop inclusive technologies that serve the needs of underprivileged communities and that help connect them to the networked computerized society, in for them appropriate ways?

To find out whether (i) the educational objectives were met, we assessed whether this course has helped deliver adequately trained professionals who are aware of the potential role of ICTs for the developing world, with a clear appreciation for diversity, complexity, specific context, socio-cultural factors and human needs.

Another important point is to evaluate (ii) whether the project is truly community-oriented and sensitive to the local context, assessed in terms of how it serves real local needs, and this requires that continous evaluation must be done by students with the users, throughout the project period, to find out whether the proposed ICT solution really serves the locally defined needs. The opinion of the local stakeholders (teachers, parents, school children in this case) is central to this type of user-centred design. Students have to take into account that the whole ICT4D project might fail, if it is not perceived as useful by the community. And project failure in the course is a real possibility to be taken into account. There are no easy answers in this type of education.

Based on the student assessments, reflection reports and group results, carried out by and received from the students by the course teachers (the authors of this Chapter) it can be said that the course "ICT4D in the Field" met its educational and social objectives in a way that fits the Principle of professional practice (No. 1 in Table 1). Students extensively collaborated with users, learned about the context, and worked collaboratively and interactively, testing and improving the technological solution according to user requirements, according the Principle of value (No. 2 in Table 1: democracy, emancipation, autonomy and socio-economic development). In terms of the Principles of action and of collaboration with the stakeholders (Nos. 3 and 4 in Table 1), the students had the opportunity to exchange ideas extensively with local users, and take action to design and build a system that offers some progress or betterment, although within the confines of severely limited time and other resources.

With respect to the principles of open dialogue and reflection and continuous learning (Nos. 5 and 6 in Table 1), the short period of four course weeks is not enough for a really satisfactory deep reflection. As a student complained (quite rightly) , there was not enough time, within such a short course, to reflect and think things properly over, as the deadline to finish the project was very short, driving out time for deliberation and open dialogue.

Also with regard to the effectiveness and project results, it is clear that, in terms of community service, one month is short for a full iterative software development lifecycle, aimed at resulting in a production-ready system. In terms of the ICT4D 3.0 socio-technical methodology, it can be said that this student project represents only a first cycle development, of a working, and fully documented and tested prototype. An ICT project usually includes more iterations. Therefore it is important to continue the project, for example by transferring it to the local students of UNIMAS, in the next years, meanwhile fostering long-term relationships and continuing working with the partner university and local community partners. The good relationship, commitment and trust between the VU, UNIMAS and local communities is key to the continuity and sustainability of this course and the long-term service to the communities.

The first results of the courses given in 2018 and 2019 show, in terms of community orientation, a first step towards the development of sustainable solutions. Student reflection reports showed that participating in a collaborative project, and designing, building and developing ICT solutions in collaboration with people in underprivileged communities in low-resource settings is an intense personal experience (some students even called it a life-changing experience). One of the main challenges for the sustainability of the course and of the project in the long term is the financing of this type of education. For the very intensive supervision by teachers as well as for the additional out-of-pocket costs of field work by students, institutional support is necessary. This depends in the first instance on the commitment of the two participating universities and the concretization in actions of its promise to support community service learning, which must be shown and effectuated beyond mere words.

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